# SCIENTIFIC-RESEARCH AND DEVELOPMENT PROJECTS

2018 – 2022

UNIVERSITY OF ZAGREB

**FACULTY OF CIVIL ENGINEERING**

# IMPRESSUM


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# FOREWORD

The scientific excellence of the Faculty of Civil Engineering of the University of Zagreb and its staff is reflected in the implementation of numerous research and development projects within the framework of HORIZON 2020, ERASMUS+, the Croatian Science Foundation, and programs funded by the structural and investment funds managed by the European Regional Development Fund, the Ministry of Science and Education and the Ministry of Economy, Entrepreneurship and Crafts of the Republic of Croatia, and within other programs. The networking between the industry and academia has been achieved on many projects, enabling even more fruitful cooperation in the research, laboratory testing, and demonstration projects. Doctoral students are actively involved or employed on projects, and project funds are used to finance their research, training, participation in conferences, and study visits to other institutions. The projects contribute significantly to the advancement of research capabilities of the Faculty, enabling development of innovative methods, technologies, and products in the field of civil engineering.

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CROATIAN SCIENCE FOUNDATION

# FP7 and HORIZON 2020

# BRIDGE SMS

## Intelligent Bridge Assessment Maintenance and Management System

| | |
|---|---|
| Duration | 01/01/2015 – 31/12/2018 |
| Overall budget | € 1,418,822 |
| Source of funding | FP7 |
| Coordinator | University College Cork, Cork, Ireland |
| Partners | University of Zagreb Faculty of Civil Engineering, Cork County Council, Infraestruturas de Portugal, Arctis Ltd. |
| Project leader at the Faculty | Assoc. Prof. Damir Bekić, PhD |

Web page: www.bridgesms.eu


## PROJECT DESCRIPTION

The BRIDGE SMS EU/FP7 project couples state-of-the-art scientific and industrial expertise in structural and geotechnical engineering, hydraulics and hydrology, materials and infrastructure management. Main objectives of BRIDGE SMS are: Development of standardised methods for bridge scour inspection; Development of standards for bridge assessment and management; Calculation of risks and establishment of management procedure for potential effects of flood events; Development of a database framework that is designed for intuitive use and encourages participation by personnel at all levels within management authorities; Development of a system that collects, integrates, and processes real-time data at regular intervals; Maximum use of the new Information and Communications Technology (ICT) hardware and software for rapid on-site communication, data collection, and analysis.

## PROJECT OUTCOMES

Various modules are developed (Inventory Module, Scour Inspection Module, Structural Inspection Module, Maintenance and Repair Module) and are implemented within the BRIDGE SMS online platform. The users – bridge managers, bridge inspectors, and administrators, all have different reading and editing permissions and can login into the system from any computer. The tablet application „AIM" is developed to provide bridge inspectors with the two-way synchronization with the online platform. The mobile app standardizes the inspection procedure and reduces reporting time. The Monitoring and Prediction Module is successfully completed and tested. The system sends Alerts and Alarms to a selected group of site engineers up to 48 hours prior to rainfall events.

# DESTinationRAIL

## Decision Support Tool for Rail Infrastructure Managers

| | |
|---|---|
| Duration | 01/05/2015 – 30/04/2018 |
| Overall budget | € 3,924,800 |
| Source of funding | Horizon 2020 |
| Coordinator | Gavin & Doherty Geosolutions |
| Partners | Iarnrod Eireann; TRL; University of Zagreb Faculty of Civil Engineering; HŽ Infrastruktura; Technische Universitaet Muenchen; ZAG Slovenija; Stiftelsen Norges Geotekniske Institutt; Norges Teknisk-Naturvitenskapelige Universitet; Eidgenoessische Technische Hochschule Zuerich; Universiteit Twente; Opentrack Railway Tech.; Roughan & O'Donovan Limited; Slovenske zeleznice |
| Project leader at the Faculty | Prof. Meho Saša Kovačević, PhD |

Web page: www.destinationrail.eu

## PROJECT DESCRIPTION

As Europe's railway infrastructure network ages, investments in its maintenance are becoming increasingly challenging. As a result, the reliability and safety are reduced, and the perception of users about this infrastructure is negative, while the policy of favouring an increased use of railway transport is relatively unsuccessful. The goal of this project (safer, more reliable and efficient railway infrastructure) will be achieved using a holistic management tool based on the FACT principle (Find, Analyse, Classify, Treat). The project will engender new techniques for the identification, analysis, and rehabilitation of critical infrastructure. These solutions will be implemented using a decision support tool that will allow railway infrastructure managers to make rational investment decisions, based on reliable data. The Faculty of Civil Engineering participates in the project by developing and applying a multi-geophysical approach for assessing the condition of railways and unmanned aerial vehicles.

## PROJECT OUTCOMES

- Development of new and improved techniques for assessing the condition of railway infrastructure.
- Advanced probabilistic models based on performance statistics, which use databases controlled by the information management system. The models will be used to assess the safety level of individual assets.
- Performance models will allow for a change in the way risk is assessed, moving from the current subjective (qualitative) basis to a quantifiable data-based assessment.
- New and innovative techniques for the maintenance and construction of railway infrastructure.

# INCEPTION

## Inclusive Cultural Heritage in Europe through 3D semantic modelling

| | |
|---|---|
| Duration | 01/06/2015 – 31/05/2019 |
| Overall budget | € 4,009,205 |
| Source of funding | Horizon 2020 |
| Coordinator | University of Ferrara, Architectural Department |
| Partners | University of Zagreb Faculty of Civil Engineering, Vision Business Consultants, Z+F, Cyprus University of Technology, NTUA, CARTIF, DEMO, Nemoris, CFR, LENZELUIG 3-L PLAN, UL |
| Project leader at the Faculty | Prof. Vlatka Rajčić, PhD |

Web page: www.inception-project.eu/en

## PROJECT DESCRIPTION

INCEPTION realises innovation in 3D modelling of cultural heritage through an inclusive approach for the time-dynamic 3D reconstruction of artefacts, built and social environments. It enriches the European identity through understanding of how the European cultural heritage continuously evolves over long periods of time.

## PROJECT OUTCOMES

- INCEPTION's inclusive approach comprises: time dynamics of 3D reconstruction ('forever'); addresses scientists, engineers, authorities and citizens ('for everybody'); and provides methods and tools applicable across Europe ('from everywhere').
- INCEPTION solves the shortcomings of state-of-the-art 3D reconstruction by significantly enhancing the functionalities, capabilities and cost-effectiveness of instruments and deployment procedures for 3D laser survey, data acquisition and processing. It solves the accuracy and efficiency of 3D capturing by integrating Geospatial Information, Global and Indoor Positioning Systems (GIS, GPS, IPS) both through hardware interfaces as well as software algorithms.
- INCEPTION methods and tools result in 3D models that are easily accessible for all user groups and interoperable for use by different hardware and software. It develops an open-standard Semantic Web platform for Building Information Models for Cultural Heritage (HBIM) to be implemented in user-friendly Augmented Reality (VR and AR) operable on mobile devices.

# GoSAFE RAIL

## Global Safety Management Framework for RAIL Operations

| | |
|---|---|
| Duration | 01/01/2016 – 30/09/2019 |
| Budget | € 1,298,750 |
| Source of funding | Horizon 2020 |
| Project coordinator | Gavin & Doherty Geosolutions |
| Partners | Irish Rail; Roughan & O'Donovan; University of Zagreb Faculty of Civil Engineering; HŽ Infrastruktura; Norwegian Geotechnical Institute; Contecht; OpenTrack Railway Technologies; Virtus IT; Infra Plan Konzalting |
| Project leader at the Faculty | Prof. Meho Saša Kovačević, PhD |

Web page: www.gosaferail.eu

GoSafe Rail

## PROJECT DESCRIPTION

The GoSAFE RAIL project aims to develop advanced tools to increase the safety of railway infrastructure assets. The project brings together interdisciplinary experts from the risk assessment sector specialized in transport infrastructure, artificial intelligence (AI), asset detection and data management, and leading institutions in the network microsimulation modelling, all with the purpose of developing a decision support tool that will enable a significant step forward in railway infrastructure safety. In the scope of this project, the Faculty of Civil Engineering develops a series of methods for the detection of potential obstacles along railway networks by combining a series of cameras, laser and radar imaging sensors, using a machine learning algorithm.

## PROJECT OUTCOMES

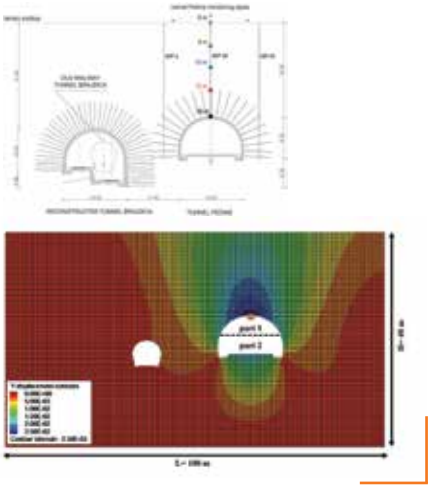
- Integration of open data from a number of sources and their transformation into a form that will allow direct use in the safety framework.
- Development and demonstration of methods for detecting objects along the railway network in real time.
- Development of analytical models that include artificial intelligence (AI) algorithms to predict the degradation of railway infrastructure.
- Development of a safety framework that can be used to plan maintenance and intervention strategies with life-cycle cost optimization.

# SAFE-10-T

## Safety of Transport Infrastructure on the TEN-T Network

| | |
|---|---|
| Duration | 01/05/2017 – 30/04/2020 |
| Budget | € 2,997,000 |
| Source of funding | Horizon 2020 |
| Project coordinator | Gavin And Doherty Geosolutions Ltd. |
| Partners | Istituto Di Sociologia Internazionale Di Gorizia; Virtus IT; Roughan & O'Donovan Limited; Infrastructure Management Consultants; Ministerie Van Infrastructuur En Waterstaat; Network Rail Infrastructure; Technische Universitat Berlin; Deutsches Forschungszentrum Fur Kunstliche Intelligenz; Forum Des Laboratoires Nationaux Europeens De Recherche Routiere; Infra Plan Konzalting; Technische Universiteit Delft; University of Zagreb Faculty of Civil Engineering; HŽ Infrastruktura |
| Project leader at the Faculty | Prof. Meho Saša Kovačević, PhD |

Web page: www.safe10tproject.eu



## PROJECT DESCRIPTION

The SAFE-10-T project aims to develop a safety framework to ensure high safety performance, with extended life cycle, of critical infrastructure on roads, railways and inland waterways. Moving from considering critical infrastructure such as bridges, tunnels and earthworks as inert structures to intelligent (self-learning) objects, the project will minimize sudden exceedance of load-bearing capacity limits. The Faculty's research activities are focused on (a) analysis of long-term deformations around the tunnel to increase safety using neural networks and genetic algorithm, and (b) implementation of a continuous monitoring system at one of the 'case study' locations – Brajdica railway tunnel near the city of Rijeka.

## PROJECT OUTCOMES

- The safety framework includes remote sensing data stored in the BIM model, which is entered into the decision support framework (DST), and which allows automatic decision-making on maintenance priority for assets that are close to exceeding one of the limit states.
- Development of algorithm at the level of the asset and at the level of the transport network with the application of machine learning to enable continuous development of decision-making systems, using available data from asset monitoring activities.
- Demonstration and validation of the tools developed at critical hubs of the TEN-T transport network.

# FIT-to-NZEB

## Innovative training schemes for retrofitting to nZEB-levels

| | |
|---|---|
| Duration | 15/06/2017 – 14/06/2019 |
| Overall budget | € 1,013,848 |
| Source of funding | Horizon 2020 |
| Coordinator | Coordinator: Centre for Energy Efficiency EnEffect, Bulgaria |
| Partners | University of Architecture, Civil Engineering and Geodesy; SEVEn, the Energy Efficiency Centre; Czech Technical University; Association Cluster for Promoting Nearly Zero Energy Buildings (Pro-nZEB); Coleguil Tehnic de arhitectura si Lucrari Publice I.N. Socolescu; Mosart Landscape Arhitecutre Research; University of Zagreb Faculty of Civil Engineering; Zero Energy and Passivhaus Insitute for Reseach SRL; Elliniko Institouto Pathitkou Ktiriou |
| Project leader at the Faculty | Asst. Prof. Bojan Milovanović, PhD |

Fit-to-NZEB
Innovative training schemes for retrofitting to nZEB-levels

Web page: www.fit-to-nzeb.com

## PROJECT DESCRIPTION

Reaching the 2020 and 2030 energy and climate objectives represents a major challenge to the construction sector, which needs to be ready to deliver deep energy renovations and, in particular, nearly zero-energy buildings. This goal requires a major effort to increase the number of qualified construction specialists at all levels, which is directly related to the accessibility and quality of the training and educational programmes, and to introduction of proper training on the intelligent energy efficiency and RES solutions in building renovations. The fundamental objective of the Fit-to-nZEB project proposal is to deliver all necessary prerequisites for introducing education on deep energy renovation of buildings in the curricula at all levels of the educational and training system in Southeastern Europe.

