BROŠURA

CENTAR ZA ISTRAŽIVANJE

ORGANIZACIONA STRUKTURA

TEHNIČKA OSPOSOBLJENOST

ISPITIVANJA

1. Uvod

U okviru fakulteta postoji Institut Građevinskog fakultet, kroz koji fakultet realizuje svoju naučno–istraživačku, visokostručnu, stručnu i savjetodavnu djelatnost u oblasti građevinarstva. Nastao je u procesu integracie Univerziteta 2014. godine, integriranjem Zavoda za projektovanje i ispitivanje materijala i konstrukcija (ZPIMK) i Zavoda za energetsku efikasnost i zaštitu okoliša (ZEEZO). Institut je lociran u novoj zgradi fakulteta sa savremeno opremljenim laboratorijama. U Institutu studenti izvode laboratorijske vježbe predviđene nastavnim planovima i programima važećih studijskih programa prvog, drugog i trećeg cikusa. Institut je jedan od nosilaca naučnog rada, transfera znanja između privrede i Univerziteta, te veza između naučno-istraživačkog rada, praktičnih probelma iz industrije i visokoškolskog obrazovanja.

Institut je uspješno realizovao više od 40 naučno-istraživačkih projekata, preko 400 naučnih i stručnih projekata za potrebe privrede različitog stepena složenosti.

Osnovni zadaci Instituta Građevinskog fakulteta su:

- razvoj i unapređenje naučno-istraživačkog i visokostručnog rada iz oblasti građevinarstva,
- obrazovanje i usavršavanje novog nastavnog kadra,
- praktično osposobljavanje mlađih naučnika i istraživača,
- eksperimentalni rad i laboratorijska nastava,
- rješavanje složenih zadataka za potrebe privrede,
- saradnja sa srodnim institucijama u zemlji i inostranstvu.

Slika 1. Zgrada Građevinskog fakulteta sa Institutom

Danas Institut Građevinskog fakulteta svoje zadatke obavlja kroz svoje podorganizacione jedinice, i to:

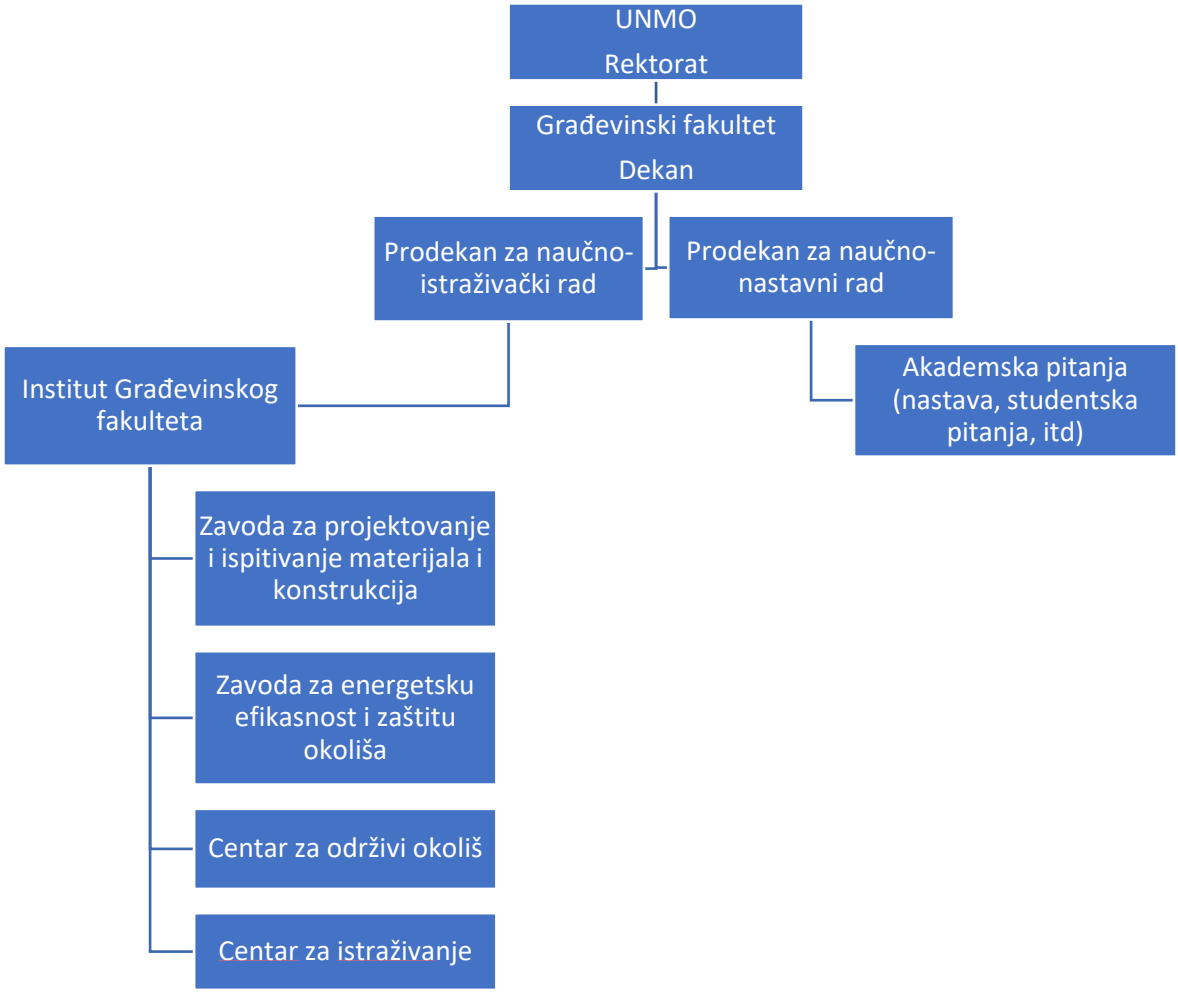
- Zavoda za projektovanje i ispitivanje materijala i konstrukcija

