



UNIVERSITY OF SPLIT
FACULTY OF CIVIL ENGINEERING, ARCHITECTURE
AND GEODESY

SCIENTIFIC RESEARCH STRATEGY OF THE FACULTY OF
CIVIL ENGINEERING, ARCHITECTURE AND GEODESY IN
THE FIELD OF ENGINEERING SCIENCES FOR THE PERIOD
2021-2025

Split, June 2021



The Strategy was prepared by the members of the Management Board of the Faculty of Civil Engineering, Architecture and Geodesy, the current principal investigators on the FCEAG Science and Arts Research Projects, and external stakeholders from the regional and Croatian industry, as well as representatives of local and regional self-government.

The Strategy was produced during 2020 and 2021 and adopted at the 9th regular session of the Faculty Council on 23 June 2021.

Contents

1. PURPOSE FOR THE ESTABLISHMENT AND ACTIVITIES OF THE INSTITUTION	4
History of the institution	4
FCEAG mission	4
FCEAG vision	5
FCEAG activities	6
2. ANALYSIS OF THE FACULTY'S SCIENTIFIC POTENTIAL AND ITS POSITION IN THE SCIENTIFIC AND BUSINESS ENVIRONMENT	7
Analysis of published papers by field of science in the last five years	7
Analysis of completed/active/submitted scientific research projects in the last five years	8
SWOT analysis of scientific research activities in the field of engineering sciences	14
3. STRATEGIC GOALS OF THE FACULTY	15
4. SUBJECT OF ELABORATION	18
5. RESEARCH TOPICS IN THE FIELD OF ENGINEERING SCIENCES	19
6. ORGANIZATIONAL DEVELOPMENT PLAN OF THE FACULTY	41
7. CONCLUSION	42
8. EXPECTED OUTCOMES OF THE SCIENTIFIC RESEARCH PROGRAMME IN THE FIELD OF ENGINEERING SCIENCES	42
9. PERFORMANCE INDICATORS OF STRATEGIC PROGRAMME IMPLEMENTATION	44
10. QUALITY ASSURANCE	44
11. REFERENCE DOCUMENTS	46

1. PURPOSE FOR THE ESTABLISHMENT AND ACTIVITIES OF THE INSTITUTION

History of the institution

The Faculty of Civil Engineering, Architecture and Geodesy in Split (hereinafter: FCEAG) is a higher education institution that commenced its operations in the fall of 1971 as the Department of Civil Engineering and part of the University of Zagreb. It started its autonomous work in 1977 and became an independent higher education and scientific research organization in July 1991 when it is separated from the Civil Engineering Institute.

In anticipation of the full development of the Dalmatian region, the need to establish study programmes in urban planning and architecture arose. The establishment of the study was initially made several times, but it was finally opened in 2003 on the initiative of the University of Split and the Faculty of Civil Engineering in Split. The founding cycle was completed in the academic year 2008/2009, and the first generation of enrolled students graduated.

In the academic year 2010/11, four decades after the initial idea and after several years of preparation, the Study of Geodesy and Geoinformatics was established with the assistance and support of the University of Split and the Faculty of Geodesy in Zagreb. Faculty was then renamed to its current title: Faculty of Civil Engineering, Architecture and Geodesy.

From the first day, FCEAG operated in its premises (buildings A and B) in 6,800 square meters of usable space for classrooms, cabinets, laboratories, library, council hall and computer rooms. A new building C was built and fully equipped, with a total area of 1,600 square meters.

The finalization of the capital project for the construction and equipping of new laboratory premises is underway (project "Implementation of Contemporary Scientific Research Infrastructure at FCEAG for Smart Specialization in Green and Energy Efficient Construction KK.01.1.1.02.0027" worth HRK 84.513.801,36 – INFRA project). Generally speaking, the facilities are adequate for the Faculty operations and implementation of study programs.

The development of higher education in civil engineering in the Republic of Croatia so far shows that, along with the faculties of the University of Zagreb (Faculty of Civil Engineering, Faculty of Architecture and Faculty of Geodesy), the Faculty of Civil Engineering, Architecture and Geodesy in Split has developed strongly to its full maturity. Considering that Split is a Mediterranean and coastal city, current trends in engineering emphasize issues on the construction in karst areas and on the coastline. Great financial, organizational and intellectual efforts are required to achieve sustainable development goals in a coastal environment. Civil engineering, architecture, urban planning, and cognate disciplines play a leading role in such endeavours and become more efficient when synthesised with other areas, skills, and fields of knowledge. This is why current scientific research topics at FCEAG are, as a rule, interdisciplinary and reflect the need to expand the activities of the institution into new research areas. The priority issues concern advancing the management of the existing built environment (specifically, infrastructure systems and built heritage), natural resources and environmental protection (specifically, water and sea management and protection), and sustainable construction in general.

FCEAG mission

FCEAG is a research and teaching constituent unit of the University of Split, with the mission of meeting society's needs in the areas of higher education, scientific, professional, and artistic activities, according to the Faculty Statute and the law. Within the scope of higher education activities, the Faculty organises and offers university-level and professional-level studies that are, in their quality, harmonised with the European higher education standards. Specifically, the learning outcomes attained after completing the study programmes reflect the societal needs and competencies required on the labour market or for the continuation of education. Learning outcomes are in harmony with the Croatian Qualifications Framework (CROQF) and, therefore, harmonised with the European

Qualifications Framework (EQF) of the Qualifications Framework for the European Higher Education Area (QF-EHEA). In defining the learning outcomes and objectives in harmony with CROQF, FCEAG always acts according to the professional requirements and internationally recognized standards within a specific profession (i.e., the qualification profile), thus ensuring the offered programs are up-to-date. For the specifically regulated profession of Architecture and Urban Planning, skills and knowledge to be attained through higher education are defined by the EU Directive on the recognition of professional qualifications. In the so-called 'notification' process carried out in 2016, the study programs in Architecture and Urban Planning were recognized to have reached a European-level quality.

The Faculty promotes scientific research in engineering sciences in fields related to civil engineering, architecture, geodesy, and geoinformatics in the broadest sense, with the aim of addressing all current issues in these fields. Contemporary societal challenges require interdisciplinarity to further develop and promote ongoing and future scientific research topics at FCEAG.

The Faculty continually strives to participate in internationally competitive European and other projects. In addition to cooperating with the largest companies in the region and the EU, FCEAG also collaborates with local authorities, thus promoting its fundamental role in society (scientific research projects in collaboration with industry stakeholders and similar). One of the general strategic objectives of the Faculty is to gain an international reputation for the quality of its work. For this reason, we encourage our students and teaching staff to become active members of the European and world scientific and teaching community. Therefore, international mobility and cooperation are among the highest priorities, as are the organization of graduate courses in English and the development of an international scientific journal published by the Faculty. Furthermore, the Faculty promotes and supports a continuous improvement of the doctoral studies to achieve greater internationalization of both studies and research (joint postgraduate study program).

Since the Faculty's primary role is to meet the current needs and goals of the society, one of the relevant strategic goals is the promotion of life-long learning in civil engineering, architecture, geodesy, and fundamental engineering sciences within the area of engineering sciences, as well as the field of project management within the interdisciplinary area of science, including all the combinations of previously mentioned civil engineering fields with other thematically cognate scientific fields and areas. Currently, the Faculty has three licensed lifelong learning programs that are subject to continuing modifications and adjustments in line with the present needs and applicable regulations. To achieve all the strategic objectives, the Faculty strives for continual and systematic advancement of all the operational areas: establishing, organization and management of study programs, increasing efficiency in the educational and scientific research process, linking educational, scientific research and professional activities, as well as capacity building and improving internal organization in accordance with ESG standards.

FCEAG vision

The Faculty will achieve recognition for its high standards in scientific, research, educational, and artistic activities and the resulting effects on society's technological and cultural development. The Faculty's status as scientific and research institution is reflected in activities focused on accomplishing mandatory, general and specific objectives of the FCEAG Science and Arts Research Projects (11 Faculty projects) that will achieve international reputation in their respective research areas.

The Faculty will become the leading promoter of collaborative research at the regional and national level, involving the industry, the academic community, and state administrative bodies and institutions. Supported by newly equipped laboratories, the Faculty's teaching staff, researchers, and students shall aim for international recognition within their specific research disciplines, collaboration with other research institutions, and publishing original research. As a result of the INFRA project that enabled modern laboratories equipped with cutting-edge technology, students will be more efficiently included in teaching and research. Access to the European and world research area will also be

facilitated for scientists and researchers. In addition, researchers will gain a competitive advantage among their international colleagues and be more easily hired on demanding projects. At the same time, industry partners, within Croatia and beyond, will be able to conduct targeted and applied research, develop new products, models and services, and test their innovative concepts and technology transfer capabilities.

Increased mobility of teachers and students will contribute to the acquisition of new experiences in education and scientific research, the creation of highly qualified staff for teaching, scientific and artistic activity, allowing adaptability to the labour market requirements within the European Union. The scientific research potential of FCEAG will be adaptable to its increasingly dynamic environment and offer the possibility of modifications and introduction of new high-quality study programs and interdisciplinary studies (and research) pertinent to regional and national development.

In the light of the contemporary, 21st-century approaches to education that interpret knowledge through the lens of the research-education-innovation triangle, FCEAG is committed to contributing to the development of all aspects of the knowledge triangle and supporting the partnership between research and business communities to meet the current societal challenges. To maintain the continuity of the abovementioned, in this preparation period, it is necessary to integrate more comprehensively into the European funding schemes (societal challenges) and the national ones (specific strategic goals and/or priority thematic areas and subareas). This implies the development of new scientific research topics at FCEAG in the interdisciplinary field of science (IFS).

The means of achieving this objective, in terms of organizational development and the selection of scientific research topics is described in Chapters 5 and 6. With such a defined vision, FCEAG has established a flexible organizational structure adapted to the needs of the European and national funding schemes, so that interdisciplinary research topics addressed so far within specific departments can be easily grouped into larger multidisciplinary research teams (also including members from outside the Faculty) that collaborate on single Science and Arts Research Project (SARP). In this way, it is possible to respond quickly to the increasingly demanding organizational challenges of the European and national research area by grouping more researchers from different fields of science into specific project teams.