## PROJECT OUTCOMES

- Elaborate a set of technological competences and learning outcomes on deep energy renovation.
- Develop new large scale training schemes and programmes on deep energy renovation at all levels of the vocational education and training (VET) system.
- Review the national educational plans and initiate the necessary changes.
- Establish capacity for professional training of trainers and train a sufficient number of trainers.
- Support and monitor pilot courses on the new programmes on deep energy renovation at all levels.

# Net-UBIEP

## Network for Using BIM to Increase the Energy Performance

| | |
|---|---|
| Duration | 03/07/2017 – 02/01/2020 |
| Overall budget | € 995,023 |
| Source of funding | Horizon 2020 |
| Coordinator | Agenzia Nazionale per le Nuove Tecnologie, L'energia e lo Sviluppo Economico Sostenibile, Italy |
| Partners | Centro Servizi Aziendale Scarl; Viaeuropa Competence Centre Sro; Fundacion Laboral De La Construccion; Viesoji Istaiga Skaitmenine Statyba; University of Zagreb Faculty of Civil Engineering; Vilniaus Gedimino Technikos Universitetas; Stichting Isso, Tallinna Tehnikaülikool; Ustav Vzdelavania A Sluzieb; Agencia Estatal Consejo Superior De Investigaciones Cientificas; Balance & Result Organisatie Adviseurs Bv; Mittetulundusuhing Eesti Timmitud Ehituse Tugiruhm |
| Project leader at the Faculty | Asst. Prof. Bojan Milovanović, PhD |

Web page: cordis.europa.eu/project/id/754016

## PROJECT DESCRIPTION

An integrated approach to the Net-UBIEP project, based on information modelling of buildings, integrated with energy efficiency requirements, will be key to solving all problems in a more efficient way. The project proposes BIM qualification models integrated with energy competencies, in order to spread a better understanding of energy issues along the entire value chain of the construction industry so that the existing and new buildings will have better energy performance. Public administration, professionals (engineers / architects), technicians (installers / maintainers) and tenants are therefore involved in Net-UBIEP activities.

## PROJECT OUTCOMES

- Identification of specific energy BIM competencies required for the implementation of BIM models throughout the life cycle of the building
- „Integrated" BIM qualification models will be validated by stakeholders by providing various training activities (seminars / classroom courses / e-courses) addressed to at least six BIM professional profiles: BIM Manager, BIM Evaluator, BIM Coordinator, BIM Expert, BIM Facility Manager, BIM User
- Standardization of approved schemes for wider acceptance at the European and international levels through regulatory organizations (CEN / ISO)

# FORESEE

## Future proofing strategis For RESilient transport networks against Extreme Events

| | |
|---|---|
| Duration | 01/09/2018 – 28/02/2022 |
| Overall budget | € 4,995,147 |
| Source of funding | Horizon 2020 |
| Coordinator | Fundacion Tecnalia Research & Innovation (Spain) |
| Partners | Rina Consulting Spa; Fraunhofer Gesellschaft zur Foerderung Der Angewandten Forschung E.V.; Universidad de Cantabria; Future Analytics Consulting Limited; Ferrovial Agroman Sa; University of Bath; Centro de Estudios de Materiales y Control de Obra Sa; Louis Berger Spain Sa; Ingeniería Y Conservación Contraincendios, S.L.; Infraestruturas De Portugal Sa; Aiscat Servizi Srl; Autostrade Per L'italia S.P.A.; European Union Road Federation; Eidgenoessische Technische Hochschule Zuerich; Telespazio Vega Uk Limited; The University of Edinburgh; Ingenieurgesellschaft für Verkehrs- Und Eisenbahnwesen Mbh |
| Project leader at the Faculty | Assoc. Prof. Damir Bekić, PhD |

## PROJECT DESCRIPTION

Transportation systemic risks are not well understood across modes, regions, and critical interdependent sectors, creating uncertainty about risks resulting from a major system disruption. There is a lack of resilience schemes, especially for the long term, integrated into transport infrastructure due to the inability to monetize resilience for investment decisions, and there are also strong barriers to its implementation to operating practice. The overall objective of FORESEE is to develop and demonstrate a reliable and easily implementable toolkit for providing short- and long-term resilience schemes against traffic disruption due to flooding, landslide and structural damage for rail and road corridors and multimodal terminals.

## PROJECT OUTCOMES

The FORESEE toolkit will include: a) A reliable Data Acquisition System, satellite and terrestrial, b) A Situation Awareness System for the prediction and alert of extreme events, c) New materials and systems regarding permeable pavements; drainage and culvert systems, and slope stabilization systems, d) A Decision Support System to provide better informed resilience schemes, e) Guidelines on Standards, Design and Technological recommendations. The setting up of a Stakeholders Reference Group at early stages of the project will guarantee the accounting for the demands and the acceptance of all end users. FORESEE will enhance international cooperation by twinning with world leading institutes.

FORESEE PROJECT

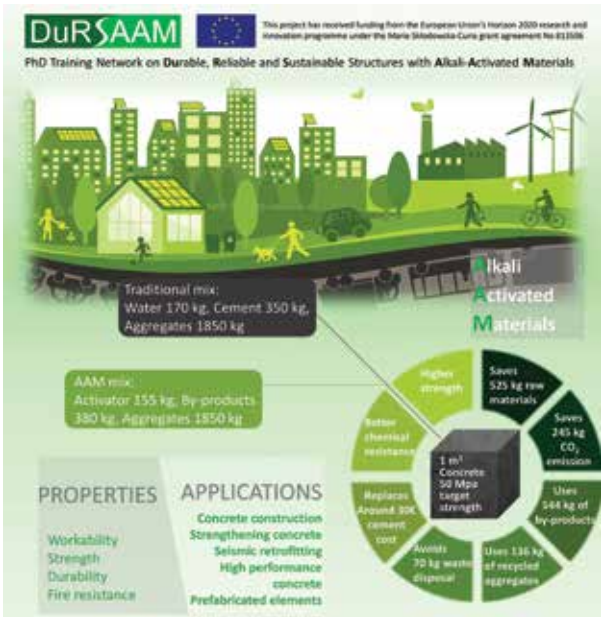
Web page: foreseeproject.eu

# DuRSAAM

## PhD Training Network on Durable, Reliable and Sustainable Structures with Alkali - Activated Materials

| | |
|---|---|
| Duration | 01/11/2018 – 31/10/2022 |
| Overall budget | € 3,397,848 |
| Source of funding | Horizon 2020 |
| Coordinator | Ghent University |
| Partners | Delft University of Technology; Karlsruhe Institute of Technology; University of Sheffield; University of Zagreb Faculty of Civil Engineering; University of Patras; ETH Zurich |
| Project leader at the Faculty | Asst. Prof. Marijana Serdar, PhD |

Web page: dursaam.ugent.be




## PROJECT DESCRIPTION

The aim of the project is to develop a new generation of cement-free alkali-activated binders, as an alternative to traditional cement-based concrete, in order to enable their application in sustainable green construction. Concrete is the most common construction material, and the omission of cement from concrete production significantly reduces $CO_2$ emissions as one of the most significant factors among the harmful effects on the environment. The interdisciplinary research is focused on the examination of alkali-activated materials from various aspects - composition design, microstructure, structural application, durability, and assessment of service life and sustainability of materials.

## PROJECT OUTCOMES

The project activities will contribute to better understanding of the properties of alkali-activated materials, to more accurate prediction of their durability, and to expansion of the scientific database in order to enable reliable application of alkali-activated materials in construction. The project will contribute to the training of scientific staff for further research and development of environmentally efficient construction by creating a connection and collaboration between thirteen doctoral students from different fields.

# oVERFLOw

# Vulnerability assessment of embankments and bridges exposed to flooding hazards

| | |
|---|---|
| Duration | 01/12/2019 – 31/07/2022 |
| Budget | € 586,192 |
| Source of funding | European Union Civil Protection Mechanism (UCPM) |
| Project coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | Infra Plan Konzalting; GEKOM – geofizikalno i ekološko modeliranje Ltd.; Veiligheidsregio Zuid – Holland Zuid; INGEO BV; Zavod za gradbenistvo Slovenije; Admin. of the Rep. of Slovenia for Civil Protection and Disaster Relief |
| Coordinator | Prof. Meho Saša Kovačević, PhD |

Web page: projectoverflow.eu

## PROJECT DESCRIPTION

An improved method for assessing the vulnerability of embankments and bridges to floods is developed in the scope of the oVERFLOw project. This will be achieved by reducing known uncertainties in the VNK2 approach using techniques and procedures developed by consortium members in recent H2020 projects (DestinationRAIL, GOSafe, SAFE 10-T), including the application of (i) non-destructive geophysical testing, advanced sensors and drones equipped with multiple cameras, and (ii) calibration of advanced numerical models based on test results, with the development of the so-called 'fragility curves' for embankments and bridges. The project also includes two pilot sites in Croatia and the Netherlands, the aim being to validate new technologies and increase the level of technological readiness of project results (TRL), and to enable validation and exploitation of results by key stakeholders (civil protection agencies, infrastructure managers).

## PROJECT OUTCOMES

- Development of advanced technologies for assessing the condition of embankments and bridges based on non-destructive methods (geophysical methods, vibration response) and remote sensing methods (unmanned aerial vehicles).
- Methodology for assessing the vulnerability of embankments and bridges, along with risk forecasting tools, tailored to the needs of key stakeholders and decision-making processes related to the planning and design of measures to improve the safety and resilience of flood protection systems and bridges.
- Increasing the resilience of flood protection and bridge infrastructure to the effects of climate change with the proposal of structural measures to mitigate these impacts.

# The **nZEB** Roadshow

| | |
|---|---|
| Duration | 01/06/2020 – 31/05/2023 |
| Overall budget | € 1,094,810 |
| Source of funding | Horizon 2020 |
| Coordinator | Centre for Energy Efficiency EnEffect, Bulgaria |
| Partners | University of Zagreb Faculty of Civil Engineering; Elliniko Institouto Pathitikou Ktiriou; Zero energy and passivhaus institute for research SRL; Asociatia cluster pentru promovarea cladirilor cu consum de energie aproape egal cu zero pro nzeb; Bulgarian Construction Chamber |
| Project leader at the Faculty | Asst. Prof. Bojan Milovanović, PhD |

Web page: www.nzebroadshow.eu
www.muza-nzeb.com

nZEB Roadshow
Bulgaria | Croatia | Romania | Greece | Italy

## PROJECT DESCRIPTION

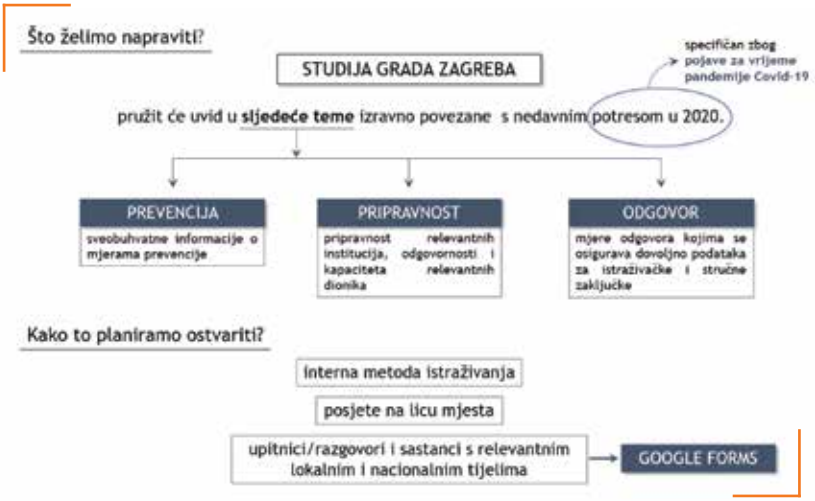
Based on EU environmental requirements, starting from 2021 (or from 2019 for public buildings) all new buildings must be nearly-zero-energy buildings (nZEBs), which means buildings with a very high energy performance. The EU-funded nZEB Roadshow project will perform the national-level marketing and communication promotions in five EU countries, organising nZEB weeks in selected cities in each of the participating countries. The action consists of a wide range of events including construction products, real estate exhibitions, practical demonstration and real-time construction activities, training for both designers and workers, career orientation and job centres focusing on the local SME construction sector. Prefabricated modular mobile buildings will be used as information centres to raise awareness of the benefits of nZEBs.

## PROJECT OUTCOMES

- Marketing and communication campaigns at national level in five European countries, focusing on nZEB weeks organized in three to five selected cities in each country involved.
- Design and construction of mobile demonstration pavilions for the promotion of nZEB through small exhibitions and lectures, built according to nZEB standards.
- Construction of the MUZA mobile pavilion (Mobile, Efficient, Healthy, Architecture) which is an example of construction according to NZEB standards. In this pavilion, visitors can get information about the almost zero energy buildings (nZEB), and will also experience nZEB at first hand.
- nZEB Roadshow contributes to ongoing efforts to promote nZEB's two very important but unfortunately still missing components: professional marketing and sales services and a strong media partnership.