- Zavoda za energetsku efikasnost i zaštitu okoliša
- Centar za održivi okoliš
- Centar za istraživanje

2. Organizaciona strutkura Centra za istraživanje

Centar za istraživanje osnovan je u sklopu Erasmus+ CB projekta "Promoting academia-industry alliances for R&D through collaborative and open innovation platform - All4R&D", sa ciljem ostvarivanja jače saradnje akademske zajednice i privrede, te povećanje kapaciteta za istraživanje studenata master i doktorskih studija.

U organizacionoj strukturi Centar se nalazi u sklopu Instituta Građevinskog fakulteta (slika 2).



Slika 2. Organizaciona struktura Centra za istraživanje u okviru Univerziteta i Instituta

Centar se sastoji od istraživačkog dijela, razvojnog dijela i edukacijskog dijela, kao na slici 3.

Slika 3. Organizaciona struktura Centra

3. Oprema Centra i ispitivanja

Centar raspolaže sa slijedećom opremom:

- Digitalni uređaj za određivanje vremena vezivanja cementa
- Uređaj za ispitivanje toplote hidratacije cementa
- Oprema za ispitivanje stalnosti zapremine cementa - Le Chatelier prstenovi
- Oprema za ispitivanje skupljanja uzoraka cementa i maltera
- Mjerač vlage za tlo sa analognim manometrom i digitalnom vagom
- Vakuumski eksikator
- L–posuda za ispitivanje samougrađujućih betona
- Uređaj za ispitivanje svježeg betona po Vebe metodi
- Porozimetar – mjerač uvučenog zraka za beton i malter
- Testni komplet za ispitivanje vode
- Mašina za bušenje jezgri
- Oprema za mjerenje modula elastičnosti betona
- Uređaj za mjerenje skupljanja betonskih uzoraka
- Uređaj za mjerenje deformacija sa digitalnim komparaterom
- Digitalni Schmidt-ov čekić za nerazorna ispitivanja betona (digitalni sklerometar)
- Oprema za detekciju korozije na armaturi (Half cell)
- Mikroskop za pukotine

- Oprema za ultrazvučno ispitivanje
- Testni komplet za mjerenje karbonacije betona

Centar za istraživanje je u potpunosti opremljen da provodi slijedeća ispitivanja:

Red. Br.	Vrsta ispitivanja/materijal	Opis
1.	Ispitivanje vezivnih materijala (cement, kreč itd.)	Vrijeme vezivanja
2.		Postojanost zapremine
3.		Finoća mliva
4.		Toplota hidratacije cementa
5.		Određivanje čvrstoće
6.		Skupljanje
7.	Naročita ispitivanje betona u laboratoriji	Svježi beton Vebe metoda
8.		Samougrađujući svježi beton
9.		Sadržaj uvučenog vazduha
10.		Modul elastičnosti
11.		Skupljanje betona
12.	Ispitivanja betona i konstrukcija in-situ	Čvrstoća pri pritisku - Sklerometar
13.		Ultrazvučna ispitivanja
14.		Karbonizacija
15.		Uzimanje uzoraka
16.		Mjerenje deformacija
17.		Mjerenje pukotina
18.		Detekcija korozije
19.	Ispitivanja maltera u laboratoriji	Skupljanje
20.		Čvrstoća pri pritisku
21.		Čvrstoća pri savijanju

4. LLL kursevi

Centar nudi kurseve za cjeloživotno učenje (LifeLong Learning):

- Održive zgrade
- Održivi novi građevinski materijali
- Obnovljivi izvori energije
- Voda (resurs, upotreba, rizik, upravljanje rizikom)
- Metode i alati za unapređenje urbanističkog planiranja: Zoniranje i GIS osnove
- EN 1992-1-1 projektovanje betona upotrebom metode štapova i zatega

Kursevi su namjenjeni za:

- Alumne
- Inženjere u praksi
- Doktorante
- Studente koji žele obogatiti svoja stečena znanja iz predmetnih oblasti

Sylabusi LLL kurseva u okviru Centra za istraživanje:

Title:	**Sustainability of the building**
Learning Outcomes:	The student will be able to understand life cycle of the building in all its phases and processes as well as to explain them. He/she will be able to identify and describe crucial points in planning construction and maintenance. He/she will be able to prepare maintenance plans for new as well as for old (historic) buildings. Students will be introduced to concept of sustainable (traditional and new) building materials and develop their understanding of need for their use, ways of usage and proper maintenance. Students will be equipped with appropriate skills and knowledge that will help them to conduct methodological research on the current condition of the building, make on their own analyses of the buildings (new and historic) and give recommendations for their conservation, reuse, retrofit, upgrade or similar. Students will be able to prepare maintenance plans with gained expertise In the end, students will be able to apply the concept of sustainability as well as need for sustainable to current civil engineering and economic issues as well as to conservation of historic structures and to discuss and compare different approaches in the field.
Method/s for teaching and learning:	Reading materials Individual research (development of learning through practice as well as critical thinking, research and managing data skills) Writing a project (individual project) (development of learning through argumentation skills) Making posters
Content/short description:	The course introduces student to the concept of sustainability through life building cycle and sustainable new materials (with overview of traditional materials and their sustainability as well). Sustainability is of crucial importance today and this course is focused on the area of sustainable development, which includes a number of aspects such as cultural and socio-economic aspects, structural design of buildings, possible reuses, limits in historic structures, life cycle of buildings, etc. This, course is focused on lifelong learning that contribute to the extension of the knowledge of a civil engineer, on the one hand, and to increasing the supply of professional specialization in the labor market on the other hand.

	Main idea of the course is to introduce to architects and civil engineers methodological approach in building scan and understanding of various solutions as well as how to choose proper one. It is very important to plan from the start and build sustainable building materials into the initial design that can provide durability and easier maintenance of the structures, mainly housing and public buildings. In addition, it is very important to understand existing structures and their possibilities of reuse, especially if they are of historical importance.
Structure of the course:	• Concept of life building cycle • Concept of sustainability • Concept of sustainability on historic structures • Need for mind shift in building design, construction and maintenance
Preparer of the course:	Merima Šahinagić-Isović and Amra Šarančić Logo
Method/s of assessment*:	
Method for evaluation of course (by students, peer review etc.):	Anonymous polling