FCEAG activities

Scientific and research activities have been one of the basic drivers of the Faculty's development since its inception. The current track record places FCEAG among the leading engineering sciences faculties in Croatia and the region. To maintain an already successful approach but simultaneously adapt to modern research management trends, the Faculty's nucleus for developing contemporary, interdisciplinary research was formally established in 2011. Specifically, this was the year when the Faculty conferred the first academic title in an interdisciplinary field of science, which was a direct consequence of having recognized the need to strengthen research in engineering sciences with knowledge and skills of social sciences, to broaden the selection of research topics, and reorganize research process. Specifically, having acknowledged contemporary research trends, FCEAG formed a matrix organizational structure, i.e., a project-oriented scientific research organization within a traditionally functioning organizational system that is more suitable for other activities. Since research directly affects professional work and activities in the industry, this research-industry nexus resulted not only in the stimulation of scientific research but also in the design and construction of many significant buildings and projects, which is why FCEAG remains a foundation of professional and scientific excellence.

In addition to scientific research, higher education and lifelong learning programmes organised through professional development courses, FCEAG offers professional engineering services, such as study preparation, expert studies, design supervision studies, preliminary designs, complex structural designs, construction site and design supervision, laboratory and field structural testing, and expert consulting.

2. ANALYSIS OF THE FACULTY'S SCIENTIFIC POTENTIAL AND ITS POSITION IN THE SCIENTIFIC AND BUSINESS ENVIRONMENT

Tables 2.1 and 2.2 present an analysis of the scientific potential of FCEAG in terms of published papers in different scientific fields and completed, active and currently submitted scientific research projects related to different funding sources, such as the Croatian Science Foundation and various operational programmes for EU funding.

Analysis of published papers by field of science in the last five years

Basic fields of science	Number of relevant publications in the last 5 years	Relevance of FCEAG in databases (WOS/Scopus); Citation metrics (number of citations/self-citations)	Assessment of potential
Engineering sciences	A = 211 B = 6 (duplicates excluded) C = 283 Total = 500	WoS - total of 235 papers (957 citations / 213 self-citations) Scopus - total of 259 papers (1133 citations / 361 self-citations)	The field is well represented (a large number of publications and citations) with a large number of researchers employed at the institution**
Natural sciences	A = 28 B = 3 (duplicates excluded) C = 16 Total = 47	WoS - total of 28 papers (89 citations / 9 self-citations) Scopus - total of 28 papers (91 citations / 37 self-citations)	The field is well represented (medium number of publications and citations) with a smaller number of researchers employed at the institution
Interdisciplinary field of science	A = 17 B = 0 (duplicates excluded) C = 14 Total = 31	WoS – total of 15 papers (55 citations / 25 self-citations) Scopus - total of 14 papers (55 citations / 28 self-citations)	The field is well represented (medium number of publications and citations) with a smaller number of researchers employed at the institution
All fields of science in total	A = 254 B = 9 (duplicates excluded) C = 312 Total = 575	WoS - total of 278 papers (1101 citations)/247 self-citations) Scopus - total of 301 papers (1279 citations / 426 self-citations)	The number of papers and citations indicates the significant scientific and research potential of the institution.

* According to the Regulations on requirements for the election to scientific titles (Official Gazette, No. 28/2017):

A = scientific papers published in journals indexed in WoSCC (Web of Science Core Collection)

B = scientific papers published in journals indexed in other bibliographic databases

C = scientific papers published and presented at international conferences/posters

** There is a significant increase in published scientific papers in categories A, B and C compared to data from the period 2012-2017 in the field of engineering sciences (A = 168, B = 37, C = 137, Total = 342)

The analysis of published papers shows a significant increase in published scientific papers in the last five years in categories A, B and C (field of engineering sciences) compared to the previous period 2012-2017, which indicates the growth of the scientific and research potential of FCEAG and is a clear indicator of continuous development of scientific research capacities of the institution.

Analysis of completed/active/submitted scientific research projects in the last five years

Type of project/number of projects	Project areas	The role of FCEAG	Assessment of potential and recognition
Croatian Science Foundation 8 projects: 4 completed and 4 in progress	Roman Water Systems of City of Salona and Diocletian's Palace and Their Impact on Urban Sustainability (completed)	FCEAG project developer	Scientific papers (20 published papers) in the journals in the first two quartiles. International cooperation was established with universities in Sheffield, Skopje, Penn State, Lisbon, Kiel, Oak Ridge National Laboratory, and others.
	Groundwater flow modelling in karst aquifers (completed)	FCEAG project developer	
	Influence of creep strain on the load capacity of steel and aluminium columns exposed to fire (completed)	FCEAG project developer	
	Development of numerical models for reinforced-concrete and stone masonry structures under seismic loading based on discrete cracks (completed)	FCEAG project developer	
	Seismic base isolation of a building by using natural materials - shake table testing and numerical modelling (in progress)	FCEAG project developer	
Experimental and numerical investigations of mechanisms in unsaturated geomaterials (in progress)	FCEAG project developer		

	<p>Parameter estimation framework for fracture propagation problems under extreme mechanical loads (approved in 2020, in progress)</p> <p>Multi-physics modelling of surface and subsurface waters (approved in 2020, in progress)</p>	<p>FCEAG project developer</p> <p>FCEAG project developer</p>	
<p>ERDF “Competitiveness and Cohesion 2014-2020” Operational Programme projects</p> <p>7 projects: 7 projects in progress</p>	<p>CAAT - Development of technology for assessment of autopurification capabilities of coastal waters (in progress)</p> <p>STIM-REI (in progress)</p> <p>COMMON (approved in 2020, in progress)</p>	<p>FCEAG project developer</p> <p>FCEAG project partner</p> <p>FCEAG project partner</p>	<p>Interdisciplinary project in the field of oceanographic and atmospheric modelling and physical process modelling related to the flow and transport of surface and groundwater runoff to Adriatic coastal waters</p> <p>Project of the Centre of Excellence for Science and Technology Integration of Mediterranean Region (STIM), connects research (R), innovation (I) and education (E) in interdisciplinary research encompassing water and the environment</p> <p>Project COMMON (COastal MONitoring) aims to apply innovative solutions for continuous coastal ecosystem monitoring as a foundation for their integral management. The Croatian part of the Adriatic Sea, due to its coastal length and a large number of islands, faces significant anthropogenic pressures, which are</p>

	<p>Increasing the development of new products in the timber industry used in civil engineering (approved in 2020)</p>	<p>FCEAG project partner</p>	<p>the result of economic growth and the increasingly more pronounced influence of climate change.</p> <p>The project aims to investigate the potential of hardwoods harvested in Croatian forests for the production of glued laminated timber (glulam). Although until recently the production of glulam implied the use of softwoods, the unexploited potential of increased share of hardwoods in European forests resulted in more intensive research of its use as material for the production of glulam during the last decade. The goal of the project is to provide an overview of the hardwoods currently represented in Croatia and to summarise the foreign studies published so far on the use of these types of wood in the production of glulam. An overview of the current state of knowledge will enable glulam producers in Croatia to obtain the best possible insight into the suitable types of wood, as well as the technological aspects of their application.</p> <p>The planned project output is development</p>
--	---	------------------------------	--

	<p>Development of drainage systems on horizontal surfaces made of permeable concrete (approved in 2020, in progress)</p>	<p>FCEAG project partner</p>	<p>of an innovative drainage system on horizontal surfaces made of permeable concrete, such as large parking lots. The research is focused on the development of a prototype drainage system under laboratory conditions using a specially designed precipitation system and measurement equipment from the INFRA project. The prototype is to be applied in a large test parking lot to demonstrate the effectiveness of the drainage system under real conditions.</p>
	<p>VODIME - Waters of the Imotski region Improving monitoring, forecasting and planning of climate change adaptation measures (approved in 2020, in progress)</p>	<p>FCEAG project developer</p>	<p>The VODIME project aims to strengthen the resilience to climate change of vulnerable sectors of water resource management, agriculture, energy, and tourism in a specific area of the Imotski region. Smart decision support system in the management of Imotski field in adapting to climate change will be developed based on research results, as well as Integral Study for the Management of the Imotski Field, consequently leading to strengthening resistance to climate change and greater</p>

	PINNA NOBILIS SSMA-19 (approved in 2020, in progress)	FCEAG project partner	<p>functionality and economic progress of the Imotski Region.</p> <p>The project is focused on applied industrial research of products in the nautical industry - anchors for soft seafloors and the transition zone between soft and hard seafloors.</p>
<p>ERDF “Competitiveness and Cohesion 2014-2020” Operational Program projects</p> <p>1 project: 1 project in progress</p>	<p>INFRA – Infrastructure project for construction and equipment of 11 Faculty laboratories</p> <p>“Implementation of Contemporary Research Infrastructure at FCEAG for Smart Specialization in Green and Energy Efficient Construction” (in progress)</p>	FCEAG project developer	<p>Planned project completion by Q3 2021.</p> <p>Significant increase in recognition of FCEAG and improvement of research opportunities and networking at all levels.</p>
<p>ESF (period 2014-2020)</p> <p>1 project: 1 project completed</p>	<p>CPORT – Risk assessment of the pollution caused by rivers and discharges in coastal areas (completed)</p>	FCEAG project developer	<p>Cooperation established with MARETEC Institute, Lisbon.</p>
<p>ERDF INTERREG projects (period 2014-2020)</p> <p>6 projects – 6 projects in progress</p>	<p>AdSWiM - Managed use of treated urban wastewater for the quality of the Adriatic Sea</p> <p>DEEP-SEA – Development of energy efficiency planning and services for the mobility of Adriatic marinas</p>	<p>FCEAG project partner</p> <p>FCEAG project partner</p>	<p>The project promotes transboundary integrated management of water resources to bring about a disrupted nutrient balance.</p> <p>The goal of the project is resolving the issue of predominant single-modality land transport (cars), highly polluting maritime transport (motor boats with endothermic engines) and limited integration of mobility services offered in the mentioned sector.</p>

	<p>E-CITIJENS - Civil protection emergency decision support system (DSS) based on citizen journalism to enhance safety of Adriatic Basin</p>	<p>FCEAG project partner</p>	<p>The project aims to increase the safety of the Croatian and Italian Adriatic basin from natural and man-made disasters by improving emergency prevention and management measures and instruments.</p>
	<p>MoST - Monitoring seawater intrusion in coastal aquifers and testing pilot projects for its mitigation</p>	<p>FCEAG project partner</p>	<p>The aim of the project is to achieve a better understanding of the physical processes driving continental-marine water exchanges and to define suitable countermeasures that limit the occurrence of saltwater contamination.</p>
	<p>NET4mPLASTIC - New technologies for macro and microplastic detection and analysis in the Adriatic Basin</p>	<p>FCEAG project partner</p>	<p>The project involves the development of cooperation between Italian and Croatian research organizations, small and medium enterprises, and local authorities in Italy and Croatia to address the common challenge of plastics and microplastics in the Adriatic Sea.</p>
	<p>PMO-GATE - Preventing, managing and overcoming natural-hazards risks to mitigate economic and social impact</p>	<p>FCEAG project partner</p>	<p>The goal of the project is creating synergy between local authorities, research institutes, schools and universities, and citizens, in order to evaluate and manage multihazard risks</p>

	<p>Plastic Busters MPA: Preserving biodiversity from plastics in Mediterranean Marine Protected Areas</p>	<p>FCEAG project partner</p>	<p>typical of included regions.</p> <p>The project provides a comprehensive, multifaceted, and coordinated approach to combat marine litter in Mediterranean coastal and marine protected areas towards healthy marine ecosystems.</p>
--	---	------------------------------	--

Based on the overview of completed/active/submitted projects, it is evident that there are currently a significant number of active research projects being carried out at FCEAG, which indicates the quality of the scientific research capacity of FCEAG as a whole and its scientific research potential in the field of engineering sciences.