# L2BR
## Learn to be Resilient

| | |
|---|---|
| Duration | 15/01/2021 – 15/06/2022 |
| Overall budget | € 229,919 |
| Source of funding | ECHO (DG for European Civil Protection and Humanitarian Aid Operations) |
| Coordinator | Réseau des Associations Nationales de Pouvoirs Locaux de L'Europe du Sud-Est (NALAS) |
| Partners | Ministry of the Interior (Montenegro); Municipality of Tirana (Albania); Ss. Cyril and Methodius University in Skopje – Seismology Institute (North Macedonia); Public Health Institute (Montenegro) |
| Project leader at the Faculty | Assoc. Prof. Josip Atalić, PhD |




## PROJECT DESCRIPTION

The overall objective of the project is to strengthen the role of the Union Civil Protection Knowledge Network as an inclusive platform of shared knowledge and expertise, good practices and networking in order to establish common understanding and shared culture of the prevention, preparedness and response in civil protection and disaster risk management activities in the EU and the wider region. The specific objective is to support the civil protection and disaster risk management actors that promote and facilitate the development, dissemination and exchange of knowledge, good practices and expertise with relevant stakeholders. The project will take into account the lessons learned from the recent earthquakes in Albania, and from the Zagreb earthquake crisis management during the COVID-19 pandemics, and will also provide an overview of the new technologies and innovative approaches in the preparedness and response to earthquakes.

## PROJECT OUTCOMES

In scope of the project, five documents and tools aimed at improving the prevention, preparedness and response to earthquakes will be created and distributed to all relevant national and international stakeholders in four partner countries. The aim is to improve the exchange of knowledge, good practices, and expertise. Moreover, the project will promote inter-sectorial cooperation through the real time HQ exercise and organization of national and international conferences. The long-term impact of the project results will be achieved through signature of the Memorandum of Understanding containing specific tools and measures to strengthen long-term cooperation and partnership between local, national, and regional entities. A new joint project proposal is also planned, thus supporting new partnerships, and strengthening the basis for future collaboration in the disaster risk management.

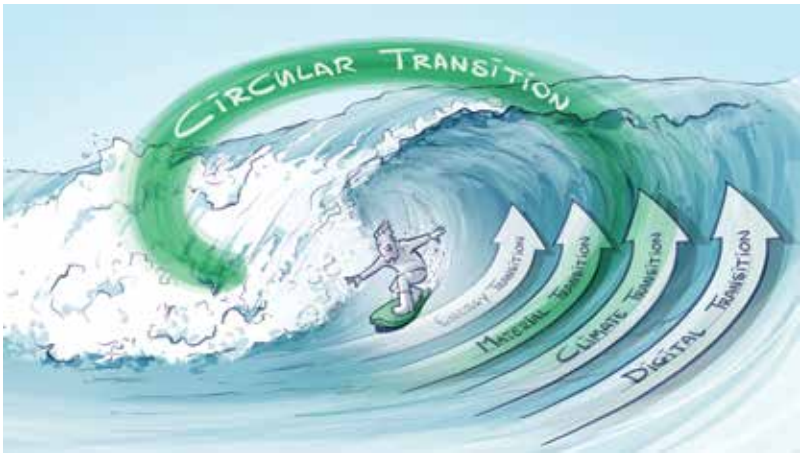
# BUS-GoCircular

## Stimulate demand for sustainable energy skills

with circularity as a driver and multifunctional green use of roofs, façades and interior elements as focus

| | |
|---|---|
| Duration | 01/09/2021 – 29/02/2024 |
| Overall budget | € 999,894 |
| Source of funding | Horizon 2020 |
| Coordinator | Stichting ISSO, Netherlands |
| Partners | Building Changes Support Bv; Fondatsiya Tsentar Za Energiyna Efektivnost – Enefekt; Universitet Po Architektura Stroitelstvo i Geodezija; Ceske Vysoke Uceni Technicke v Praze; Institut Cirkularni Ekonomiky Zu; Instituto Valenciano De La Edificacion; Federacion Valenciana De Empresarios De La Construccion; University of Zagreb Faculty of Civil Engineering; Emi Epitesugyi Minosegellenorzo Innovacios Nonprofit Kft; Limerick Institute Of Technology; Conseil Des Architectes D'europe; Iclei European Secretariat Gmbh |
| Project leader at the Faculty | Asst. Prof. Bojan Milovanović, PhD |

Web page: busgocircular.eu




## PROJECT DESCRIPTION

The overall goal of the BUS-GoCircular project is to address and overcome the challenges in the stimulation of demand for green energy skilled labour, and in building practical capacity to increase the number of skilled labour throughout the value chain. BUS-GoCircular will achieve this goal by developing and implementing a qualification framework of circular construction skills with an emphasis on multifunctional green roofs, facades and interior elements. This overall goal is translated into the following specific objectives:

- Stimulating market demand for circular skills.
- Improving the reputation of the construction sector and attracting women and young people to circular skills.
- Expanding the BUS-GoCircular project at the national and EU levels by developing and implementing a communication and replication strategy.

## PROJECT OUTCOMES

- Apply successful instructor-training methods and techniques in the included value chain.
- Stimulate demand for sustainable energy skills.
- Stimulate demand complemented with hands-on and practical upskilling of local and regional training capacity and workforce.
- Ensure broad involvement of small and medium enterprises.

# ERASMUS+

ERASMUS+

# **BIMzeED** – Education for zero energy Buildings using Building Information Modelling

| | |
|---|---|
| Duration | 01/11/2018 – 30/04/2022 |
| Overall budget | € 955,633 |
| Source of funding | Erasmus+ |
| Coordinator | Limerick Institute of Technology |
| Partners | Tipperary Energy Agency; University of Zagreb Faculty of Civil Engineering; Emi; Óbuda University; Institut de Tecnologia de la Construcció de Catalunya; CIM – UPC; Architects' Council of Europe – ACE; North West Regional Energy Agency |
| Project leader at the Faculty | Asst. Prof. Bojan Milovanović, PhD |

Web page: bimzeed.eu

## PROJECT DESCRIPTION

The BIMzeED project is aimed at defining the training that the construction industry currently needs, as well as the training that needs to be encouraged In the future: 1) better employment opportunities, 2) low-carbon development, 3) green skills and near-zero energy building (nZEB) skills, 4) increasing youth employment. The challenge of the BIMzeED project is to overcome skills mismatches and improve employment opportunities in the current European construction market by improving the existing skills of trainers, SMEs, construction site managers, craftsmen and other construction workers.

## PROJECT OUTCOMES

Twelve to sixteen learning units will be established and developed as part of the BIMzeED project in order to increase the understanding of BIM tools and nZEB within the existing curricula in the construction sector. BIMzeED will train 120 trainers at European universities and vocational schools through a series of trainings sessions using innovative and new educational materials. BIMzeED plans to educate 400 to 500 students, construction site managers, craftsmen and other participants in construction projects to improve their employment opportunities.

# Construction Safety with Education and Training using Immersive Reality (**CSETIR**)

| | |
|---|---|
| Duration | 01/09/2019 – 31/08/2022 |
| Overall budget | € 399,210 |
| Source of funding | ERASMUS+ |
| Project coordinator | Technical University of Košice |
| Partners | University of Zagreb Faculty of Civil Engineering; University of Porto; Aristotle University of Thessaloniki; Kamgrad Ltd. |
| Project leader at the Faculty | Prof. Ivica Završki, PhD |

Web page: csetir.civil.auth.gr/

CSETIr
Construction Safety with Education and Training using Immersive Reality


## PROJECT DESCRIPTION

The aim of the project is to create a European network for adult learning that will train isolated groups of people about safety on construction sites. Such education will increase employment opportunities and reduce potential accidents at work in construction industry. The objective is to develop a learning system based on knowledge acquired through work and test a modern way of organized learning so that adults can develop their skills. Furthermore, upon completion of the project, construction companies will be able to use the developed platform to train their newly hired employees, with the aim of helping them adapt to the new work environment. The results of the project will enable students and young professionals of related professions to receive proper training for working on construction sites.

## PROJECT OUTCOMES

- review of existing knowledge in the field of education, virtual reality, and work safety.
- BIM models of buildings at different phases of construction serving as basis for forming a virtual reality platform for education in the field of occupational safety.
- an innovative virtual reality platform for adult education in the field of occupational safety, which is available and feasible on all platforms (mobile phones, personal computers, virtual reality systems, etc.).
- methodology and a manual for non-formal education of adults in construction or related professions, enabling them to work safely on construction sites.
- online platform through which all project outcomes will be available upon completion of the project (YouTube channel, social platforms, 3D models, virtual reality education platform, and an accompanying education manual).

# Erasmus+

## Skilled to be a fire expert

| | |
|---|---|
| Duration | 01/10/2020 – 31/10/2022 |
| Overall budget | € 171,135 |
| Source of funding | Erasmus+ Programme, KA2 Strategic Partnership Project |
| Coordinator | Univerza v Ljubljani |
| Partners | Slovensko združenje za požarno varstvo; VSB – Technical University of Ostrava; Majaczech, z.s.; University of Zagreb Faculty of Civil Engineering; Inspekting Ltd. (Croatia) |
| Project leader at the Faculty | Asst. Prof. Marija Jelčić Rukavina, PhD |

Web page: www.skilledfe.eu

SKILLED TO BE A **FIRE EXPERT**

## PROJECT DESCRIPTION

The analysis of major fires (e.g., Grenfell Tower, Notre Dame Cathedral fire, etc.) that have caused human casualties and enormous economic, environmental, and cultural damage shows that regulators and industry are ill prepared to respond to new threats. There is insufficient sharing of knowledge about the impact of new products and services on building safety in a fire event. Experts involved in fire safety include architects, civil, mechanical, electrical, and other engineers taking part in building design, construction and maintenance, working in fire departments, etc. The access to information indispensable to this large community of experts is enabled by lecturers at universities, fire protection associations and other stakeholders involved in the transfer of knowledge about fire protection.

## PROJECT OUTCOMES

An online platform for trainers in the field of building safety in the event of fire (Online Learning Platform for Fire Expert Trainers), based on the latest knowledge in this field, will be developed in the scope of this project.

# EUROPEAN CLIMATE INITIATIVE („EUKI")

# **CONGREGATE** – Consumer Engagement in building renovation and renewable energy cooperatives for grassroot climate action

| | |
|---|---|
| Duration | 01/11/2020 – 31/03/2023 |
| Overall budget | € 978,082 |
| Source of funding | European Climate Initiative („EUKI") 2020, German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) |
| Coordinator | Center for Energy Efficiency EnEffect |
| Partners | Institute for Zero Energy Buildings INZEB; University of Zagreb Faculty of Civil Engineering; The Energy Efficiency Centre SEVen; Cluster pRO-nZEB; Centre for the Study of Democracy |
| Project leader at the Faculty | Asst. Prof. Bojan Milovanović, PhD |

Web page:
www.de/en/euki-projects/congregate/

## PROJECT DESCRIPTION

The CONGREGATE project is funded by the European Climate Initiative („EUKI") 2020, and by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). In Croatia, the project involves monitoring and analysis of the way in which current energy renovation programs affect the energy and financial savings of tenants, as well as their behaviour and attitudes. The results of this study will be used in future national campaigns for civic engagement in building energy renovation programs.

## PROJECT OUTCOMES

- The CONGREGATE project includes monitoring thee energy consumption of apartment buildings in the energy-renovated and non-renovated buildings for a period of one year.
- In addition to monitoring the energy consumption in each building on the example of one apartment, thermal comfort as well as air quality will be monitored.
- Upon completion of the project, the results of the research will be available to all interested representatives of co-owners as well as building managers

# OTHER EUROPEAN FUNDS

# **SBRI+** Valorisation of Knowledge for Sustainable Steel-Composite Bridges in Built Environment

| | |
|---|---|
| Duration | 01/07/2016 – 01/07/2018 |
| Overall budget | € 1,125,079.80 |
| Source of funding | Research Fund for Coal and Steel (RFCS) |
| Project coordinator | Arcelormittal Belval & Differdange SA (AMBD), Luxemburg |
| Partners | ArcelorMittal, Universität Stuttgart Universidade Coimbra, Aktien-Gesellschaft der Dillinger Hüttenwerke, Institut Français Des Sciences Et Technologies Des Transports, De L'aménagement Et Des Réseaux, Ramboll Sverige, Brisa Engenharia e Gestão SA, Forschungsvereinigung Stahlanwendung e.V., Universitatea Politehnica Timisoara, Ceske Vysoke Uceni Technicke V Praze, Fundacion Tecnalia Research & Innovation, Universita Degli Studi Di Napoli Federico II, Atkins Consultants Limited, Stichting Bouwen Met Staal, BKE sp. z o.o., University of Zagreb Faculty of Civil Engineering, S. Stathopoulos - K. Farros Consulting Engineers |
| Project leader at the Faculty | Prof. Darko Dujmović, PhD |

Web page: www.grad.unizg.hr/sbriplus


## PROJECT DESCRIPTION

Based on the results of the previous RFCS research project SBRI „Sustainable Steel-Composite Bridges in Built Environment", in which a holistic approach was applied to three types of steel-composite bridges by combining analyses of environmental (LCA), economic (LCC) and functional qualities (LCP) along the entire life-cycle of bridges, the project SBRI+, as an upgrade, covers the valorisation, dissemination and extension of the developed methodology for advanced practical examples.