Title:	**Sustainable new building materials**
Learning Outcomes:	Through the set of lectures, students will be introduced to new building materials and their properties. Students will be able to understand performances of the materials, their use and possibilities in construction industry as well as maintenance requirements. They will be able to describe and discuss proper installation of building materials and their effectiveness in interior and exterior application. Also, they will acquire basic knowledge on specifications and relation to building standards, passive building requirements and seismic requirements. In addition, they will be able to define life cycle of the building built using new materials, and compare it with buildings built from traditional material. He/she will be able to illustrate positive and negative sides of use of new materials for building new buildings, but also in conservation and renovation processes of existing buildings. He/she will examine the best-practice options for achieving effective and aesthetically pleasing interior protection of the building. He/she will be able to analyze and calculate advantage for use of new materials compere to traditional ones, as well as to discover strategies to successfully design for the long term by avoiding the trap of first- cost value engineering. Students will be equipped with appropriate skills and knowledge that will help them to properly introduce use of sustainable new materials in new construction as well as in conservation and reuse interventions. In the end, students will be able to demonstrate and advocate for use of sustainable new materials in construction and building design where their use is appropriate and offers advantages.
Method/s for teaching and learning:	Reading materials Individual research (development of learning through practice as well as critical thinking, research and managing data skills) Writing a project (individual project) (development of learning through argumentation skills) Making posters
Content/short description:	The course is focused on the area of sustainable development, which includes a number of aspects such as cultural and socio-economic aspects, structural design of buildings, new environmental friendly and durable materials and the life cycle of buildings. All stated starts with sustainable new materials. It is very important to plan from the start and build sustainable building materials into the initial design that can provide

	durability and easier maintenance of the structures, mainly housing and public buildings. This course offers an in-depth examination of the materials used for all types of buildings. It also offers overview of systematic and deeper analyses of building operations, life building cycle and maintenance costs, all based on fact of use of sustainable materials. All this in order to avoid known scenario in which first-cost value engineering ends up costing building owners more in the long run. Sustainability is of crucial importance today and this course can contribute to widening of knowledge of a civil engineer, on the one hand, and to increase personal professional specialization in the labor market on the other hand.
Structure of the course:	• Meaning and possibilities of sustainability in materials and constructions • New and sustainable new materials in construction • Presentation of best practices and possible applications in our environment • Need for mind shift in building design, construction and maintenance
Preparer of the course:	Merima Šahinagić-Isović and Marko Ćećez
Method/s of assessment*:	
Method for evaluation of course (by students, peer review etc.):	Anonymous polling

Title:	**Renewable energy sources**
Learning Outcomes:	After successful completion of the course, students will learn the necessary terminology in the field of energy and renewable energy sources. They will have basic knowledge about the division, technical and technological characteristics, etc.
Method/s for teaching and learning:	Lecture, individual research project (critical thinking-logical reasoning)
Content/short description:	Within the available fund of hours, students will be introduced to the field of sustainable management of natural resources; basics of different forms of renewable energy sources. Course will provide the necessary background knowledge to continue studying various different forms of renewable energy sources.
Structure of the course:	• Definition of Renewables. • Definition of Non - Renewables. • Overview of energy in the world. • Renewable energy sources. • Hydropower. • Biomass. • Wind energy. • Solar energy. • Geothermal energy. • Tidal energy. • Wave energy. • Ocean thermal energy conversion (OTEC). • Hydrogen energy. • RES benefits. • Problems and limitations. • Current trends. • Potential and forecasts. • RES in Bosnia and Herzegovina.
Preparer of the course:	Elvir Zlomušica
Method/s of assessment*:	
Method for evaluation of course (by students, peer review etc.):	Questionnaire by students