SWOT analysis of scientific research activities in the field of engineering sciences

Strengths

- General increase in the number of applications for scientific projects over the past five years, with participation of scientific and teaching staff in the fields of construction, architecture and geodesy
- Increase in the number of published papers in the field of engineering sciences in journals indexed in the WoS database compared to the period 2012-2017
- General increase in the number of published scientific papers in all fields of science within the scientific domain of FCEAG in the last five years
- The possibility of using new scientific equipment obtained as part of the financing of the FCEAG infrastructure project: INFRA in engineering sciences research

Weaknesses

- Lack of experience of active FCEAG research staff in finding partners to create consortia for project applications within the current EU framework programme for research and innovation
- A part of research active staff carries a maximum teaching workload in some undergraduate and graduate study programs
- A relatively small number of students enrolled in the Civil Engineering doctoral study program
- A relatively small number of laboratory personnel employed to conduct scientific research

Opportunities

- Utilising the full potential of the new scientific research infrastructure implemented through the FCEAG infrastructure project: INFRA in engineering sciences research
- Use of the University's SEA-EU initiative through international cooperation and/or application of collaborative international projects
- Currently active collaborative research with other research groups in European Union countries
- Application of FCEAG scientific research topics to solve current economic problems in the Republic of Croatia and the Split-Dalmatia County

Threats

- Doctors of science leaving the sector, due to a lack of available jobs in the scientific research sector
- In the context of an underdeveloped Croatian economy, there is a lack of recognition and exploitation of knowledge and competencies of recent PhD graduates in the field of engineering sciences
- Relatively high costs of laboratory research

3. STRATEGIC GOALS OF THE FACULTY

FCEAG has adopted and is currently implementing the strategic goals defined in the Strategy of the Faculty of Civil Engineering, Architecture and Geodesy for the period 2018-2022 (hereinafter: Strategy 2018-2022), which was adopted for the purpose of planning the development of scientific research activities and the development of teaching and professional activities at the Faculty for the specified period. The listed strategic goals were defined in such a way that they support the current goals of the mentioned strategy, whereas new goals were added to plan the development of the scientific organization in the period 2021-2025.

Strategic goals	Subgoals	Activities
<p>Students and teaching work:</p> <p>Improving the compatibility of teaching programs with European programs. Constantly improving the current programs and introducing new programs recognizable and attractive to students at the undergraduate, graduate and postgraduate levels with clearly defined learning outcomes, aligned with the long-term demands of the community, the economy and the development of society.</p>	<p>Improving the compatibility of teaching programs with European programs. Constantly improving the current programs and introducing new programs recognizable and attractive to students at the undergraduate, graduate and postgraduate levels</p> <p>*Development of postgraduate doctoral studies in Civil Engineering</p>	<p>Development of popular interdisciplinary study programs at graduate studies</p> <p>*Development of a doctoral study in an interdisciplinary field of science founded on a combination of existing scientific research at FCEAG</p>

		(engineering, social, natural sciences)
<p>Scientific research activity and international recognition:</p> <p>Increasing recognition in the European Research Area by conducting scientific research with the aim of contributing to the development of the region, the Republic of Croatia and the EU.</p>	<p>Identifying and increasing research and innovation capacities at FCEAG</p> <p>Increasing research funding through structural and other EU funds</p> <p>Using the project results to impact developments in the region, the Republic of Croatia or the EU</p> <p>Encouraging cooperation with the industry and the public sector</p>	<p>Securing financial resources for research by applying for research funding of competitive projects</p> <p>Conducting research in the proposed scientific topics</p>
<p>Strengthening international cooperation and mobility:</p> <p>Increasing the number of joint PhD and cotutelle agreements</p> <p>Organizing joint workshops and summer schools for doctoral students</p> <p>Increasing the number of science lectures given by foreign scientists</p> <p>Increasing the number of projects implemented with foreign universities, laboratories and business enterprises</p> <p>Encouraging incoming and outgoing mobility of researchers, participating in the ERASMUS+ mobility programme</p>	<p>Applying for funding of competitive joint research projects with other national and international research institutions and business enterprises</p> <p>*Ensuring cooperation with foreign scientific and research institutions through the ERASMUS+ mobility programme</p>	<p>Applying for funding of competitive joint research projects with current and new partners</p> <p>*Advancing the FCEAG summer school through the participation of external stakeholders from foreign scientific and research institutions</p> <p>*Increasing the number of incoming/outgoing mobility of researchers</p>
<p>*Initiating, strengthening and developing the FCEAG research infrastructure:</p> <p>Initiating and developing the activities of existing and new</p>	<p>*Using the scientific research equipment of FCEAG laboratories for the purpose of exploring research topics proposed within the framework of the research</p>	<p>* Applying for funding of competitive research projects for the purpose of exploring research topics proposed within the framework of this strategy,</p>



FCEAG scientific research laboratories with the aim of achieving the objectives of the INFRA project.	strategy in the field of engineering sciences and the interdisciplinary field of science.	and achieving self-sustainability of FCEAG laboratories *Increasing the number of laboratory staff in FCEAG laboratories
---	--	---

* Additional goals, subgoals and activities defined within the framework of this strategy

4. SUBJECT OF ELABORATION

The commitment of FCEAG to conducting scientific research with the aim of developing FCEAG's infrastructural capacities and commitment to strengthening scientific research activities and recognition through research topics in the field of engineering sciences was presented in Chapter 3 Strategic goals of the Faculty. This elaboration of the existing Faculty Development Strategy for the period 2018-2022, which also represents the strategy for the development of research and scientific work in the field of engineering sciences for the following five-year period, forms the basis for defining scientific research work in the field of engineering sciences within the future FCEAG development strategy for 2023-2028. Research topics in the field of engineering sciences that are planned to be carried out through the organizational units of FCEAG Science and Arts Research Projects are elaborated in detail in Chapter 5. The table presents 32 research topics in the field of engineering sciences planned for research at FCEAG, each topic explained with the following elements: summary, list of objectives, expected number of researchers, cooperation with external research institutions.

5. RESEARCH TOPICS IN THE FIELD OF ENGINEERING SCIENCES

Topic 1: Seismic resistance testing of different types of structures (buildings, bridges, towers, tunnels, dams, etc.)
Research topic summary: In this research field, experimental tests of seismic resistance of different types of buildings are carried out. Various effects are investigated that influence the behaviour of structures due to earthquakes. Furthermore, new structural systems are being investigated to develop seismically resistant structures. The research aims to deepen the understanding of the behaviour of structures subjected to earthquakes, develop new guidelines, and improve existing guidelines for construction in seismically active zones. The final outcome of the research is increasing the safety and cost-effectiveness of structures. The seismic testing laboratory with installed equipment (a 4 × 4 m shake-table) is unique in the broader regional area. Namely, there is no similar laboratory in a broader area of approximately 500 km around this facility. Since the Republic of Croatia, as well as southern and eastern Europe, is a highly seismically active area, research of this kind is essential to mitigate or eliminate the consequences of earthquakes.
Research objectives: The research aims to deepen the understanding of the behaviour of structures subjected to earthquakes, develop new guidelines, and improve existing guidelines for construction in seismically active zones. The final outcome of the research is increasing the safety and cost-effectiveness of structures.
Research is planned in the following laboratory/laboratories: <ul style="list-style-type: none">• Seismic engineering laboratory (SAR project - Experimental and Numerical Testing of Materials and Structures under Static, Dynamic, and Impact Loads)
Human resources: Approx. 11 staff members (teachers, associates, doctoral students)
External cooperation: -

Topic 2: Investigation of the behaviour of materials and structures using an impact tower
Research topic summary: In this field of research, experimental investigations of the resistance of structures to impact loads are carried out. The behaviour of different materials and structures exposed to impact loads is being investigated experimentally. Furthermore, the efficacy of strengthening existing structures with new materials and their resistance to impact load will also be examined. Laboratories for testing materials and structures under impact loads are rare; there is no similar laboratory in the Republic of Croatia. In addition to testing materials and structures used in construction using an impact tower, it is possible to test different types of structures and materials used to transport certain goods (packaging of certain products, etc.).
Research objectives: Research aims to deepen the understanding of the behaviour of structures subjected to impact loads. The final outcome of the research is increasing the safety and cost-effectiveness of structures.

Research is planned in the following laboratory/laboratories:

- Seismic engineering laboratory (SAR project - Experimental and Numerical Testing of Materials and Structures under Static, Dynamic, and Impact Loads)

Human resources:

Approx. 11 staff members (teachers, associates, doctoral students)

External cooperation:

-

Topic 3:

Investigation of seismic base isolation

Research topic summary:

In this research field, experimental investigations are carried out on the efficiency of seismic base isolation in structures. Experimental research is carried out to investigate the possible application of appropriate devices to reduce seismic load on structures. Furthermore, the potential for the application of natural materials as seismic base isolation of a structure will be investigated.