## PROJECT OUTCOMES

- SBRI+: Valorisation of Knowledge for Sustainable Steel-Composite Bridges in Built Environment- Design Manual I: General information and worked examples. Author: Constança Rigueiro. Editors of Croatian Edition: Darko Dujmović and Ivan Lukačević, Publisher: University of Zagreb Faculty of Civil Engineering. Year: 2018. ISBN 978-953-8168-27-7.
- SBRI+: Valorisation of Knowledge for Sustainable Steel-Composite Bridges in Built Environment- Design Manual II: Advanced Applications. Author: Ana Pascual. Editors of Croatian Edition: Darko Dujmović and Ivan Lukačević, Publisher: University of Zagreb Faculty of Civil Engineering. Year: 2018. ISBN 978-953-8168-28-4.
- Application SBRI+ for life cycle analyses of bridges.
- Workshops for the dissemination of project results in 12 European countries.

# Establishment of the **national training centre** for nearly Zero Energy Buildings (nZEB)

| | |
|---|---|
| Duration | 05/2021 – 04/2024 |
| Overall budget | € 1,600,000 |
| Source of funding | EEA Grants: Energija i klimatske promjene (Energy and Climate Changes) |
| Coordinator | Hrvoje Požar Energy Institute |
| Project leader at the Faculty | Asst. Prof. Mislav Stepinac, PhD |

## PROJECT DESCRIPTION

The overall objective of the project is to increase, at the national level, the capacity to implement the newly adopted, yet not utilized, nearly Zero Energy Building standard (nZEB). Addressing poor energy performance of public buildings is at the core of Croatian energy strategies and action plans. Although the newly implemented building standard – nearly zero energy building (nZEB) – has been adopted, the real implementation is still lagging behind. One of the increasingly topical issues in Croatia today is how to efficiently transfer relevant regulations and recently developed methodologies regarding nZEB standards to all key stakeholders. This project will therefore support the key stakeholders in the realisation of all benefits of the nZEB standard. The project will prove that the nZEB approach, although innovative, is an optimum and cost-effective solution for the renovation of public buildings. Project also aims to capitalize on the results of key Norwegian initiatives, developed by the well-known research institution SINTEF, regarding nZEB and zero emission neighbourhoods.

## PROJECT OUTCOMES

- Development of the entire documentation needed for achieving nZEB standard while retrofitting the existing public building.
- Deep retrofit of the existing public building based on state-of-the-art technologies, which will be thoroughly documented and monitored by the group of nZEB experts.
- Design of the training programme and project development assistance for nZEB projects at the level of local communities, with the action plan on how to achieve a zero-emission neighbourhood.
- Cooperation with Norwegian scientific institutions and other nZEB initiatives.

# UIC Harmotrack project (Harmonisation of track quality description and assessment)

| | |
|---|---|
| Duration | 2020 – 2023 |
| Source of funding | European Regional Development Fund |
| Project coordinator | UIC – International Union for Railways |
| Partners | Austrian Federal Railways – ÖBB (Austria), Bane NOR (Norway), Camrail (Cameroon), Department of Transportation – DOTr (Republic of Philippines), Ethiopian Railway Corporation – ERC (Ethiopia), Hungarian State Railways (MÁV Magyar Államvasutak Zrt. – MÁV Zrt.) (Hungary), Research Design and Standards Organisation – RDSO (India), Sydney Trains (Australia), Infraestruturas de Portugal (Portugal), SNCF (France), African Railway Centre of Excellence (Ethiopia), Bern University of Applied Sciences (Switzerland), Central Queensland University (Australia), University College Dublin (Ireland), University of Birmingham (United Kingdom), University of Novi Sad (Serbia), University of Pretoria (South Africa), University of Zagreb (Croatia) |
| Project leader at the Faculty | Asst. Prof. Ivo Haladin, PhD |

Web page: uic.org/com/enews/nr/698/article/uic-harmotrack-project-a-worldwide-project-bringing-together-companies-across?page=modal_enews


## PROJECT DESCRIPTION

Railway track condition management is mainly based on the analysis of track geometry parameters. Track condition data are often collected by dedicated inspection vehicles, and track maintenance procedures are based on meeting certain limit values of required parameters based on historical experience. In recent years, measuring the acceleration of track elements has proven to be a useful tool for obtaining interesting information about the condition of the track. The use of accelerometers offers undeniable advantages, such as the reduced cost and easier portability of measuring devices, but their implementation in maintenance processes is not trivial. The measured accelerations depend on various factors that must be controlled to define the limit values on which maintenance is based. The Harmotrack project brings together global international experts to tackle current and future challenges with regard to dynamic measurements. The main objectives of the project are the adoption of international measures for implementation of the state-of-the-art measurement techniques for determining dynamic responses of the track (acceleration and force) to monitor its quality; determination of specifications for optical measuring devices; definition of reliable track quality indicators based on acceleration for improved network maintenance; contribution to better safety and cost reduction on all networks due to corrections of track geometry, with an emphasis on those parts with the most dangerous impact on vehicle dynamics; recommendation of limit values for accelerations in future international standards.

## PROJECT OUTCOMES

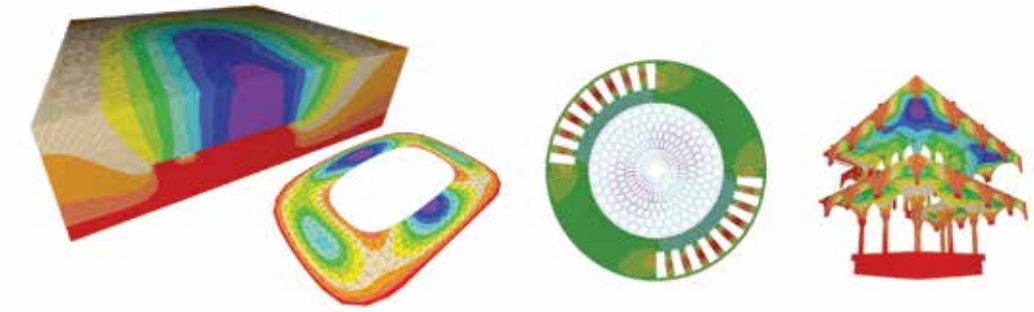
- Machine learning models for evaluation of track geometry based on accelerations.
- Guidelines for implementation of the state-of-the-art measurement techniques for determination of dynamic responses of the track.
- Application of low-cost (mobile) devices for the interpretation of dynamic track properties.

# CROATIAN SCIENCE FOUNDATION

# **YODA** – Novel, Efficient Iterative Procedure for the Structural Analysis - Generalisation of Modern Methods

| | |
|---|---|
| Duration | 01/09/2015 – 31/08/2019 |
| Overall budget | € 78,146 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Prof. Damir Lazarević, PhD |

Web page: www.grad.unizg.hr/yoda



## PROJECT DESCRIPTION

The idea of the project is to develop a rapid iterative method for structural analysis that is faster than modern direct and iterative solvers for the same memory usage, and much faster for larger memory usage. The proposed procedure is especially significant because the majority of modern iterative methods can be represented as a special case of our procedure. In each iteration step, the discrete Ritz method is applied, and coordinate vectors are generated forming a subspace in which a local energy minimum is sought, and decreasing the total energy of the system, which thus converges to the required minimum. The number of coordinate vectors is not limited, but it tends to be much smaller than the number of unknowns.

## PROJECT OUTCOMES

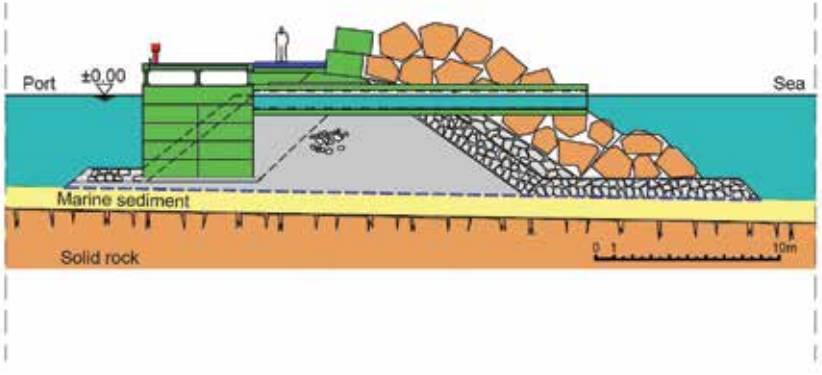
The iterated Ritz method shows good results when applied to large systems with sparse matrices from design practice. The conjugacy property, on which some iterative methods are based, and which applies only to linear problems, is not strictly required in this case, and so the method can be successfully applied to nonlinear computations where the conjugacy property is not defined at all. Finally, by applying the original methods of integer arithmetic, the exact solution of appropriate, realistic (not just trivial, so-called benchmark) examples can be determined, and thus the convergence, stability, and accuracy of any numerical procedure can be assessed.

# EKO MARINA

## Implementation of flushing culverts for sea quality improvement in harbours/ marinas

| | |
|---|---|
| Duration | 01/10/2015 – 30/09/2018 |
| Overall budget | € 77,702 |
| Source of funding | Croatian Science Foundation |
| Project coordinator | University of Zagreb Faculty of Civil Engineering |
| Principal investigator | Assoc. Prof. Dalibor Carević, PhD |

Web page: grad.hr/ecomarina/




## PROJECT DESCRIPTION

The purpose of pipe culverts is to allow water exchange between the open sea and the sea closed in port and thus ensure satisfactory water quality in the port. The installation of pipe culverts in breakwater structures is the most economically acceptable method. In general, there is a lack of knowledge to describe the functioning of pipe culverts as an instrument for water exchange. The project was implemented in the following phases: PHASE I: Determining the amount of flow through culverts under the action of wind waves and the value of transmitted wave energy, PHASE II: Functioning of pipe culverts in real conditions (measured in Opatija Marina), PHASE III: Determining the impact of pipe culverts on the sea exchange in ports.

## PROJECT OUTCOMES

The results of the project are organized into a series of conclusions on measures to be implemented to ensure sufficient water exchange in the future and existing ports. The functioning of pipe culverts is a complex process influenced by the simultaneous action of three dominant forces: wind, waves, and tidal oscillations. For better understanding, the research is divided according to different actions under the assumption of process independence. Finally, conclusions are given on the correct positioning of pipe culverts in the breakwater body, methods for calculating wave energy transmission through culverts, and guidelines on the size (area) of pipe culverts that need to be installed to ensure satisfactory circulation.

# VETROLIGNUM

## Prototype of a multi-purpose composite panel wood - load-bearing glass

| | |
|---|---|
| Duration | 01/03/2017 – 29/02/2020 |
| Overall budget | € 98,983 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Prof. Vlatka Rajčić, PhD |

Web page: www.grad.unizg.hr/vetrolignum




## PROJECT DESCRIPTION

The load-bearing glass in combination with a wooden frame is a composite system that exhibits good behaviour during earthquakes, is at the same time energy-efficient and cost-effective, aesthetically acceptable, and has good load-bearing characteristics. Several studies of wood - glass composite systems have recently been conducted in monotonous and cyclic tests, which are necessary for composites to be applicable in seismically active zones. The project examined not only the load-bearing properties of the panel but also the energy efficiency of the entire system.