Title:	**Water (resource, usage, risk, risk management)**
Learning Outcomes:	Although many theoretical developments have been achieved in recent years, the progress both in understanding and application of risk and reliability analysis in water resources and environmental engineering remains slow. One of the reasons seems to be the lack of training of students with phenomena of statistical nature, including optimum cost and benefit decisions under uncertainty. The course introduces student to the various aspects of risk and reliability in both water quantity and quality problems. Traditionally, risk events are measured by two main criteria: impact and probability of occurrence. However, some of the risks associated with water resource management may contain high expected costs and be beyond the control of human society. Therefore, an additional criterion is proposed for the assessment of risks - the controllability. Students will gain knowledge on uncertainty analysis of water quantity and quality data, stochastic simulation of hydro systems, decision theory under uncertainty and case studies. He /she will understand and be able to describe and use in work methods for risk analysis of extremes in hydrology, groundwater clean-up, river and coastal pollution as well as total risk management.
Method/s for teaching and learning:	Reading materials Individual research (development of learning through practice as well as critical thinking, research and managing data skills) Writing a project (individual project) (development of learning through argumentation skills) Making posters
Content/short description:	Fresh water resources are critical for human survival. Without them, human society would be unable to prosper or even exist. The ever-growing conflicting demands for fresh water supplies threaten the sustainability of this essential resource. Decreasing usable water supplies, coupled with rapid increases in demand and poor management, have led to the inefficient and unsustainable use of water resources with significant economic, social, and environmental ramifications. The failure to meet basic human and environmental needs for water has given rise to increasing tensions over access to water. Many believe that the competition over scarce water resources, which regularly occurs at local, regional, and international scales, will increase

	tensions and possibly cause armed conflicts between states and sectors. Decisions made today regarding water resources have an impact not only on current water usage, but also on that of years to come. Thus, both surface and groundwater resources should be managed with sensitivity to present needs, as well as consideration for future threats. The risks concerning water resources are either natural risks that may be difficult or impossible to be controlled and prevented, or risks resulted from human actions. The risk management method is most commonly used in the planning and developing phases of complex projects. The use of risk management methodology is suggested to increase the flexibility and security of agreements over the management of water resources. The experience, gained through managing risks related to commercial projects, has greatly contributed to the applicability of risk management theory. Therefore, it is an adequate tool, which can help improve water resource management by mitigating risks involved in its maintenance and utilization.
Structure of the course:	• Rainfall-runoff modelling, hydraulic modelling • Drainage design in urban environments • Environmental hydrology and surface water impacts assessments • Flood risk assessments and mitigation planning
Preparer of the course:	Suad Špago
Method/s of assessment*:	
Method for evaluation of course (by students, peer review etc.):	Anonymous polling

Title:	**Metdodes and tools for improvement of urban planing: Zonning and GIS basic**
Learning Outcomes:	The student will be able to understand complexity and importance for everyday life of urban planning. He/she will be able to identify needed planning processes as well as to identify which one is most suitable to situation. The student will be able to make analyses of current planning approaches, compare planning processes and results using zoning method / approach, and to formulate and discuss its own response toward problems. He/she will be able to identify most of the factors crucial for development planning, explain importance and influence of each of them and to discuss its inclusion into planning processes. He/she will be able to take active participation into urban planning processes, and work on preparation of all planning documents. Students will be able to apply the zoning approach and understand all its steps in methodological way. Students will also be introduced to GIS tool and its uses in planning and monitoring. Students will acquire basic knowledge on possibilities of GIS and be able to discuss relevance of its use in own institution.
Method/s for teaching and learning:	Reading materials Individual research (development of learning through practice as well as critical thinking, research and managing data skills) Writing a project (individual project) (development of learning through argumentation skills) Making posters
Content/short description:	Urban planning has never had such big impact and importance as today. Planning is no longer matter only of the urban planners and architects. For years now, it is multidisciplinary and interdisciplinary approach. Also, it is living and constantly changing process and way of city development and not just set of documents. Therefore, it is subject of lifelong learning course intended for architects and civil engineers, both students and practitioners. The course introduces student to the concept of urban planning and zoning, presenting differences between possible and forced development, focusing importance of understanding spatial potentials, city growth, residence needs,

	and other factors that play crucial role in planning of the city. All this, of course in line with sustainability, nature friendly, heritage respectfully and human scale approaches. Course gives overview of planning on all scales, starting with city development plans, zoning of city areas, and so on till urban project for particular sites. This overview provides understanding of interconnectedness. Along with approaches and processes of urban planning course gives basic introduction to one of the tools that is helpful in all these processes – GIS. Students will be introduced to its possibilities, use in planning and in monitoring spatial development as well as planning and monitoring of use of different infrastructure systems.
Structure of the course:	• Concept of urban planning and zoning • Overview of advantages of zoning approach compared to traditional ones • Presentation of whole planning process • GIS – possibility and uses
Preparer of the course:	Senada Demirović Habibija
Method/s of assessment*:	
Method for evaluation of course (by students, peer review etc.):	Anonymous polling