Research objectives:

The research aims to deepen the understanding of the behaviour of structures subjected to earthquakes. The final outcome of the research is increasing the safety and cost-effectiveness of structures.

Research is planned in the following laboratory/laboratories:

- Seismic engineering laboratory (SAR project - Experimental and Numerical Testing of Materials and Structures under Static, Dynamic, and Impact Loads)

Human resources:

Approx. 11 staff members (teachers, associates, doctoral students)

External cooperation:

-

Topic 4:

Investigation of the behaviour of retaining wall during an earthquake

Research topic summary:

In this research field, tests of the behaviour of concrete and masonry retaining walls are carried out. The influence of various parameters on the behaviour of retaining walls during an earthquake will be investigated (i.e., the method of reinforcing concrete walls, height of the wall, type of backfill, humidity of the backfill, influence of antiseismic insulation behind and under the wall).

Research objectives:

The research aims to deepen the understanding of the behaviour of retaining walls. The final outcome of the research is increasing the safety and cost-effectiveness of structures.

Research is planned in the following laboratory/laboratories:

- Seismic engineering laboratory (SAR project - Experimental and Numerical Testing of Materials and Structures under Static, Dynamic, and Impact Loads)

Human resources:

Approx. 11 staff members (teachers, associates, doctoral students)

External cooperation:

-

Topic 5:

Testing seismic behaviour of stone walls and stone masonry houses

Research topic summary:

In this field of research, investigations are carried out on the behaviour of stone walls and stone houses during an earthquake. The influence of various parameters will be investigated (such as the behaviour of walls during an earthquake perpendicular to the plane of the wall and in the plane of the wall, the influence of the ratio of thickness and height as well as the ratio of width and height of the wall, the influence of different types of mortar in the joints, the influence of the type of stone connection, the influence of the size of the stone block, the influence of different types of earthquakes) on the behaviour of stone walls and stone houses during an earthquake. Most historical buildings designated as cultural heritage of the Republic of Croatia and other countries, especially in the Mediterranean, are stone masonry structures.

Research objectives:

Research aims to deepen the understanding of the behaviour of stone structures subjected to earthquakes. The final outcome of the research is increasing the safety and cost-effectiveness of structures.

Research is planned in the following laboratory/laboratories:

- Seismic engineering laboratory (SAR project – Experimental and Numerical Testing of Materials and Structures under Static, Dynamic, and Impact Loads)

Human resources:

Approx. 11 staff members (teachers, associates, doctoral students)

External cooperation:

-

Topic 6:

Testing of metal structures elements

Research topic summary:

The research is focused on determining the mechanical properties and behaviour models of steel and aluminium beams, columns and joints at atmospheric temperatures. As part of the research, the effects that can occur during the lifetime of structures are described, such as local and global stability losses, the influence of corrosion, the behaviour of joints, dynamic characteristics of assemblies, etc. Most of the research will be carried out experimentally, supported by appropriate numerical and analytical models. The described research aims to increase the safety and cost-effectiveness of structures.

Research objectives:

- Defining new experimental procedures to determine the parameters of structural behaviour

- Describing the mechanical properties of steel and aluminium products used in construction
- Supporting the industry in the development of new products

Research is planned in the following laboratory/laboratories:

- Structures laboratory (SAR project – Research of the behaviour of different types of structures under extreme loads)

Human resources:

4 teachers, 4 associates, 2 laboratory assistants

External cooperation:

- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split
- Faculty of Civil Engineering, University of Zagreb
- Faculty of Engineering, University of Rijeka
- Faculty of Civil Engineering, University of Rijeka
- Lavčević d.o.o. Split
- Tromont d.o.o. Split
- Brodograđevna industrija split d.d., Split
- (Brodosplit d.d.)

Topic 7:

Investigation of the behaviour of parts of structures exposed to high temperatures

Research topic summary:

In this research topic, investigations of the behaviour of various structures and parts of structures exposed to high temperatures, typical for fires in closed spaces, are carried out. The tested structures are mostly made of metal (steel and aluminium), with mechanical behaviour significantly influenced by temperature. At elevated temperatures, the rheological properties of these materials change, which affects the load-bearing and stability parameters of the structure. The rheological properties are modelled using analytical models that use different parameters to calculate long-term deformations. Together with the heat conduction model and the mechanical model, the structure's resistance to high temperature is defined. The research is mainly experimental and is carried out in several phases. Primarily, the thermal and mechanical properties of the material are tested by compressive-tensile tests of samples in a tear machine with a temperature chamber. The next phase is an experimental study of heat conduction in a structure. Finally, by conducting sets of stationary and non-stationary eccentric pressure tests at high temperatures on structural elements, appropriate models and parameters describing fire resistance for one type of element are defined. All experimental research is supported by appropriate numerical and analytical studies.

Research objectives:

- Defining new experimental procedures for the optimal determination of behaviour parameters of structures at high temperatures
- Describing the mechanical properties of steel and aluminium products used in construction at high temperatures
- Supporting the industry in the development of new products

Research is planned in the following laboratory/laboratories:

<ul style="list-style-type: none">Structures laboratory (SAR project – Research of the behaviour of different types of structures under extreme loads)
Human resources: 4 teachers, 4 associates, 2 laboratory assistants
External cooperation: <ul style="list-style-type: none">Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of SplitFaculty of Civil Engineering, University of ZagrebFaculty of Engineering, University of RijekaFaculty of Civil Engineering, University of RijekaLavčević d.o.o. SplitTromont d.o.o. SplitBrodograđevna industrija split d.d., Split(Brodosplit d.d.)

Topic 8: Research of structures built from other materials
Research topic summary: In this research field, mechanical properties of wooden products are investigated, with a special focus on glued laminated supports, brick elements, and elements made of plastics. The research is predominantly experimental. Using photogrammetric and 3D measuring methods, a digital model of the shape of the sample is defined. The sample is loaded in one of the load testing machines in the laboratory and peak force, deformation and mechanical properties are measured during testing. In addition to standard measuring sensors of displacement and force, innovative methods of 3d scanning and extraction of displacement and deformation fields using photographic procedures are used.
Research objectives: <ul style="list-style-type: none">Developing new measurement systems integrating photographic methodsDeveloping experimental procedures to optimize the process of obtaining the required parametersSupporting the industry in the development of new products
Research is planned in the following laboratory/laboratories: <ul style="list-style-type: none">Structures laboratory (SAR project – Research of the behaviour of different types of structures under extreme loads)
Human resources: 2 teachers, 2 associates, 1 laboratory assistant
External cooperation: <ul style="list-style-type: none">Drvena industrija Voćin d.o.o.KRAH d.o.o.AD plastika d.o.o.Drnišplast d.o.o.Dracomerx d.o.o.

Topic 9:

Research of concrete structures

Research topic summary:

In this research field, testing of the mechanical properties of smaller concrete elements under atmospheric conditions is carried out. The tests are aimed at determining the effects of individual parameters in the concrete on the global behaviour of the reinforced concrete assembly. The testing procedure covers compression and bending tests, CTOD tests, dynamic responses of the structure and the effects of defects on the elements. The tests will be conducted in combination with numerical modelling.

Research objectives:

- Developing experimental methods for defining the mechanical properties of concrete elements
- Supporting the industry in the development of new products

Research is planned in the following laboratory/laboratories:

- Structures laboratory (SAR project – Research of the behaviour of different types of structures under extreme loads)

Human resources:

2 teachers, 2 associates, 1 laboratory assistant

External cooperation:

- Faculty of Civil Engineering, University of Zagreb
- Faculty of Engineering, University of Rijeka
- Faculty of Civil Engineering, University of Rijeka
- Lavčević d.o.o. Split
- Tromont d.o.o. Split

Topic 10:

Field measurements

Research topic summary:

This research field is focused on defining the mechanical behaviour of built structures under static and dynamic loads. Tests are carried out using inertial acceleration sensors, deformation sensors and photogrammetric methods. The research is carried out on bridges, columns and floor structures.

Research objectives:

- Experimental procedures integrating traditional measurement methods (inertial systems and displacement sensors) with photogrammetric methods
- Optimization of load test procedures
- Development of a construction monitoring system

Research is planned in the following laboratory/laboratories:

- Structures laboratory (SAR project – Research of the behaviour of different types of structures under extreme loads)

Human resources:

2 teachers, 4 associates, 2 laboratory assistants

External cooperation:

- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split
- Faculty of Civil Engineering, University of Zagreb
- Faculty of Engineering, University of Rijeka
- Faculty of Civil Engineering, University of Rijeka
- Tromont d.o.o. Split
- Brodograđevna industrija Split d.d., Split (Brodosplit d.d.)
- Dalekovod d.o.o.

Topic 11:

Determining soil properties and stress under structures in seismically active areas

Research topic summary:

The seismic resistance of structures is one of the key factors affecting the safety of human life in populated areas. Assessment of the bearing capacity of a structure and behaviour of a structure during an earthquake, damage mechanisms and the behaviour after collapse, including the investigation of the collapse mechanism, represent a long-term research interest with the aim of acquiring knowledge on the protection of new and existing buildings, thus reducing the risk of collapse and loss of human life. The seismic resistance of the buildings and the stress under the buildings cannot be determined without determining the properties of the soil, considering the speed of propagation of the seismic waves.

Research objectives:

- Determining stress and improving methods and procedures for determining stress under and around existing structures, especially historic buildings;
- Determining stress under coastal structures on piles, berets, pylons and massive walls;
- Determining the stress and modulus of materials for new buildings in seismically active areas;
- Defining stress at the contact of the foundation soil and the structure of existing buildings on a macro level;
- Defining the speed of propagation of transverse waves in the soil with the aim of determining soil properties
- Detection of dynamic properties of sections and units of existing buildings in seismically active areas

Research is planned in the following laboratory/laboratories:

- Structures laboratory (SAR project – Research of the behaviour of different types of structures under extreme loads)

Human resources:

4 teachers, 4 associates, 2 laboratory assistants

External cooperation:

- Faculty of Civil Engineering, University of Zagreb
- Faculty of Civil Engineering, University of Rijeka
- Pomgrad d.o.o. Split

Topic 12:

Improving the properties of sustainable cement composite

Research topic summary:

Concrete is a composite building material consisting of cement, water, aggregate, and possibly additives. Adding microfibers can potentially increase the bending strength and delay the propagation of microcracks. In the past, it was considered that the strength of this "artificial stone" increases over time as a result of the long-lasting chemical process of cement hydration. However, many structures, especially in an aggressive environment, do not have the necessary exploitation safety level due to material degradation. The present applications require environmentally friendly and energy-friendly concrete. In the design process, in addition to the load-bearing capacity and durability criteria, the impact on the environment should also be taken into account. Some of the options for protecting the environment include the use of natural fibres and recycled material.