## PROJECT OUTCOMES

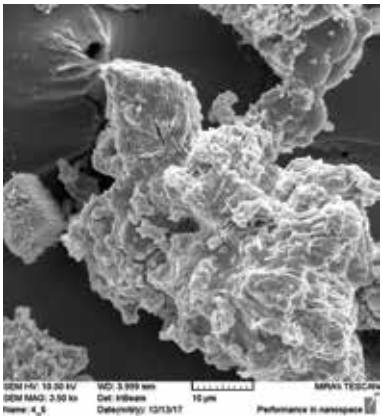
- Development and new knowledge about the joints of CLT structures with glued bars
- Development of a wood-load-bearing hybrid panel in terms of energy efficiency
- Development of a wood-load-bearing hybrid panel in terms of seismic resistance
- Development of details and joints in wooden structures
- Construction of a demonstration facility

# TAREC² – Transformation of Wood Biomass Ash into Resilient Construction Composites

| | |
|---|---|
| Duration | 01/03/2017 – 28/02/2021 |
| Overall budget | € 125,141 |
| Source of funding | Croatian Science Foundation |
| Project coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Prof. Nina Štirmer, PhD |

Web page: www.grad.unizg.hr/tarec

TAREC²
Transformacija pepela iz drvene biomase u građevne kompozite s dodanom vrijednošću



Morphology of bottom ash particles

Project workshop

## PROJECT DESCRIPTION

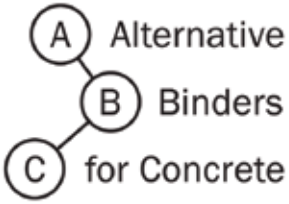
Solid and gaseous biomass fuelled power plants are the biggest source of renewable energy in the EU. Burning of one tonne of forest biomass and wood waste typically generates 5 MWh of energy as well as 20 – 50 kg/t of the bottom ash and fly ash. Currently, 70% of the wood biomass ash (WBA) is landfilled, 20% tends to be used as a soil supplement in agriculture, and 10% is used in miscellaneous applications. The project assessed the quantities and properties of WBA available in the Republic of Croatia and, based on experimental research, identified the possibilities of using WBA in the concrete industry.

## PROJECT OUTCOMES

- Detailed characterization of available WBA; considering the combustion technology, types and hydrodynamics of the furnace and tree species.
- Development of novel supplementary cementitious materials.
- Development of a novel mineral admixture.
- Development of novel construction composites by combining WBA, cement or other SCMs.
- Realisation of a mini-demonstration project using the developed composites.

# **ABC** – Alternative binders for concrete: understanding microstructure to predict durability

| | |
|---|---|
| Duration | 01/04/2019 – 31/03/2024 |
| Overall budget | € 283,666 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Asst. Prof. Marijana Serdar, PhD |




Web page: www.grad.hr/latom/index.php/projects/abc/


## PROJECT DESCRIPTION

Alternative concrete binders are a new generation of construction materials based on industrial waste that are a sustainable and economical alternative to traditional Portland cement. In order to achieve an almost full replacement of cement, it is of the utmost importance to use more thorough approaches to the research of alternative binders, enabling the understanding of materials at multiple levels (nano-micro-macro). The objectives of the project are to establish a research group as a centre of excellence for the research, understanding and correlation of the microstructure and durability of alternative binders for concrete, to realise training in an independent use of advanced analytical instrumental methods provided by a regional network of instrumentation, and to realise training via international centres of knowledge and excellence in a specific research area.

## PROJECT OUTCOMES

The ABC project will result in the formation of a research team that will have, thanks to the knowledge gained from education and research on research infrastructure, a broad understanding of alternative concrete binders made from waste materials and by-products found in the region. Also, the resulting alternative binders will be exposed to various exposure classes to enable full understanding of microstructural changes that occur in aggressive environments. Finally, the service life, cost, and environmental footprint of Portland cement and alternative binders will be compared, and the knowledge gained will be used for testing new materials through other sources of funding.

# **BEACHEX** – Sustainable construction of artificial gravel beaches - Construction of new beaches and increase of existing capacity

| | |
|---|---|
| Duration | 01/11/2019 – 30/04/2023 |
| Overall budget | € 267,667 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Assoc. Prof. Dalibor Carević, PhD |

Web page: grad.hr/beachex/en/

## PROJECT DESCRIPTION

Croatian beaches are under pressure to expand capacity for tourists while being at risk for erosion due to an increase in storm intensity caused by climate change. Croatia's beach management strategy aims to efficiently manage coastal resources but only with basic measures, which is why additional technical support is needed. That is the aim of the Beachex Project – to provide technical support for the long-term natural and artificial beach management while minimizing ecological risks.

## PROJECT OUTCOMES

There are multiple project results: a database containing information on the beaches that were nourished or expanded. Extensive fieldwork will provide insight into morphological processes on nourished beaches in the Adriatic wave climate while also developing a tool for technical calculations (SHINGLE model). The environmental impact will also be assessed through five distinct diving missions aimed at assessing the state of biotic community near regularly nourished beaches. Following implementation of numerical models, technical measures will be provided for the reduction of material loss in beach nourishment while minimizing the impacts of climate change.

# **BRAVOBRICK** – Use of treated oily wastewater and sewage sludge in brick industry – production of innovative brick products in the scope of circular economy

| | |
|---|---|
| Project duration | 01/12/2019 – 15/02/2024 |
| Total budget | € 185,514 |
| Source of financing | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Team leader | Assoc. Prof. Dražen Vouk, PhD |

Web page: https://www.bravobrick.com/


## PROJECT DESCRIPTION

The possibility of bringing the electrochemical technology of oily wastewater treatment to the level of quality that will enable efficient application in brick production will be analysed. New brick products with integrated treated water will have the same characteristics as conventional brick products. In addition, optimum conditions for thermal treatment of sewage sludge will be examined in order to obtain dried sludge best suited for brick production. In addition to obtaining sludge/ash with favourable characteristics, it will be possible to integrate significant amounts of sludge/ash as a substitute for clay and / or sand in brick production. New brick products with integrated sludge/ash will have the same characteristics as conventional brick products.

## PROJECT OUTCOMES

- Determining the possibility of reusing the treated oily wastewater and sewage sludge in the production of innovative construction products in brick industry, which would significantly reduce environmental pressures, and contribute to the development of circular economy, while also increasing the competitiveness of brick products in the market.
- Determining optimum conditions for thermal treatment of sewage sludge as related to the quality of the obtained dried sludge and ash suitable for use in brick production.
- Increasing the level of sustainable waste management in Croatia.
- Increasing the level of sustainable sludge management in Croatia.
- Reducing total costs of sludge management.

# **R3PEAT** – Remote Real-time Riprap Protection Erosion AssessmenT on large rivers

| | |
|---|---|
| Duration | 13/12/2019 – 12/12/2024 |
| Overall budget | € 259,121 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Asst. Prof. Gordon Gilja, PhD |

Web page: www.grad.hr/r3peat/

## PROJECT DESCRIPTION

The R3PEAT project (Remote Real-time Riprap Protection Erosion AssessmenT on large rivers) aims to bridge the gap between scour monitoring next to the riprap scour countermeasures installed around the bridge pier through development of the remote monitoring system ScourBuoy, enabling scour development monitoring in real-time. The research is conducted through field campaigns and a hybrid modelling approach – combination of experiments using a scaled model (phase 1) and numerical simulations (phase II). Research group consists of 7 members: four researchers from the Faculty of Civil Engineering, one researcher from the Faculty of Geodesy, PhD and Postdoc recruits, and external associates.

## PROJECT OUTCOMES

Key results of the research are the development of innovative methods and technologies for scour monitoring, and the development of a scour estimation methodology based on the hydraulic environment data, thus enabling bridge hazard assessment for various flood scenarios.

# **ARES** – Assessment and rehabilitation of existing structures – development of contemporary methods for masonry and timber structures

| | |
|---|---|
| Duration | 09/01/2020 – 08/01/2025 |
| Overall budget | € 185,000 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Asst. Prof. Mislav Stepinac, PhD |

Web page: www.grad.hr/ares/

## PROJECT DESCRIPTION

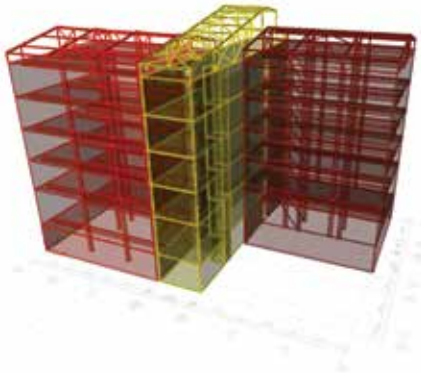
The aim of this research project is to study the role of assessment in the reliability analysis of existing structures. The project focuses on the existing masonry and timber structures and aims to evaluate the benefits of assessment with regard to the economy and safety of structures. In addition to establishment of a strong research group and application to other sources of funding, the main objectives of the project proposal are: to develop concise databases of structures and assessment techniques, to get an insight into material and structural properties obtained by assessments and structural analyses, to produce probabilistic database of material properties for masonry and timber structures, to quantify material properties and time-dependent material behaviour for structural analysis of existing structures, to optimize models for the prediction of structural performance, and to evaluate proportionality and reliability for development of design guidelines.

## PROJECT OUTCOMES

The project aims to deliver the basis for an advanced assessment and design of existing structures, allowing a more economical design and a more accurate analysis of the consequences of failure. Also, methods for updating the assessment and verification of structures will be developed, and due consideration will be given to the time-dependent behaviour and the influence of environmental conditions. Design guidelines for the advanced assessment and rehabilitation of existing structures and for the integration of updating methods in the process of verification of the reliability of existing structures, will be the main benefit of the project. This knowledge will assist in achieving long-term objectives of code-writers and designers in continuous improvement of design codes.

# **Seismic and energy renovation** of existing structures

| | |
|---|---|
| Duration | 20/08/2020 – 20/10/2020 |
| Overall budget | € 4,100 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Asst. Prof. Mislav Stepinac, PhD |



## PROJECT DESCRIPTION

The need to maintain the built environment is supported by global policies, as is clear from, for example, the 1997 Kyoto Protocol and all world congresses related to climate change and its impact on the built environment and construction in general. Long-term global goals are related to sustainable development, which includes implementation of the renovation, maintenance and replacement of existing buildings. It is important to distinguish between two types of existing buildings, defined based on their value. The first type relates to newer existing buildings with higher economic or financial value, while the second type concerns cultural heritage buildings whose value is intangible or cultural in nature. This project will focus on buildings characterised by high financial and material value (residential and industrial buildings). The importance of this research is evident in the preservation and renovation of the existing built infrastructure, and in development of guidelines for simultaneous energy and seismic reinforcement of existing structures.

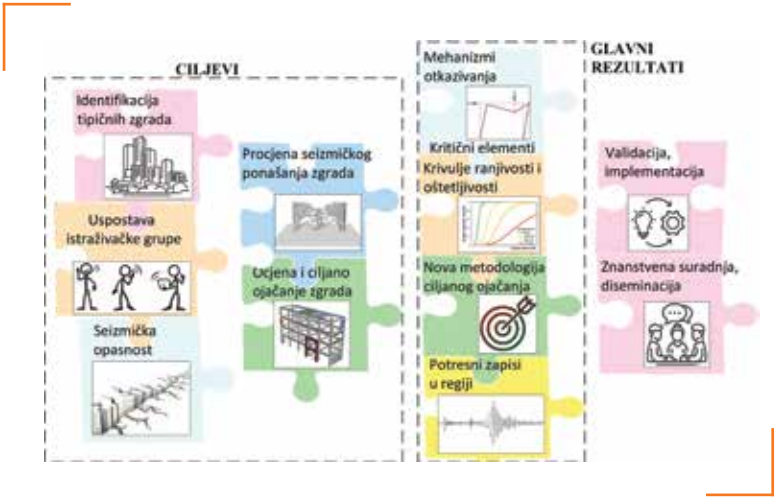
## PROJECT OUTCOMES

The project elaborates ideas for assessing the condition and maintenance of the existing masonry structures, and conceptually discusses models related to the energy and seismic reinforcement of the existing masonry structures. The focus of the research is on seismic risk and the response of the masonry structures most affected by the Zagreb earthquake. The project has also encouraged collaboration with Professor Paulo Lourenco, one of the world's most cited scientists in the field of civil engineering. One of the results of the project is the following joint publication: Stepinac, M.; Lourenço, P.B.; Atalić, J.; Kišiček, T.; Uroš, M.; Baniček, M.; Šavor Novak, M.: Damage Classification of Residential Buildings in Historical Downtown after the ML5.5 Earthquake in Zagreb, Croatia in 2020. Int. J. Disaster Risk Reduct. 2021, 56, 102140.

# **2BESAFE** – New vulnerability models of typical buildings in urban areas: applications to seismic risk assessment and target retrofitting methodology

| | |
|---|---|
| Duration | 01/02/2021 – 31/01/2026 |
| Overall budget | € 146,950 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Assoc. Prof. Mario Uroš, PhD |

Web page: 2besafe.grad.hr/




## PROJECT DESCRIPTION

Although seismic risk should be among key priorities in Southeastern Europe, the activities actually taken to reduce it are very limited. Recent earthquakes in the region have demonstrated that earthquake consequences can be disastrous. In the scope of the proposed project, new methods will be developed, and the existing ones enhanced, as necessary for complete definition and description of seismic structural performance. The project will focus on the building types potentially exhibiting high seismic vulnerability, which represent a significant part of the urban building stock in the region.

## PROJECT OUTCOMES

The level of seismic hazard, depending on seismotectonic conditions, will be defined, and the database of ground acceleration records will be formed, during implementation of this project. Complex collapse mechanisms of the selected structures will be systematically described, new fragility and vulnerability models which do not exist in scientific literature will be developed and, finally, a new methodology for target (optimal) retrofitting of the most vulnerable building types will be developed.