Title:	**EN1992-1-1 concrete design using strut and tie (SAT)**
Learning Outcomes:	The student will be able to design structural elements or whole building using Eurocode 0, 1 and 2. Student will be enabled to transfer their own practical knowledge from actual codes of practice still in force in BIH to Eurocodes which will be, in due time, introduced in the country, by discovering common grounds similarities and differences between them. He/she will be given practical ability to design some structural concrete elements and will receive a basis for independent usage of Eurocodes 0 to 2. Apart from theoretical background some practical issues in Eurocodes 0 to 2 will be discussed. Through theoretical grounds and many worked examples student will be given practical ability to design some structural concrete elements using SAT modeling and will receive a basis for independent usage of Eurocodes 2. Students will be introduced to basis of structural concrete design, principles and requirements for safety, serviceability and durability of concrete structures based on the limit state concept used in conjunction with a partial factor method given in EN 1990 and which is intended to be used, for direct application, together with Eurocodes EN 1991, giving design guidance and actions for the structural design of buildings and civil engineering works. The stress of the course will be on the practical design tasks assigned to the team of the students which will require their own research, cooperation, and practical usage of the Eurocodes, all supervised and guided by the tutor. At the end, students will be able to apply Eurocodes rules individually and as the team members to the practical tasks in their working places.
Method/s for teaching and learning:	Reading materials. Individual and team research (development of learning through practice, critical thinking, research and managing data skills) Preparation of individual part of the project assigned to the team (acquiring certainty and knowledge strengthening through theory application and argumentative discussion with tutor and other team members). Making panel and presentation.

Content/short description:	Introduction to strut and tie modelling. Lower bound theorem of plasticity theory. Dividing RC element to D and B regions. Load path, characteristic stress distribution and combination of both methods with support of any elastic FEM application. SAT components. Arrival to its own SAT model. Ductility, compatibility, optimal model. Design criteria for struts, ties and joints. Worked examples: corbels, half joints, directly and indirectly supported deep beams, pile caps, frame corners, pocket foundations, treatment of openings in slender beams and shear walls. Reinforcement layout and detailing according to EN 1992 and established SAT model This, course is designed on lifelong learning that contribute to the extension of the knowledge of a civil engineer.
Structure of the course:	• Theoretical background to SAT modelling; • Practical application through worked examples; • Reinforcement layout and detailing according to SAT model.
Preparer of the course:	Armin Hadrović
Method/s of assessment*:	
Method for evaluation of course (by students, peer review etc.):	Anonymous polling

5. Partnerske institucije

Naši partneri i saradnici:

- "Ss. Cyril and Methodius" University in Skopje, North Macedonia
- Institute for Environment, Civil Engineering and Energy, Skopje, North Macedonia
- Ruhr University Bochum, Germany
- University of Vaasa, Finland
- World University Service - Austrian Committee – WUS Austria
- University of Sarajevo, Bosnia and Herzegovina
- National University Architecture and Construction of Armenia, Yerevan
- National Polytechnic University of Armenia Foundation, Yerevan
- Winner Project d.o.o. Sarajevo
- HP Investing d.o.o. Mostar

- Yerevan Telecommunication Research Institute CJSC, Armenia
- National Institute for Informatics and Automation Problems, Armenia
- University of Niš
- University of Natural Resources and Life Sciences, Vienna, Austria
- Norwegian University of Life Sciences, Oslo, Norway
- Aristotle University of Thessaloniki, Greece
- University of Architecture, Civil Engineering and Geodesy, Sofia, Bulgaria
- University of Rijeka, Faculty of Civil Engineering, Croatia
- Universidade de Lisboa, Portugal
- University of Novi Sad, Serbia
- University of Montenegro
- Agencija "Stari grad" Mostar, Bosna i Hercegovina
- Udruženje "Urbana kuća – IDEAA" Mostar
- Inženjerska Komora Federacije Bosne i Hercegovine
- J.P. "Deponija" d.o.o. Mostar
- ARHI PLUS d.o.o. Mostar