Natural, cellulose fibres are locally available, biodegradable, renewable, low density, safer to handle and produce, non-abrasive and economical. They are created by the photosynthesis process, as the plant takes in carbon dioxide and releases oxygen. A significant issue is the durability of cellulose fibres. There is a need for thorough tests before starting serious production of cement composites reinforced with natural fibres. The decomposition of fibres in the cement composite occurs under the influence of alkalis, which dissolve lignin and hemicellulose. Fibre treatments involve chemical processing of fibres, and it is necessary to consider an environmentally sound approach to processing fibres before incorporating them into a cement composite.

Recycled material does not necessarily have to be created by recycling construction waste. It is also possible to use waste materials from other industries, such as the textile industry. Industrial waste is deposited at designated sites, the number of which decreases with accelerated development. The most cost-effective way of using waste is the one that requires minimal processing and allows reuse. Further investigations include examining the possibility of using textile waste as part of the cement composite.

Depending on the method of incorporating the mentioned materials into the cement composite, improved physical and mechanical properties of the composite are expected. Due to the specific structure of the material, it is necessary to examine the durability parameters in order to define possible applications of the composite.

Research objectives:

- Production and testing of the physical and mechanical properties of composites
- Testing of durability parameters
- Use of recycled materials
- Publication of scientific papers
- Completion of a doctorate

Research is planned in the following laboratory/laboratories:

- Building materials laboratory (SAR project – Research in improving the properties of concrete and other basic building materials)

Human resources:

- 2 teachers
- doctoral candidate
- laboratory assistant (Building materials laboratory)

External cooperation:

- Faculty of Chemistry and Technology, University of Split
- University of Applied Sciences Marko Marulić Knin – Karst agriculture department
- Faculty of Civil Engineering and Architecture, University of Osijek
- Faculty of Civil Engineering, University of Rijeka
- University Department of Health Studies, University of Split

Topic 13:

Safety related to the impact of extreme wind load

Research topic summary:

Long-term wind speed and direction measurements have been carried out by FCEAG, as the first profile measurements in Croatia and at different locations: the Poljud stadium in Split, the Dubrovnik bridge, the Bobani antenna pole in the hinterland of Split. In this research field, the risk to structures and road transport in relation to wind load will be analysed based on the data on wind energy described in the area of wind energy research. Using specialised equipment, the deformations, displacements, and immediate stresses in the structures (antenna poles, wind turbine poles, power transmission structures, etc.) for certain types of wind (bora, scirocco, and levanter).

The obtained results will be compared with the designed values and should provide an answer to the adequacy of the standards (Eurocode) applied in the construction design. The described research can be applied to several locations and research fields of interest to the industry and Croatian institutions.

Research objectives:

- Investigating basic properties of wind load and response analysis of structures (structure behaviour)
- Developing wind-structure interaction calculation methodology
- Developing a general procedure for calibrating numerical models
- Determining the reliability of specific structures (dominant wind load) and comparison with the applicable standards

Research is planned in the following laboratory/laboratories:

- Structures laboratory (SAR project – Research of the behaviour of different types of structures under extreme loads)
- Wind energy measurement station (SAR project – Effect of wind energy and climate change in civil engineering)
- Hydrotechnical laboratory Žrnovnica (SAR project – Research of water resources and coastal areas)

Human resources:

3 teachers

External cooperation:

-

Topic 14:

Development of new numerical models and analysis of complex behaviour mechanisms in mechanics of structures and materials

Research topic summary:

The research involves development of new numerical models in the field of mechanics of structures and materials, including the analysis of the behaviour of building structures and materials, the development of appropriate mathematical models that describe their behaviour, the development of numerical algorithms, the production of computer problem-solving software, the validation of the obtained solutions, the sensitivity analysis of the developed algorithms and conclusions on the possible applications of the developed models. The model development will be focused on the non-linear behaviour of building materials such as concrete, steel, glass, reinforced concrete and

prestressed concrete under static, cyclic and dynamic loads. Special attention will be paid to the development of efficient models for numerical modelling of physical problems related to material damage. The finite element method, the finite element method with embedded discontinuities, the finite-discrete element method and the discrete element method will be applied in the modelling. The structures to be analysed include frame structures, plane structures, plate structures, and shells. Developed numerical models, combined with professional computer software, will be used in the analysis of the behaviour of building structures exposed to extreme loads (wind, earthquake, fire, explosions).

Research objectives:

- Development of a numerical model for crack propagation in materials exposed to cyclic and dynamic loading by the finite element method with embedded discontinuities
- Development of a numerical model for time-dependent deformations of concrete in a 3D analysis of reinforced concrete and prestressed structures
- Development of a numerical model for the behaviour of glass exposed to static and impact loads
- Development of numerical models for the analysis of the stability of beams involving material nonlinearity, small and large deformations, large displacements, and large rotations
- Development of numerical models for the analysis of shells involving material nonlinearity, small and large deformations, large displacements, and large rotations
- Numerical analysis of the stability of shells exposed to dynamic load
- Numerical analysis of flat structures made of ductile materials exposed to large displacements, rotations and deformations with the possibility of cracking and contact interaction
- Simulation of fluid behaviour due to the transmission of shock waves caused by explosions or seismic load
- Calculation of the load bearing capacity and safety of existing buildings exposed to extreme loads with an emphasis on historic buildings to preserve cultural heritage
- Development of numerical models of soil mechanics with emphasis on the analysis of saturated and unsaturated materials
- Modelling of surface and groundwater flow and transport in karst and other basins
- Modelling 'multiphysics' problems in which domains are associated with different behaviours of material / media and/or physical laws.

Research is planned in the following laboratory/laboratories:

- Numerical modelling laboratory (SAR project – Numerical modelling in civil engineering)

Human resources:

10 teachers, 3 associates

External cooperation:

- Faculties of Civil Engineering in Zagreb, Rijeka, Osijek and Mostar
- Institute of Earthquake Engineering and Engineering Seismology (IZIIS) Skopje, Republic of North Macedonia
- Sorbonne Universités/UTC Compiègne, France
- University of Ferrara, Italy
- Oak Ridge National Laboratory, USA
- Royal Institute of Technology (KTH), Sweden

Topic 15:

Development of numerical algorithms for modelling problems in structural mechanics using spline functions

Research topic summary:

The purpose of the research is the development of new numerical models based on the application of spline functions, as an effective solution to the problems of deformable body mechanics. The development of numerical algorithms mainly involves the application of atomic basis functions, which can produce highly accurate and smooth approximation solutions, both for problems of structural mechanics and problems of fluid mechanics. The application of atomic basis functions of the algebraic type will be investigated, enabling the implementation of hierarchical functions of different order in an adaptive approach. Considering the problems of fluid mechanics, where solutions include large gradients, the application of atomic basis functions of the exponential type will be investigated, as an approach not yet used in numerical analyses until now. Research will examine the stability of the developed numerical algorithms and the accuracy of the obtained solutions, reaching conclusions on the applicability of the developed models. The control volume method and the collocation method will be applied in the modelling. Frame, plane and plate structures will be analysed.

Research objectives:

- Development of computer software for adaptive numerical modelling using the control volume method and collocation method based on Fup hierarchical basis functions
- Development of a meshless method based on the solution structure method and atomic basis functions, adaptation of the method for the application of the collocation procedure in numerical simulations of structural mechanics engineering problems described by partial differential equations in irregular areas
- Implementation of atomic basis functions of exponential type in flow modelling in porous media

Research is planned in the following laboratory/laboratories:

- Numerical modelling laboratory (SAR project – Numerical modelling in civil engineering)

Human resources:

3 teachers, 1 associate

External cooperation:

-

Topic 16:

Development of methodology for parameter estimation in fracture propagation problems under extreme mechanical loads

Research topic summary:

The ability to understand and correctly analyse the failure of building materials and structures under extreme loads (significant static loads, dynamic impact loads, earthquakes, etc.) is of great importance for predicting and preventing catastrophic events of structural failure and finding the optimal and safe design of structural elements in the design phase. The development of a methodology for reliable estimation of fracture parameters in crack propagation problems will be based on the solution of a stochastic inverse problem that combines measurements and a computer model. The basis of the methodology is the integration of probability theory with Bayes theorem

and a new numerical fracture model. Fracture parameters depend on the unknown microstructure of the material with its defects and imperfections, i.e. uncertain parameters. The initial knowledge of the uncertain parameters will be presented by prior probabilistic distributions, updated to posterior distributions using measurements, probability theory, and fracture models. A new numerical fracture model will be developed based on previous research and embedded strong discontinuities to simulate localised fracture with novelties in determining the elastic parameters of lattice elements that model the material microstructure. Monte Carlo Markov chain and Kalman filter methods will be implemented and used to estimate the fracture parameters of steel and concrete exposed to extreme loads. The methodology will also be able to quantify the uncertainties arising from the microstructure, which will result in a deeper understanding of the physical processes. A reliable assessment of the material parameters of failure will advance strategies for predicting the behaviour of structures, both in the design of new structures and in the evaluation of the condition and bearing capacity of existing structures.