# **ReWire** – Cementitious Composites Reinforced with Waste Fibres

| | |
|---|---|
| Duration | 08/02/2021 – 07/02/2026 |
| Overall budget | € 173,176 |
| Source of funding | Croatian Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Asst. Prof. Ana Baričević, PhD |

Web page: rewire.grad.hr

a) b) c) d)

Waste fibres from the production of high-performance textiles for construction industry:
a) glass fibres – roving end, b) basalt fibres – scrap from production,
c) carbon fibres – roving end, d) glass fibres – scrap from production.

## PROJECT DESCRIPTION

Construction industry is the world's largest consumer of natural resources and is responsible for 25-40% of global carbon emissions. Therefore, collective action is needed to promote transition to a low-carbon economy that is climate neutral, resource efficient and circular. The ReWire project will contribute to the much-needed paradigm shift in engineering solutions. It will enable development of high-performance cementitious materials reinforced with locally available waste fibres and boost awareness of their long-term environmental impacts and life-cycle costs. The ReWire project will address the need to build an internationally recognised research group to keep Croatia competitive in this area of research. At the same time, the project will improve technologies for the use of high-quality waste fibres and develop the scientific background for their application in the construction sector.

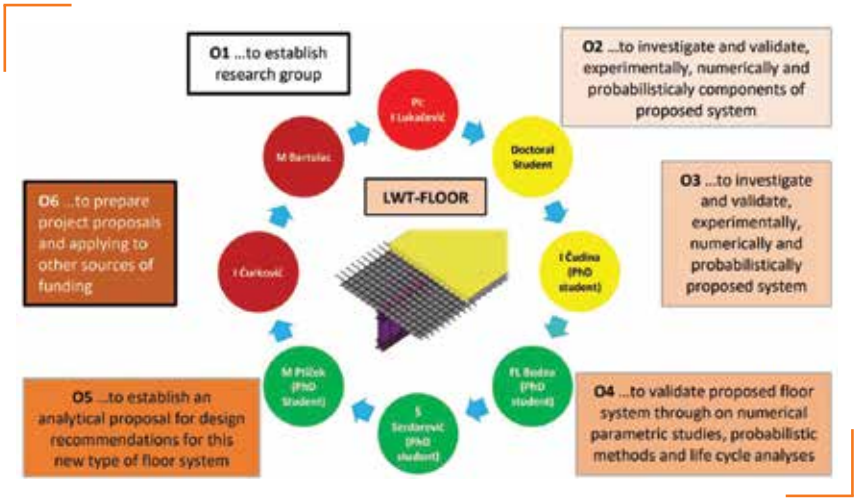
## PROJECT OUTCOMES

The project will analyse the application of carbon, glass and basalt waste fibres from the production of high-performance textiles and recycled tyre polymer fibres as materials for reinforcement of cementitious composites in construction sector. To this end, the quantities of waste fibres available in the region will be identified, and technologies for processing and integration will be developed. The waste fibres will thus become a valuable resource for construction industry and enable development of high-strength fibre-reinforced cementitious materials. In addition, the project will establish a research group dedicated to the research, understanding, and modelling of cementitious composites reinforced with waste fibres, linking scientific organisations by training members of the research group in international centres recognised in this field.

# **LWT-FLOOR** – Innovative lightweight cold-formed steel-concrete composite floor system

| | |
|---|---|
| Duration | 11/01/2021 – 10/01/2026 |
| Overall budget | € 221,162 |
| Source of funding | Croatian Science Foundation |
| Project coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Assoc. Prof. Ivan Lukačević, PhD |

Web page: www.grad.unizg.hr/lwtfloor




## PROJECT DESCRIPTION

The LWT-FLOOR project integrates state-of-the-art knowledge in new, fast and productive spot-welding technology and innovative cold-formed steel-concrete composite solutions, proposing a new construction method as a combination of built-up cold-formed steel members and cast-in-place concrete slab. This lightweight floor system offers vital benefits in terms of a high degree of prefabrication, reusability, and long spanning capability. The extensive experimental, numerical, and probabilistic research is planned within the project. Probabilistic analyses and life cycle performance evaluation of the proposed floor system solution will be crucial for establishing the first analytical proposal for design recommendations of this new system within the European standards.

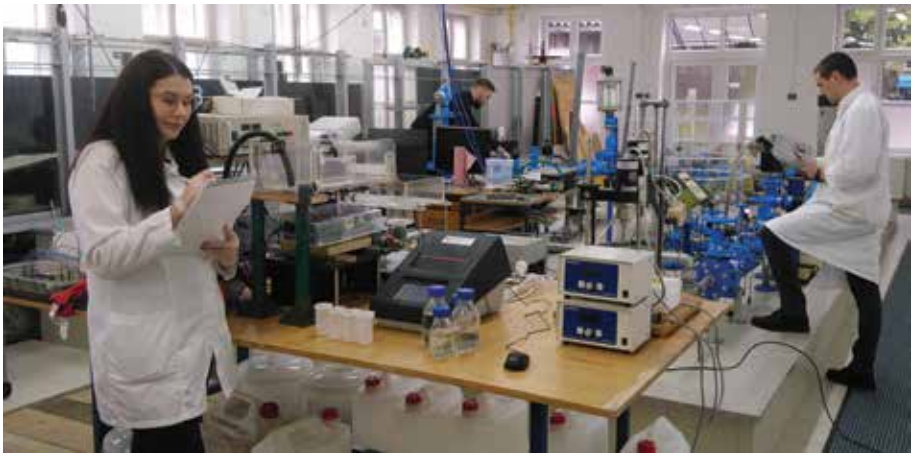
## PROJECT OUTCOMES

- Research group equipped with knowledge and instrumentation.
- Technical report with test results on materials, optimal solutions for welded and shear connections.
- Technical report with test results and optimal solution for steel built-up cold-formed elements with or without web openings.
- Technical report with results for the proposed floor system.
- Report with validation of FEM models for different floor system typologies and results of numerical, probabilistic, and life cycle studies of specimens with larger spans.
- Technical recommendations for design and fabrication will be proposed.
- Research group as a centre of expertise self-sustained through other national and international funding sources.

# **PRIMEUS** – Purification of Microbiologically and Chemically Contaminated Drinking Water by Electrochemical and Ultrasonic Processes

| | |
|---|---|
| Duration | 11/01/2021 – 10/01/2026 |
| Overall budget | € 249,250 |
| Source of funding | Croatian Science Foundation |
| Project coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Asst. Prof. Ivan Halkijević, PhD |

Web page: primeus.grad.hr/



## PROJECT DESCRIPTION

The purpose of the project is to determine the efficiency of electrocoagulation and ultrasound, as advanced oxidation methods for the removal of microbiological contamination and heavy metals in the water purification process. The goal is to develop a small continuous flow device for water purification which will, based on the research, define an optimum configuration of process parameters of electrocoagulation and ultrasound, and to develop the design of the device.

## PROJECT OUTCOMES

The project will result in an innovative and cost-effective water purification process that will successfully remove chemical and microbiological contamination without development of cancerous chlorination by-products. The results will also provide guidelines for the design of water purification systems based on the use of electrochemical and ultrasonic processes. The research will define the competitiveness of these technologies, compared to the conventional water disinfection, through determination of operational costs. In addition, it is expected that the project will result in a successfully developed continuous flow reactor, with guidelines for creating a pilot device with the potential for practical application in public or individual water supply systems.

# COMPETITIVENESS AND COHESION 2014 – 2020

## EUROPEAN REGIONAL DEVELOPMENT FUND

# Research and development of the **E-exchange portal for energy renovation** of buildings and industry

| | |
|---|---|
| Duration | 01/03/2018 – 31/08/2019 |
| Overall budget | € 178,387 |
| Source of funding | European Regional Development Fund |
| Project coordinator | Speculum Ltd. |
| Partner | University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Prof. Ivana Banjad Pečur, PhD |

Web page: speculum.hr/eng/


## PROJECT DESCRIPTION

The E-Exchange of Energy Renovation portal is a unique platform that answers the most frequently asked questions about energy renovation and provides interesting information for everyone involved in the process. The overall goal of the project is to increase the competitiveness, modernization, and diversification of Croatian economy by improving cooperation of the business sector with R&D institutions, by strengthening the capacity of companies for research, development, and innovation, and by developing new products and creating jobs.

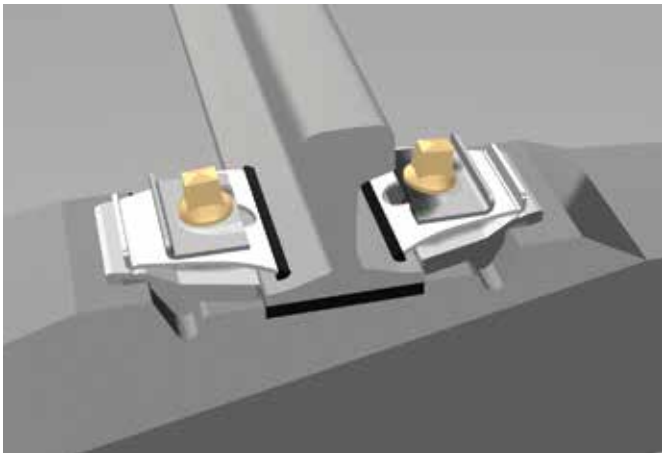
## PROJECT OUTCOMES

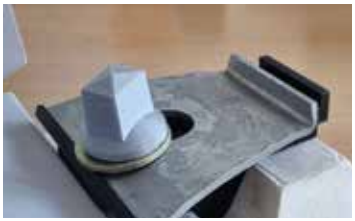
- Defined scope of energy renovation.
- Defined socio-economic and legislative aspects of energy renovation.
- Development of an electronic exchange and establishment of an internet portal of energy renovation.
- Application for intellectual property protection (trademark protection).
- Research and development of construction aspects of energy renovation.
- Final evaluations of the phases of industrial research and experimental development, and of the research and development project as a whole.
- Informing the general public and the target group of stakeholders about the implementation of the project and its results, and demonstrating the visibility of the project.

# Development of **DIV** elastic railway clamp

| | |
|---|---|
| Duration | 01/07/2018 – 01/07/2023 |
| Overall budget | € 3,311,686 |
| Source of funding | European Regional Development Fund |
| Project coordinator | DIV Ltd. |
| Partner | University of Zagreb Faculty of Civil engineering |
| Project leader at the Faculty | Prof. Stjepan Lakušić, PhD |

Web page:
www.divgroup.eu/en/research-and-development-projects/development-of-div-elastic-railway-clamp/





## PROJECT DESCRIPTION

Elastic clamps are used to fasten rail tracks to sleepers. A key objective of the project is to develop an elastic railway clamp that could be easily and economically produced, while also being simple, quick, and reliable for assembling/disassembling – providing long-lasting and reliable connection between railway sleepers and rails throughout their entire service life. The research and development program aims to enable development of a functional and innovative product - DIV elastic railway clamp - and, consequently, its placement and commercialization on the world market of construction and maintenance of railways.

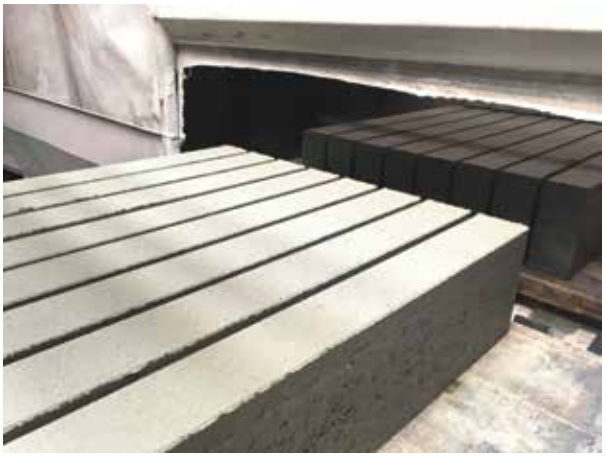
## PROJECT OUTCOMES

- A new type of elastic fastening system for railways.
- Easy installation and easy tightening check of the fastening system.
- Noise and vibration reduction at the fastening level.
- Anti-vandal protection.
- Tested and certified product.
- Product protected by patent.

# Development of innovative construction products using bio-ash

| | |
|---|---|
| Duration | 01/02/2019 – 01/02/2023 |
| Overall budget | € 632,906 |
| Source of funding | European Regional Development Fund |
| Coordinator | Beton Lučko RBG d.o.o |
| Partner | University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Prof. Nina Štirmer, PhD |

Web page: www.betonlucko.hr/razvoj-inovativnih-gradjevnih-kompozita-primjenom-biopepela.html



## PROJECT DESCRIPTION

The overall objective of the project is to contribute to the strengthening of the economy through application of research and innovation in construction industry by developing innovative environmental products, technologies, and business processes. Innovative products – construction composites with bio-ash – are a solution to the problem of the wood biomass ash disposal as well as to environmental greenhouse gas emission problems. Industrial research includes a review of the state-of-the-art in the field, characterization of wood biomass, characterization and assessment of bio-ash effects on the properties of construction composites, while experimental development includes an in-plant demonstration of selected technologies.