Research objectives:

- Development of a new numerical fracture model
- Probabilistic estimate / identification of parameters
- Development of a methodology for the solution of the stochastic inverse problem
- Development of a new fracture model
- Assessment of steel parameters in dynamic impact test
- Assessment of concrete parameters
- Obtaining results, methodological experiences and engineering applications

Research is planned in the following laboratory/laboratories:

- Numerical modeling laboratory (SAR project – Numerical modeling in civil engineering)

Human resources:

1 teacher, 3 associates, 2 teachers (foreign researchers)

External cooperation:

- INSA Toulouse / Institut Clement Ader, Universite Federale Toulouse Midi-Pyrenees, France
- Institute of Scientific Computing TU Braunschweig, Germany
- University of Twente, Enschede, The Netherlands

Topic 17:

Soil and rock testing for construction purposes from an environmentally sustainable perspective

Research topic summary:

The research topic involves tests of soil and rock properties for the purposes of geotechnical field research and design according to Eurocode 7, and general support of environmental sustainability (control of environmental protection conditions) and industry - construction in the coastal area of the Republic of Croatia. The problems of environment/soil/terrain/nature protection, mitigating the consequences of climate change, smart energy management and reducing resource consumption as part of sustainable development are inseparable from the geotechnical profession (coastal erosion, defense against floods/droughts, landslides, rockfalls - problems of stability, safety, waterproofing, special foundations, waste disposal sites, etc.). Possible research subtopics include: soil and rock parameters required for further analysis of structures and various forecasts and assessments (e.g., settlement, consolidation, deformability modules) or numerical analyses; interaction at the contacts of soil and buildings or building products (e.g., geosynthetics); non-standard tests or tests outside the expected limits; new testing systems and modernization of

existing testing systems; tests of new, mixed or waste materials, effects of soil improvement and strengthening. This research area covers a wide range of occurrences of soil/rock materials and geotechnical problems in general.

Research objectives:

Conducting laboratory and field tests and observations, required in addition to or as part of more complex research in geotechnics and broader field, both individually and through cooperation with other scientific-research and higher education institutions and business enterprises. In addition to joint research and applications for projects, the objective is to achieve appropriate dissemination through scientific papers and doctoral and diploma theses.

Continuously support the industry and other stakeholders outside the scientific and research institutions, such as design and consulting companies, state companies, contractors, construction supervision companies, manufacturers of construction products, for example, on demanding design and construction projects and testing of used soil materials and/or construction products.

Research is planned in the following laboratory/laboratories:

- Geotechnical laboratory (SAR Project – Geotechnics and environmentally sustainable construction approach)

Human resources:

3 teachers, 1-2 associates (geology, if necessary numerical modelling), 1 laboratory assistant

External cooperation:

- Other civil engineering faculties in the Republic of Croatia
- Faculty of Geotechnical Engineering in Varaždin
- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split
- Institut IGH d.d. Zagreb
- other design and consulting companies

Topic 18:

Soft rocks and weathering

Research topic summary:

Research involves testing the properties of soft rocks (marl, siltite) of the flysch sequence typical for the Dalmatian area and other rocks prone to degradation and wear after excavation, as well as modelling the consequences of these properties, in relation to the construction, maintenance of buildings, and environmental sustainability. The research mainly covers argillaceous marls and marls, with a transition to calcareous marls. The following aspects are related to this topic:

- Soft rock, as a material in a minimally processed state without any additions, can be used as sealing liner material in the construction of new landfills and remediation of existing landfills;
- Control of environmental protection conditions in the coastal zone of the Republic of Croatia with regard to the increase in the number of rockfalls and landslides, floods and droughts, the increase in erosion and the effects of the sea;
- Reduction of resource consumption - use of locally available material for the construction of earthfill structures instead of exploiting limestone, development of technologies and recipes.

Research objectives:

Improving the knowledge of the impact of weathering on the engineering properties of soft rocks and the modelling of weathering-related occurrences affecting the stability, safety and cost of structure maintenance (degradation over time - the problem of durability, erosion of the surface layer and related landslides, rockfalls, etc.), through independent work and partner research. Improving the existing and developing new soft-rock classifications and test procedures, as well as

systematisation of knowledge. Contribution of Croatian researchers to the work of the ISRM (International Society for Rock Mechanics) Commission on Soft Rocks and better integration into international teams. Cooperation on projects - joint research and applications for projects, publishing research results in all types of publications.

Research is planned in the following laboratory/laboratories:

- Geotechnical laboratory (SAR Project – Geotechnics and environmentally sustainable construction approach)

Human resources:

2 teachers, 1 associate (doctoral student/geologist), 1 laboratory assistant

External cooperation:

- Croatian Geological Institute in Zagreb
- Faculty of Mining, Geology and Petroleum Engineering in Zagreb
- Foreign institutions from countries with similar research interests in soft rocks (Italy, Slovenia, Portugal, Spain, Greece...)

Topic 19:

Seismic and dynamic loading

Research topic summary:

The research area is closely related to the current topic of interest - protecting the environment from the harmful effects of natural disasters, as well as assessing the resistance, load-bearing capacity and behaviour of structures during earthquakes. Corresponding long-term research in the field of geotechnics is planned, to provide answers to questions related to soil properties necessary for further analyses of stability and load-bearing capacity and the design of structures taking into account seismic and general dynamic loading. The earthquakes registered by the seismograph represent the input data and the load for which the soil response would be determined. For this purpose, sophisticated research equipment is needed, which can reproduce an arbitrary dynamic load (e.g., any form of seismic wave). Knowledge of soil and rock properties under conditions of specific dynamic loads is related not only to extreme/earthquake effects on structures and the environment, but also to the much-heralded activities of railway design and construction in Croatia (e.g., environmentally friendly embankments under dynamic loads) and increased utilisation of renewable energy sources. Research is further motivated by other sources of dynamic/ vibrational/ cyclic loads such as waves, wind (onshore and offshore wind farms; further development of advanced wind turbines, establishing special requirements), blasting, traffic, machinery.

Research objectives:

Application of acquired knowledge in the construction industry and other fields; findings on soil response to dynamic loads and further modelling of the effects of earthquakes and other dynamic loads (displacements, interaction with products embedded in the soil, liquefaction risk assessment), sustainable and green construction.

Cooperation in research and projects with other institutions and units of local self-government (e.g., seismic microzoning, geotechnics as mandatory segment of earthquake engineering).

Dissemination through publishing research results in all types of publications.

Research is planned in the following laboratory/laboratories:

- Geotechnical laboratory (SAR Project – Geotechnics and environmentally sustainable construction approach)

Human resources:

1-2 teachers, 1-2 associates (doctoral student/postdoctoral student, associate in a special field), 1 laboratory assistant

External cooperation:

- Institutions and laboratories with adequate test equipment and resources for dynamic tests

Topic 20:

Application of advanced technologies in geotechnics

Research topic summary:

The research topic is an expansion of the existing research field defined in the previous Croatian-Japanese project, primarily involving the application of VIS-NIR spectrometry in the analysis of soft rock properties and other interdisciplinary areas, as well as terrestrial laser scanning (LIDAR) for modelling the process of erosion of cuts and possible broader applications. This field of research also includes horizontal subfields which can be integrated into most topics - numerical modelling (application of the results of experimental analysis in models, further development of modelling) and automated measurement systems for measurements and observations in the laboratory and in the field (development of systems for new types of measurements and tests, automation of existing systems).

Research objectives:

Research with the aim of establishing correlations of spectrometer results and other physical-mechanical properties, corresponding mineralogical-petrographic analysis, interdisciplinary application of hyperspectral surveying in agriculture, etc., application in GIS systems and visual surveillance systems with a wide range of applications (LIDAR). Cooperation on projects - joint research and applications for projects, publishing research results in all types of publications.

Research is planned in the following laboratory/laboratories:

- Geotechnical laboratory (SAR Project – Geotechnics and environmentally sustainable construction approach)

Human resources:

1-2 teachers, 1-2 associates (doctoral student/postdoctoral student, associate in a special field), 1 laboratory assistant

External cooperation:

- Croatian Geological Institute in Zagreb
- Faculty of Mining, Geology and Petroleum Engineering in Zagreb
- Institute for Adriatic Crops and Karst Reclamation in Split (spectrometer)
- Foreign institutions with suitable equipment and technologies, including LIDAR and spectrometer, i.e. hyperspectral measurements
- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split (measuring systems)

Topic 21:

Unsaturated soil/soft rock

Research topic summary:

New field of research investigating the mechanics of unsaturated environments, where the unsaturated or partially saturated state represents actual conditions of the terrain and structures which need to be studied. The planned focus of the research is soft rock; however the research can be applied to a broader area of other geomaterials. In a wider sense, mechanisms in unsaturated

geomaterials are studied, where complex hydro-mechanical interaction and behaviour controlled by the appearance of suction in small pores occurs. The research focuses on specific phenomena in soft rocks such as wetting-induced settlement, irreversible deformations due to suction cycles, swelling deformations and structural collapse, temporal degradation of properties and consequent loss of strength and durability. Furthermore, the differential suction process and the resulting differential swelling in interaction with the environment significantly contribute to the development of weathering. Apart from the soft rock, in the context of the problem of weathering and erosion on slopes, the subject of this research is also compacted mixtures of soft rock and clay soil as intergranular filling or other materials/improvement procedures, i.e., mixed or improved materials (in relation to the requirements and challenges of environmentally sustainable construction of embankments, plateaus, dams and other earthfill structures using available non-traditional materials). Advanced research equipment is required for research in this field, to maintain controlled unsaturated conditions and measure suction.

Research objectives:

Application of research results in construction industry and other fields, findings and modelling of the effects of suction, clarification of phenomena related to suction, determining the composition of mixtures and appropriate recipes for earthfill structures, forecast of additional volume deformations due to suction, etc.

Development and improvement of the research group and laboratory for unsaturated tests.

Cooperation with other scientific and research institutions investigating unsaturated soil, joint projects, and all types of scientific and student publications. Correlations with other research areas, such as numerical modelling, the influence of unsaturated soil on agricultural production, water resource management, etc.

Extending existing standards and introducing the subject of unsaturated soil in legislation.

Research is planned in the following laboratory/laboratories:

Geotechnical laboratory (SAR Project – Geotechnics and environmentally sustainable construction approach)

Human resources:

1-2 teachers, 1-2 associates (doctoral student/postdoctoral student, associate in a special field), 1 laboratory assistant

External cooperation:

- Foreign institutions from countries with similar research interests in soft rocks and/or resources for unsaturated conditions (Italy, Slovenia, Portugal, Spain...)
- Faculty of Civil Engineering in Rijeka
- Institute for Adriatic Crops and Karst Reclamation in Split
- Faculty of Agriculture in Zagreb
- Faculty of Mining, Geology and Petroleum Engineering in Zagreb

Topic 22:

Defining spatial and temporal data of the coastal zone

Research topic summary:

Defining and updating the existing spatial and temporal data of the coastal, coastline and offshore zone. The data are used for official and unofficial maps and cartographic representations, in environmental impact studies and as spatial-temporal basis for hydrotechnical construction. The focus of the research is coastline data, coastal zone structures and consolidation with different official vertical datums.