## PROJECT OUTCOMES

- Development of innovative products from ecological construction composites as a result of research, development, and innovation activities.
- Improvement of technological processes in construction industry.
- Closer cooperation with scientific research institutions in applied research activities.

# **ASAP** – Autonomous system for assessment and prediction of infrastructure integrity

| | |
|---|---|
| Duration | 20/12/2019 – 19/12/2022 |
| Overall budget | € 950,949 |
| Source of funding | European Regional Development Fund |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | University of Zagreb Faculty of Electrical Engineering and Computing, and University of Zagreb Faculty of Mechanical Engineering and Naval Architecture |
| Project leader | Asst. Prof. Marijana Serdar, PhD |

Web page: asap-project.com/en/


## PROJECT DESCRIPTION

Road and railway infrastructure buildings require more rational planning of maintenance activities in order to minimize the consequences of their inevitable degradation. Proper maintenance of this type of buildings can greatly increase user safety and reduce the risk of collapse. The project is focused on the development of an autonomous robotic system and unmanned aerial vehicle using detailed inspection methods. Combining the developed systems with numerical modelling of structures will enable assessment of their load-bearing capacity and service life, timely response, and ultimately lower maintenance costs.

## PROJECT OUTCOMES

The project activities will lead to the achievement of main results which will be transferred in the form of knowledge transfer to teaching, scientific and professional activities. The most important result of the project is the creation of a new product – an autonomous measuring system for testing structures based on a climbing robot and an unmanned aerial vehicle. Next, a conceptual protocol will be created to link the data obtained by testing the structures and numerically predicting the load-bearing capacity and service life of the structure. Finally, the result of the project will be the creation of an ASAP training program to train potential project beneficiaries.

# Advanced monitoring of soil salinization risk in the Neretva Delta agroecosystem

| | |
|---|---|
| Duration | 01/01/2020 – 01/01/2023 |
| Overall budget | € 395,976 |
| Source of funding | European Regional Development Fund |
| Coordinator | University of Zagreb Faculty of Agriculture |
| Partners | Ruđer Bošković Institute; Croatian Geological Survey; University of Zagreb Faculty of Electrical Engineering and Computing; University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Prof. Neven Kuspilić, PhD |

Web page: www.deltasal.hr/

DELTASAL

## PROJECT DESCRIPTION

The aim of the project is to develop and implement an advanced system for the monitoring, forecasting and reporting the water and soil conditions in the Neretva Delta agroecosystem that is primarily used for agriculture. The selected pilot location is specific due to its biodiversity – water network within the delta consists of the surface irrigation and drainage canal network, karst aquifer dominated by the tidal regime while also replenished by freshwater from the upstream river flow, all of which is used for citrus fruits production while at the same time influencing the water regime of the adjacent protected salt marshes ecosystem. Salt water intrusion is present in the entire delta, which is reflecting on the irrigation water quality and, subsequently, on the agricultural production of citruses which are salt-sensitive horticultural crops.

## PROJECT OUTCOMES

An extensive spatial and temporal monitoring of water quality data through multisensory monitoring stations will be used for development of guidelines for salt stress alleviation in citrus fruits. The monitoring is focused on the continuous real-time measurement of surface water levels and index water velocity, using radars, shallow and deep piezometers for monitoring ground water levels, rain gauges, and multiparameter water quality measurements (dissolved oxygen, water depth, electrical conductivity, total dissolved solids, salinity, pH, oxidation reduction potential, temperature, nitrate and chloride). The data are transmitted in real-time to the cloud-based interface for remote access. The integrated data management will be used in the upcoming project stages for analysing the impact of the salt water intrusion on the Neretva Delta agricultural production. The final outcome of the project are the Neretva Delta management guidelines with the future outlook in the climate change context, compliant with UNFCCC convention according to which this area is one of the most vulnerable areas in Croatia.

# Development of concrete for sustainable construction in marine environment

| | |
|---|---|
| Duration | 17/02/2020 – 17/08/2023 |
| Overall budget | € 1,958,279 |
| Source of funding | European Regional Development Fund |
| Coordinator | TPA održavanje kvaliteta i inovacija Ltd. |
| Partners | University of Zagreb Faculty of Civil Engineering; Pomgrad inženjering Ltd. |
| Project leader at the Faculty | Assoc. Prof. Ivan Gabrijel, PhD |

Web page: www.tpaqi.com/databases/internet/_public/content30.nsf/web30?Openagent&id=DE-TPAQI.COM_EU_hr.html

## PROJECT DESCRIPTION

The main problems tackled within this project are the insufficient research and development capacities of TPA and Pomgrad companies, which are the prerequisites for the development of innovative products and, at the same time, for broadening the cooperation between these companies and the scientific and research sector. In addition, the purpose of the project is to develop innovative concrete mixtures that enable sustainable construction in the marine environment. Striving for the recycling of industrial by-products while maintaining robustness in terms of durability requires optimization that will produce the most favourable environmental and economic effects.

## PROJECT OUTCOMES

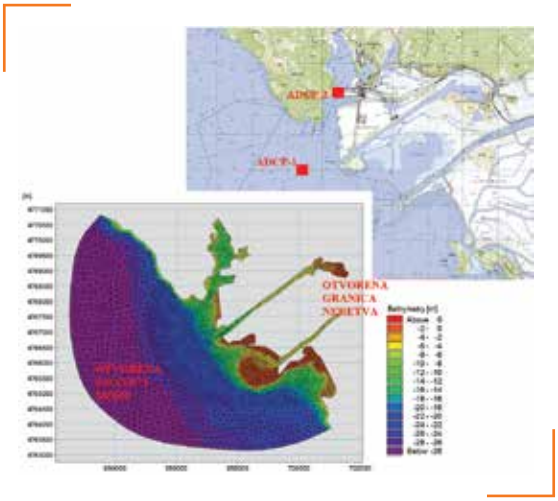
The aim of the project is to improve the innovation and competitiveness capacities of TPA and Pomgrad companies through research activities and development of innovative concrete mixtures. Three innovative concrete mixtures for sustainable construction in the marine environment will be developed in the scope of the project. The work includes two thematic priority areas S3, through strengthening research, development and innovation capacity of TPA and Pomgrad companies, and cooperation with the University of Zagreb Faculty of Civil Engineering.

# PROTECTAS

## Development of system for control and protection of ports from introduction of alien species

| | |
|---|---|
| Duration | 01/06/2020 – 31/05/2023 |
| Overall budget | € 423,170 |
| Source of funding | European Regional Development Fund |
| Project coordinator | University of Dubrovnik |
| Partners | University of Zagreb Faculty of Civil Engineering, Ruđer Bošković Institute, Teaching Institute of Public Health of Primorsko-Goranska County, University of Rijeka Faculty of Maritime Studies |
| Project leader at the Faculty | Assoc. Prof. Dalibor Carević, PhD |

Web page:
protectas.com.hr/en/protect-adriatic-sea-english/




## PROJECT DESCRIPTION

The spreading of species and their settlement in new habitats has begun with the development of first living organisms on the Earth. However, the transfer of species to the areas where they did not exist before, and which they could not reach naturally, has accelerated as a result of human activity. The majority of the present-day transport of cargo takes place by sea, and the ships, in addition to cargo, transport various marine organisms found in ballast waters. As part of the ProtectAS project, five partner institutions will conduct interdisciplinary research in the busiest Croatian cargo ports, Ploče and Rijeka. In addition to the determination of abiotic factors, the composition of planktonic communities, and the presence of viruses and pathogens, the marine currents in these ports will be modelled on the basis of field measurements to determine the dynamics of the spreading of species in ports.

## PROJECT OUTCOMES

The aim of the project is to collect data for an effective protection of port areas from the introduction of foreign and harmful species via ballast water carried by ships. The research conducted in two ports (Ploče and Rijeka) will provide the following information 1. an overview of marine circulation in the ports of Ploče and Rijeka based on numerical modelling, 2. a list of identified species of pathogens, phytoplankton and zooplankton in the ports of Ploče and Rijeka with categorization of harmful species (toxic / foreign / invasive alien species), 3. a review of the dynamics of the spread of planktonic species within the ports of Ploče and Rijeka and towards the open waters of the Adriatic, and 4. an overview the influence of abiotic factors and meteorological conditions on pathogens in the ports of Ploče and Rijeka. The main result of the ProtectAS project is the development of the document entitled „System of control and defence of ports from the introduction of alien species".

# Centre for Research and Development of Safe and Sustainable Built Environment

| | |
|---|---|
| Duration | 29/06/2020 – 12/02/2022 |
| Overall budget | € 633,962 |
| Source of funding | European Regional Development Fund |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Prof. Stjepan Lakušić, PhD |

Web page: centar-borongaj.grad.hr/

## PROJECT DESCRIPTION

The purpose of the project is to develop the project documentation that will enable establishment of a Centre for Research and Development of Safe and Sustainable Built Environment, which involves investing in research, development and innovation infrastructure, and implementing organizational reform of the Faculty of Civil Engineering, with the aim of accelerating the process of transforming the Faculty into an internationally competitive scientific institution that creates a new added value in terms of scientific, social, and economic development.

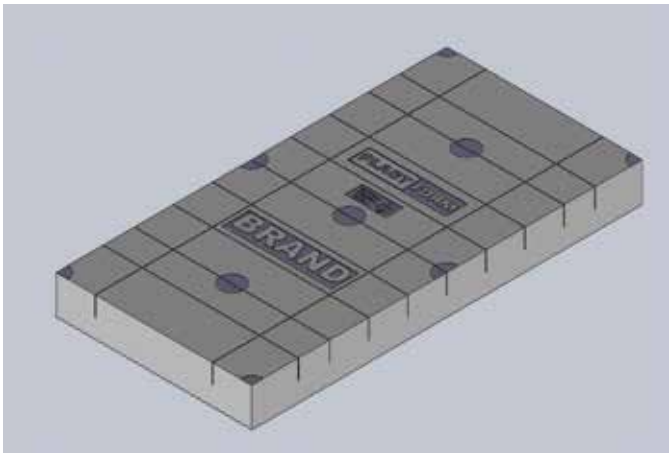
## PROJECT OUTCOMES

- Contribution to smart development and improvement of the competitive performance of the Republic of Croatia by investing in a research system open to innovation, which meets the needs of the economy.
- Positive impact on strengthening the research capacities of the Faculty of Civil Engineering for the implementation of top scientific research
- Contribution to smart and sustainable development through concrete examples of the balance established between environmental, social and economic goals (positive impact on green public procurement, climate challenges, principles of green growth and resource efficiency)
- After establishment of the Centre, research will be conducted in all development segments of construction through the work of individual research units related to the organization of the faculty and its 9 institutes and 5 laboratories

# Development and research of **PLASTOPOR compact** EPS (F) board

| | |
|---|---|
| Duration | 05/03/2020 – 04/09/2023 |
| Overall budget | € 1,356,568 |
| Source of funding | European Regional Development Fund |
| Project coordinator | Plastform Ltd. |
| Partner | University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Prof. Ivana Banjad Pečur, PhD |

Web page: www.plastform.hr/novosti.php




## PROJECT DESCRIPTION

The project involves development of a new construction product with optimized properties, intended for the construction and renovation of nearly zero energy buildings. The aim is to achieve an environmentally friendly technology for the production of boards, and to implement a production line modernisation project by purchasing new machinery for the production of modern thermal insulation PLASTOPOR compact EPS F boards with improved properties, compared to panels presently available on the market.

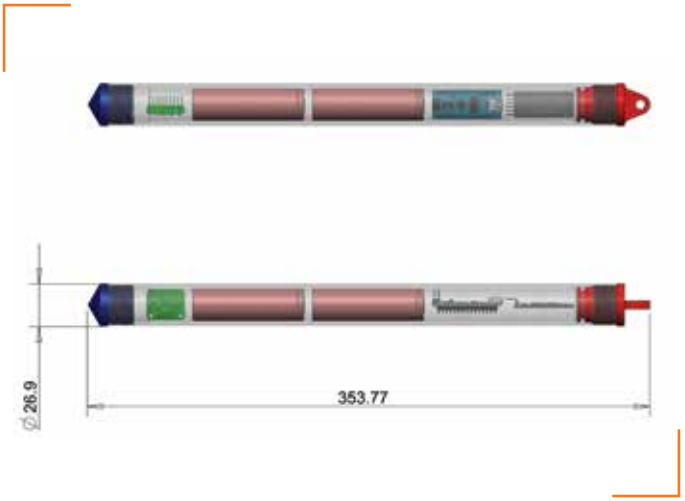
## PROJECT OUTCOMES

The result of the project is the development and optimization of a new thermal insulation board PLASTOPOR compact EPS F with improved thermal insulation and fire-resistant properties.