Research objectives:

Integral coastal area management, sustainable planning and modelling in the coastal area, study of the impact of climate change on the coastal zone

Research is planned in the following laboratory/laboratories:

- Geodetic laboratory (SAR project - Geodetic research in the environment)

Human resources:

11 teachers, associates and laboratory assistants

External cooperation:

- Hrvatske vode (national authority responsible for water management)
- Croatian Hydrographic Institute

Topic 23:

Creation of 3D models of buildings with application in the protection of cultural heritage, building cadastre, utility cadastre, etc.

Research topic summary:

Processing and analysis of geospatial data and parameters collected using different sensors and creation of 3D models for different applications (construction planning, construction, extension, renovation and reconstruction of buildings...). One of the possible applications of this method is urban area modelling and urban expansion forecasting using artificial intelligence and deep learning methods. Adapting and creating software applications for the presentation and use of geospatial data (e.g., geoportals, e-services, etc.) for building or utility records.

Research objectives:

Improvement of 3D models and procedures for modelling structures, buildings and urban areas, created based on data collected using geodetic instruments and methods

Research is planned in the following laboratory/laboratories:

- Geodetic laboratory (SAR project - Geodetic research in the environment)

Human resources:

11 teachers, associates and laboratory assistants

External cooperation:

- Institute for the Protection of Cultural Heritage
- Architecture and urban planning bureau

Topic 24:

High-precision measuring system for monitoring deformations (auscultation) of structures (e.g., dams)

Research topic summary:

Processing and analysis of geospatial data collected using sensors and creation of 3D models used for various purposes (monitoring of structure deformations, test loads). Deformation measurements will be collected using the RTK GPS method and a 3D laser scanner. The collected data and additional collected parameters will be processed and modelled in different computer software.

Research objectives:

Development and application of new high-precision geodetic measurement methods, processing and modelling of measurements

Research is planned in the following laboratory/laboratories:

- Geodetic laboratory (SAR project - Geodetic research in the environment)

Human resources:

11 teachers, associates and laboratory assistants

External cooperation:

- Geoprojekt

Topic 25:

Road design from the perspective of safety and cost-effectiveness

Research topic summary:

The focus of the research is the harmonisation and selection of optimal road design elements, considering safety, capacity, and impact on the environment.

From the aspect of safety, in accordance with EU Directive 2008/96/EC, the procedure for assessing the safety of the selected roads will be defined based on the analysis of traffic accident data and recorded data on the conditions of the pavement, geometry and environment of the observed road. Considering the defined parameters impacting traffic safety, recommendations can be given for the selection of optimal elements of the horizontal and vertical alignment in the design phase. Furthermore, in recent years, special attention has been devoted to research on the effects of driving and road parameters on fuel consumption and exhaust gas emissions, in the context of sustainable traffic development and reduction of environmental pollution. The research will be conducted on a selected section of a state or county road with a length of approximately 20 km. A series of test drives will be carried out with a vehicle equipped with a high-frequency 10 hz GPS device recording the vehicle trajectory, speeds, acceleration and road curvature, and an OBD connector recording the output of vehicle sensors, including data on fuel consumption and exhaust gas emissions. On the basis of the field data collected and using the appropriate software, an analysis of the impact of geometrical elements of the route on individual parameters will be performed. Models will be developed to estimate fuel consumption and exhaust gas production according to road design elements (horizontal and vertical alignment) and driving style. The model will be developed for the operating speed in dependence on straight sections and curves. Based on the road consistency criteria, the influence of the dimensions and sequence of the road design elements on the safety of driving at operating speeds will be investigated. Based on the set consistency criteria, the minimum radii and the applicable size ranges of the adjacent road design elements will be defined to ensure safe driving.

Research objectives:

- Defining minimum applicable horizontal curve radii considering the safety margin (side friction)
- Creating a model for estimating fuel consumption and CO₂ emissions in dependence of geometric characteristics of the road (radii and length of curves, length of straight sections between curves, longitudinal slope...)
- Defining the acceptable adjacent curve radii, with and without tangent between, considering traffic safety and cost-effectiveness

Research is planned in the following laboratory/laboratories:

<ul style="list-style-type: none"> • Transportation laboratory (SAR project – Research in the field of road design and road infrastructure management)
Human resources:
3 teachers (FCEAG), 1 doctoral student (FCEAG)
External cooperation:
<ul style="list-style-type: none"> • Hrvatske ceste d.o.o. • County Road Administration

<p>Topic 26:</p> <p>Geoinformatics research (geographic information systems and decision-support modelling in construction)</p>
<p>Research topic summary:</p> <p>The research in this project interconnects geoinformation systems (GIS) with management, optimization, and semantic models in various areas of human activity. The research also includes and utilises systems for collecting geospatial data, processing algorithms, semantic modelling, linking (data fusion) and dissemination of geospatial data, and the specifics of geospatial-temporal and smart data. Furthermore, the research covers management, optimization, and semantic models in disaster management, water resources, transport infrastructure, urban development, and similar, and expands them with geoinformation systems and decision support systems (DSS). The research area is part of the priority horizontal topic Information and Communication Technologies (ICT) with application in the priority areas of Security, Traffic and Mobility and Energy and Sustainable Environment.</p>
<p>Research objectives:</p> <p>The research aims to connect GIS with management, optimisation, and semantic models in a unified decision support system (DSS).</p>
<p>Research is planned in the following laboratory/laboratories:</p> <ul style="list-style-type: none"> • GIS laboratory (SAR project – Geographic information systems and decision-support modelling in construction) • Geodetic laboratory (SAR project - Geodetic research in the environment) • Transportation laboratory (SAR project – Research in the field of road design and road infrastructure management)
Human resources:
16 teachers, associates, doctoral students
<p>External cooperation:</p> <ul style="list-style-type: none"> • Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture • Faculty of Economics, Business and Tourism in Split • local administration • state administration bodies (e.g., National Protection and Rescue Directorate, Coast Guard) • public companies

<p>Topic 27:</p> <p>Research in karst aquifers in the coastal area</p>
<p>Research topic summary:</p>

The specific hydrogeological properties of the karst aquifer investigated in the context of climate change raise the question of the availability of underground water for consumption, agriculture and energy. Research is focused on contact areas between the sea and karst formation and the analyses of various risks threatening the availability and quality of water (climate change, temporal and spatial redistribution of precipitation, pollution transfer, saltwater intrusion, and other risks) and conducted in the hydrotechnical laboratory. The newly equipped hydrotechnical laboratory provides a scientific infrastructure for the research of the mentioned phenomena on different scales. Therefore, future research requires the synergy of different disciplines and relies on interdisciplinarity.

Research objectives:

Developing green and blue infrastructure, developing different protocols that minimise the risks of aquifer pollution, adapting to climate change, and developing the resilience of vital infrastructure systems.

Research is planned in the following laboratory/laboratories:

- Hydrotechnical laboratory (SAR project – Research of water resources and coastal areas)

Human resources:

9 teachers, associates, doctoral students

External cooperation:

- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split
- Faculty of Electrical Engineering and Computing, Zagreb
- Faculties of Science in Croatia
- University of Split School of Medicine

Topic 28:

Applied research related to open streamflows

Research topic summary:

Open streamflows represent one of the main sources of drinking water, as well as a potential resource for electricity production. Many open streamflows are also traffic routes and as such are crucial for the development of the economy, and their biological diversity guarantees the water quality of the observed water body as well as the rich fish stock. Open streamflows are significantly affected by climate change and the potential use as energy source. The infrastructure of the hydrotechnical laboratory provides a platform for various research with the aim of developing technological measures that can additionally protect open streamflows, ensuring a sufficient influx of nutrients for the fish stock, investigating various technical proposals for the protection of biodiversity and improving power generation facilities, considering projected changes in flow due to climate change.

Research objectives:

Developing green and blue infrastructure, adapting to climate change and developing the resilience of vital infrastructure and energy systems.

Research is planned in the following laboratory/laboratories:

- Hydrotechnical laboratory (SAR project – Research of water resources and coastal areas)

Human resources:

9 teachers, associates, doctoral students

External cooperation:

- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split
- Faculty of Electrical Engineering and Computing, Zagreb
- Faculties of Science in Croatia
- University of Split School of Medicine

Topic 29:

Wind tunnel research of impact of wind load on structures

Research topic summary:

The research topic involves investigation of dynamic and quasi-static phenomena of the air flow modelling of the parts of structures under different flow regimes. The dynamic responses of the parts of structures to wind load will be investigated, along with measuring forces and moments on a three-axis basis, enabling empirical calculations of drag and lift coefficients and the calibration of numerical models. In addition to the response of the three-axis base, the wind tunnel enables the recording of particle velocities with the application of PIV and PLIF systems, allowing reconstruction of the velocity field near the tested parts of the structure. The results obtained in the wind tunnel will be used to verify numerical flow models, develop aerodynamic studies of objects and as a basis for field research on the impact of wind load, carried out as part of the Wind Energy research field.

Research objectives:

Development and implementation of experimental procedures to test the impact of wind load on structures

Processing and interpretation of data collected in the wind tunnel

Implementation of numerical models for calculating the flow around structural elements

Research is planned in the following laboratory/laboratories:

- Hydrotechnical laboratory (SAR project – Research of water resources and coastal areas)
- Wind energy measurement station (SAR project – Effect of wind energy and climate change in civil engineering)

Human resources:

3 teachers, associates, doctoral students

External cooperation:

- SINTEF AS, Norway

Topic 30:

Research on the implementation of modern materials and technologies in architecture

Research topic summary:

This research topic investigates the possibilities of modern technologies in all phases of the process, from the design process to the production and construction processes. As part of the research, the development of processes from design to realisation based on parametric design, optimisation, and digital production of standard and non-standard elements in architecture is examined. In addition, research is conducted on the properties of modern materials and the possibilities of their application in architecture. The research examines the effects that can be achieved, the shapes that can be produced, and other characteristics of modern materials.

Research objectives:

The purpose of the research is to examine the properties and cost-effectiveness of the application of advanced materials and technologies in architecture, as well as improvement of conventional materials and technologies

Research is planned in the following laboratory/laboratories:

- Contemporary architectural technologies laboratory (SAR project: Research on the implementation of modern materials and technologies in architecture)

Human resources:

10 employed teachers, 1 laboratory assistant

External cooperation:

Public institutions:

- Faculty of Architecture in Zagreb
- Faculty of Civil Engineering and Architecture in Osijek
- Faculty of Civil Engineering in Mostar
- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split
- Environmental Protection and Energy Efficiency Fund
- Energy Institute Hrvoje Požar

Business enterprises:

- stone – Jadrankamen
- concrete – Cemex, Strabag
- metal – Brodosplit, Brodotrogir
- plastics – AD Plastik, Salona Group LTD.
- Green Building Council Croatia

Topic 31:

Research in implementation of modern technologies and materials in the protection of architectural heritage

Research topic summary:

A special focus of the research is to test modern technologies and materials in the field of protection of the rich architectural heritage of Dalmatia, as well as World Heritage Sites. The investigations involve structures and the effects of the sun, the sea and other climatic conditions in the Mediterranean area.

Research objectives:

The purpose of the research is to examine the properties and cost-effectiveness of the application of advanced materials and technologies in architecture, as well as improvement of conventional materials and technologies in the field of architectural heritage protection

Research is planned in the following laboratory/laboratories:

- Contemporary architectural technologies laboratory (SAR project: Research on the implementation of modern materials and technologies in architecture)

Human resources:

5 employed teachers, 1 laboratory assistant

External cooperation:

- Ministry of Culture and Media, Conservation Department in Split
- Faculty of Architecture, Zagreb
- Arts Academy, Split
- Croatian Conservation Institute, Department for Conservation in Split

Topic 32:

Computer spatial simulations and data management

Research topic summary:

Research in this area addresses the capabilities of computer spatial simulations, and can be divided into two parts: digital processes related to spatial planning and management, and digital processes related to construction. As part of research of digital processes related to spatial planning and management, systems for planning, monitoring and management of territory are developed, including transport and infrastructure systems.

As part of research related to construction, digital processes in the design of new buildings based on parametric design and digital processes in observing the existing structures are examined. The basis for work in both areas is the preparation of projects in digital form using specialised computer software.

Research objectives:

The purpose of the research is to improve the computer simulation process and test new simulation models for spatial planning and management processes and digital processes related to construction.

Research is planned in the following laboratory/laboratories:

Contemporary architectural technologies laboratory (SAR project: Research on the implementation of modern materials and technologies in architecture)

Human resources:

5 employed teachers

External cooperation:

Split-Dalmatia County Spatial Planning Department

City of Split, International and EU Projects Administration, Smart City Projects and Digitization Department

Split parking d.o.o., Split

Jadrolinija, Rijeka

Zračna luka Split d.o.o., Kaštel Štafilić

HŽ Putnički prijevoz, Zagreb

6. ORGANIZATIONAL DEVELOPMENT PLAN OF THE FACULTY

Organizational development with regard to creating interdisciplinary organizational units of FCEAG takes place through 11 SARLU (Science and Arts Research Logical Unit), i.e. 11 FCEAG Science and Arts Research Projects (currently 11 projects, with the development of scientific research activities in the future, several projects are planned in each SARLU). The purpose of organizational SARLU and corresponding SAR projects defining scientific research activities, is focused and continuous improvement of the development of scientific research and artistic work of FCEAG employees and institution as a whole, in a manner adapted to contemporary needs within the Croatian and European research area. Each of the 11 SAR projects includes multiple project activities and several research topics, with at least one interdisciplinary topic. The prevailing topics belong to the field of engineering

sciences, while the interdisciplinary topics developed within SAR projects are mainly determined by engineering sciences, as the dominant research area at the Faculty. Research topics are usually presented as a combination of research problems, the solution of which requires scientific contributions in the field of engineering sciences and one or more other fields of science. SAR projects and associated activities are suitable organizational elements to conduct competitive research in the described topics.

The basic features of SAR projects are: stated objectives, project activities (also developed as projects – subprojects), financial, human and material resources and a temporal/dynamic implementation plan. Interdisciplinarity is achieved through the participation of employees with research areas/ fields of specialisation (in one or several SARLUs or on one or several SAR projects). Some members of project teams are employed exclusively on projects, i.e., SAR project activities or other projects carried out by the Faculty, and their salaries are financed from other funding sources, as they are not registered in the central employee register of the Republic of Croatia. In addition, project team members also include employees of cooperating institutions, companies and individuals conducting scientific research (based on research cooperation agreements with the Faculty) in several common research areas and/or fields, within the framework of specific research topics of any particular SAR project.

Research topics in all areas and fields of science that had been traditionally implemented at Faculty departments are now being continuously carried out within specific SARLU and through defined SAR projects. Faculty staff employed in scientific and associate research positions at several Faculty departments, recently employed researchers on scientific projects and researchers from collaborating institutions and companies constitute effective interdisciplinary teams, based on joint SAR project activities and knowledge synergy. The project-based approach to organising research work enables the formation of interdisciplinary project teams and facilitates the adaptation to different research topics and interdisciplinary topics, as well as reaching well-founded scientific results. All of the above contributes to the development of scientific and research activities within the interdisciplinary field of science. The organizational structure established in this way provides continuous support, conformity, and direction to SAR projects research topics, in accordance with societal needs, national priorities, and the EU thematic areas within particular projects/calls and programmes.

7. CONCLUSION

The main determining factor for conducting research and comprehensive development of FCEAG in the period 2021-2025 is the established integrated environment consisting of 11 newly formed organizational units (SAR projects) and the corresponding 32 research topics, including complementary networking with business enterprises.

The specific objectives of the research topics defined in Chapter 5 of this Strategy serve to accomplish general strategic objectives stated in the current Faculty Development Strategy for the period 2018-2022: Improving existing and developing new interdisciplinary study programs, increasing scientific excellence and international recognition in the European research area, and development of FCEAG infrastructure capacities.

8. EXPECTED OUTCOMES OF THE SCIENTIFIC RESEARCH PROGRAMME IN THE FIELD OF ENGINEERING SCIENCES

The scientific and research strategy of the FCEAG in the field of engineering sciences describes the expected outcomes of achieving proposed research objectives and activities within the framework of specific research topics. The expected outcomes in relation to the proposed research topics in the field of engineering sciences can be presented as follows:

- Increase in scientific research activities at FCEAG in a general sense (increase of the number of competitive research projects applications focused on applied research and experimental development, with at least one application for scientific research project planned each year);
- Increase in the number of published scientific papers in the field of engineering sciences in reputable international journals (at least 40 papers in the WoS database per year);
- Stronger links with the community and the industry through better cooperation and concluding new collaborative research agreements (signing at least one new collaborative research agreement with partners from the industry and/or local community each year);
- Improving the research quality (reaching an annual average of one published paper per each FCEAG employee);
- Preparation and proposal of the postgraduate doctoral study programme in an interdisciplinary field of science (application for initial accreditation) with the aim of fulfilling the considerable research potential of FCEAG in the field of engineering sciences.

9. PERFORMANCE INDICATORS OF STRATEGIC PROGRAMME IMPLEMENTATION

Successful implementation of the proposed FCEAG Scientific Research Strategy in the field of engineering sciences is assessed using performance indicators related to the activities in applied research and experimental development, namely:

- Performance indicators for scientific activity (number of published papers, number of citations, journal quartiles);
- Performance indicators for scientific research projects (number of submitted/approved scientific research projects);
- Performance indicators for cooperation projects with industry and local community (number of projects realised and signed cooperation agreements);
- Performance indicators for the completed international mobility of researchers (number of research and professional trainings of doctoral students, postdoctoral students, and scientific and teaching staff);
- Performance indicators for dissemination of scientific research (number of scientific panels, congresses, conferences, round tables, etc. organised by FCEAG).

10. QUALITY ASSURANCE

Strategic goals	Subgoals	Activities
The quality assurance system is an integral part of all Faculty activities and involves all Faculty stakeholders	Implementing and supporting all the activities constituting parts of the quality assurance system in accordance with national and ESG standards	Adopting and monitoring of the implementation of strategic documents based on established indicators (in accordance with ESG standards and higher-level strategic documents) and their publication Harmonization of legal acts with legal regulations and university documents Regular quality evaluation through cyclical external quality evaluation and self-evaluation

Measurable indicators for achieving quality assurance goals are defined as follows:

- Adopting and publishing strategic documents of the Faculty and corresponding operational (action) plans and reports at the annual level;
- Adopting and publishing legal acts of the Faculty;
- Adopting reports on the conducted evaluations and procedures/ reports based on the received recommendations.



11. REFERENCE DOCUMENTS

Strategic Plan of the Ministry of Science and Education of the Republic of Croatia for the period 2020-2022

[\(MSE Strategy 2020-2022\)](#)

Scientific Strategy of the University of Split 2021-2025, March 2021

Strategy of the Faculty of Civil Engineering, Architecture and Geodesy for the period 2018-2022

[\(FCEAG Strategy 2018-2022\)](#)

Strategic programme of scientific research of the Faculty of Civil Engineering, Architecture and Geodesy for the period 2015-2020

[\(FCEAG Strategy 2015-2020\)](#)

Smart Specialisation Strategy of the Republic of Croatia for the period 2016-2020

[\(S3 Strategy\)](#)

European Commission Strategic plan 2020-2024 – Research and innovation

[\(EU 2020-2024\)](#)

Report on the implementation of the Action Plan to Improve the Quality of Postgraduate University Studies in Civil Engineering for 2018, Split, 28 February 2018

Action Plan to Improve the Quality of Postgraduate (Doctoral) University Studies in Civil Engineering in the follow-up monitoring phase for 2019 and 2020, Split, 26 November 2020

Implementation of Contemporary Research Infrastructure at FCEAG for Smart Specialization in Green and Energy Efficient Construction - feasibility study with cost-benefit analysis, UHY Consulting

Class: 003-05/21-02/0002

Ref.no.: 2181-208-21-0001 (540)

Split, 23 June 2021

Dean:

Associate Professor Nikša Jajac, Ph.D.

I, Jelena Madunić, court interpreter of English language, as appointed by the Republic of Croatia Ministry of Justice and Public Administration, Ref.No.: 514-03-03-03/01-23-06 of 26 May 2023, do hereby certify that the above translation is a faithful and complete translation of the original document written in Croatian language.

Date: 7 May 2024, cert.no. 21/2024