# Sensor system for continuous monitoring of pavement performance under load

| | |
|---|---|
| Duration | 14/08/2020 – 14/08/2023 |
| Overall budget | € 864,927 |
| Source of funding | European Regional Development Fund |
| Coordinator | Geoprojekt JSC, Split |
| Project leader at the Faculty | Prof. Tatjana Rukavina, PhD |

Web page: geoprojekt.hr/hr/sustav-senzora-za-kontinuirano-pracenje-ponasanja-kolnicke-konstrukcije-pod-opterecenjem




## PROJECT DESCRIPTION

Pavement deflection is measured as the vertical deflected distance from the surface, resulting from an applied load (either static or dynamic). When a pavement structure is properly designed and built, this deflection is relatively small and almost entirely reversible (elastic). In a weak and distressed pavement, deflection is much higher, and part of it remains after unloading (plastic). The magnitude of deflection is inversely proportional to the load-bearing capacity of the pavement, and it is generally accepted that pavement deflection can be used as an indicator of its structural condition. A sensor system for continuous monitoring of pavement behaviour under load will be developed in the scope of the project. The measuring hardware-sensor units will continuously provide real-time information to the investor and road manager about pavement condition. The sensor system will be able to register anomalies and alert road managers about irregularities. Using such system, responsible agencies could undertake pavement rehabilitation and reconstruction measures in due time. Therefore, pavement degradation and significantly higher costs of its rehabilitation will be avoided.

## PROJECT OUTCOMES

- Development of sensor system for continuous monitoring of pavement behaviour under load.
- Development of methodology for the installation, measurement and analysis of measurement results obtained by sensor system.

# Development of new innovative product **ECO$_2$Flex**

| | |
|---|---|
| Duration | 17/08/2020 – 16/08/2023 |
| Overall budget | € 3,667,433 |
| Source of funding | European fund for regional development |
| Coordinator | Calucem Ltd., Pula |
| Partners | University of Zagreb Faculty of Civil Engineering; Calucem GmBH, Mannheim, Germany |
| Project leader | Asst. Prof. Marijana Serdar, PhD |

Web page:
www.grad.hr/latom/index.php/hr/ecoflex


## PROJECT DESCRIPTION

The $ECO_2$Flex project is based on the development of a new product and an innovative production process aimed at reducing $CO_2$ emissions. By combining Calucem Ltd.'s own patented calcium aluminate cement (CAC), with selected $CO_2$ -neutral cementitious materials, a new type of cementitious binder is being developed, a unique product on the world market. The new product, called $ECO_2$Flex, is an innovative technological solution in the cement industry enabling reduction of $CO_2$ and production energy. As a scientific partner, the Civil Engineering Faculty conducts activities related to the research of reactivity, durability, and microstructure of the developed binder.

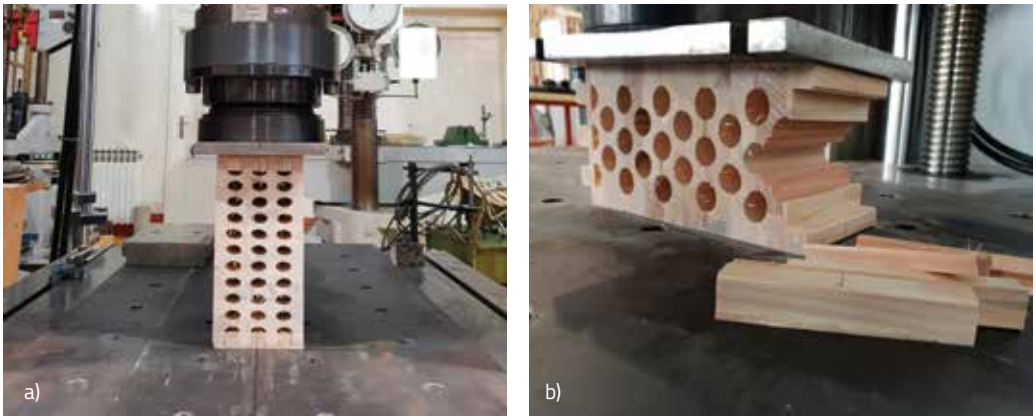
## PROJECT OUTCOMES

The goal of the project is the successful development of $ECO_2$Flex products and the related production process. The implementation of the project will intensify research and development activities by users and partners, and increase cooperation between private and scientific research organizations. In addition to the successful implementation of project management tasks and the efficient use of human, time and financial resources, the successful use of project results will be ensured, and the basis for implementation of $ECO_2$Flex products on the market will be established.

# Development of a modular house using innovative wooden elements

| | |
|---|---|
| Duration | 01/10/2020 – 01/10/2022 |
| Overall budget | € 1,115,907 |
| Source of funding | European Regional Development Fund |
| Coordinator | Tersa Ltd. |
| Partner | University of Zagreb Faculty of Civil Engineering |
| Project leaders | Vlado Šakić (director) and Prof. Vlatka Rajčić, PhD |

Web page: tersa.hr/projekti/




Innovative glued-laminated wooden elements: a) elliptical hollows; b) circular perforations

## PROJECT DESCRIPTION

The project is based on the implementation of collaborative research and development activities - necessary activities of industrial research and experimental development – for the purpose of developing a new higher added-value product. The project includes the phase of architectural design, structural and technological development, production and testing of prototypes and samples, and the implementation of test results in the final product. Due to the mutual transfer of knowledge and technology between the scientific research institution and the economic entity, and the development of an innovative new product through effective cooperation of Tersa Ltd. and the University of Zagreb Faculty of Civil Engineering, the final result will be realized: a modular house – a set of innovative wooden elements.

## PROJECT OUTCOMES

- Development of innovative wooden elements.
- Innovative nature of wood elements that are a new generation of wood products that allow easier construction, assembly, material savings, and global environmental sustainability.
- Defining fire resistance of innovative elements.
- Development of details and joints in innovative wooden elements.
- Development of technology and business processes in order to develop an innovative modular house made of wood.
- Construction of a demonstration facility – a set of innovative wooden elements.

# **KLIK** – Composite Light Steel Framed Panel with an Integrated Load-bearing Structure

| | |
|---|---|
| Duration | 16/12/2020 – 16/12/2023 |
| Overall budget | € 1,117,097 |
| Source of funding | European Regional Development Fund |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | Tehnoplast profili Ltd., Palijan Ltd., Keira Ltd. |
| Project leader at the Faculty | Prof. Ivana Banjad Pečur, PhD |

Web page: www.grad.unizg.hr/klik-panel

KLIK PANEL

Kompozitni lagani panel s integriranom nosivom konstrukcijom

## PROJECT DESCRIPTION

In construction, the goal is to achieve the lowest possible construction cost per unit area with the lowest possible consumption of materials and time, while meeting the increasingly stringent requirements relating to the characteristics of the building. It is well known that the price, quality and characteristics of a building depend on weather conditions at the construction site, on the labour force and the available machinery, which is characteristic of the traditional construction process. The aim of the project is to develop an innovative lightweight composite panel with integrated load-bearing structure to be used for the construction of prefabricated nearly zero energy buildings in an industrial way.

## PROJECT OUTCOMES

Research and development activities in this project will develop panels with the following advantages:

- integrated steel structure made of open thin-walled C-profiles,
- good thermal and diffusion properties for use in nearly-zero energy buildings (NZEB)
- required fire resistance.

# **NORMENG** – Development of an automated system for standardization of resources in energy efficient construction

| | |
|---|---|
| Duration | 16/12/2020 – 15/12/2023 |
| Overall budget | € 831,123 |
| Source of funding | European Regional Development Fund |
| Project coordinator | University of Zagreb Faculty of Civil Engineering |
| Partner | Normag expert, Simple Ltd. |
| Project leader at the Faculty | Prof. Ivica Završki, PhD |

Web page: www.normeng.eu/

## PROJECT DESCRIPTION

The construction sector is one of the pillars of economic development and has a significant impact on the environment. The construction process consumes large amounts of resources (materials, workers, and machinery). Unlike most developed countries, the Republic of Croatia does not have modern standards of resources according to which participants in construction can more effectively assess, contract, and perform construction work. In addition, the standards currently in use date back to 1986 and are not in line with energy-sustainable construction and related regulations. Therefore, the aim of this project is to develop an innovative technological solution for the standardization of construction resources. The solution will be applied to six basic professions for green building. The results will be reflected in the published standards.

## PROJECT OUTCOMES

- A concise description of standard cost items.
- Definition of general technical conditions.
- Proof of applicability of new technologies in the standardization process (production methods).
- Creation of a database of standards (material, machine, work) in printed and digital form, which is compliant with the IFC BIM standard and the EU standards

# Development of new technologies and services in the field of special construction works

| | |
|---|---|
| Duration | 01/03/2021 – 01/09/2023 |
| Total cost | € 1,504,246 |
| Source of funding | European Regional Development Fund |
| Lead Institution | Spegra Ltd., Split |
| Partner | University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Asst. Prof. Ana Baričević, PhD |

Web page:www.spegra.hr/hr/home/eu-1
projekti.grad.hr/projekt/razvoj-novih-tehnologija-i-usluga-u-izvodenju-specijalnih-gradevinskih-radova

Rehabilitation of the Krk bridge

## PROJECT DESCRIPTION

Development of new technologies and services in the field of special construction works, focusing on the protection of cultural heritage, prevention of natural disasters, protection of the coastal area and reconstruction of infrastructure. The main challenge is to reduce the use of new resources, increase overall safety of the existing structures, enable preservation of cultural heritage and prevent uncontrolled urbanization of rural, green, coastal and protected areas.

## PROJECT OUTCOMES

Expected research and development outcomes include: an innovative technology for coastal environmental rehabilitation using recycled materials (harbours, docks, piers, breakwaters, and other coastal infrastructure), development of high-performance products (repair mortars) and a service for infrastructure rehabilitation using the newly developed products. In addition, the goal of the project is to develop a digitized knowledge database. The database will contain information on innovative technological rehabilitation methods for various types of buildings.

# Seismic vulnerability assessment of buildings – development of a system for automatic damage detection

| | |
|---|---|
| Duration | 06/2021 – 12/2021 |
| Overall budget | 2 contracts (€ 15,000 + €15,500) |
| Source of funding | Innovation vouchers for SMEs – European Structural and Investment Funds |
| Coordinator | AIR-RMLD Ltd. |
| Partner | University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Asst. Prof. Mislav Stepinac, PhD |

## PROJECT DESCRIPTION

The aim of the project is to transfer expertise and technical knowledge in the use of highly sensitive cameras in the analysis of seismic damage, primarily in culturally protected urban cores, which is applicable in the rapid post-earthquake assessment of damaged buildings.

## PROJECT OUTCOMES

A methodology for surveying cities from the air and providing assistance in the evaluation of buildings after the earthquake was developed within the project. Also, the same methodology can be used for pre-seismic situations and for the assessment of seismic damage and, finally, seismic risk. Very valuable data (better than expected) were collected, and will be used for further improvement of the assessment of seismic damage to buildings in order to develop an innovative automatic damage detection system. The cooperation between „drones" and „designers" has proven to be excellent, and we believe that development of this service is crucial for the development of a complex service. The expected result, which is a simple, fast and efficient method of data collection and identification of key indicators for seismic vulnerability of urban cores, has been fully achieved in the scope of the project.

# In-situ acoustic properties determination of **RUCONBAR** noise barriers on a railway line

| | |
|---|---|
| Duration | 2021 – 2022 |
| Overall budget | € 14,530 |
| Source of funding | Innovation voucher for MSP European Regional Development Fund, OP Competitiveness and cohesion 2014 – 2020 |
| Project coordinator | Beton Lučko Ltd. |
| Partner | University of Zagreb Faculty of Civil Engineering |
| Project leader at the Faculty | Asst. Prof. Ivo Haladin, PhD |

## PROJECT DESCRIPTION

RUCONBAR innovative barriers for noise protection were applied for the first time in 2014. The location where practical usability of this innovative product was proven was on a section of the state road, near toll stations for the Island of Krk. The product was also applied for railway noise protection on the railway line Oštarije-Knin-Split in Croatia. A total of 5 walls with a total surface area of absorbing panels of 1011 $m^2$ were built at the Perušić-Gračac subsection. This project is important because it was the first application of noise barriers on a railway section in the Republic of Croatia. Significant future investments in railway infrastructure in the Republic of Croatia are the motivation for the implementation of project activities aimed at optimizing RUCONBAR barriers for use on railways, and for proving their effectiveness and better positioning in the very competitive market of noise barriers. The projects defined in the tender documentation are characterized by increasingly demanding requirements for the products for implementation of noise protection on railways. An increasingly common requirement is the proven in-situ acoustic performance of the product. The installation of RUCONBAR barriers along the section of the Oštarije-Knin-Split line enabled implementation of this type of testing on railway infrastructure and proved the in-situ acoustic performance of this type of concrete barriers for noise protection.

## PROJECT OUTCOMES

The planned tests for proving acoustic performance and optimization of RUCONBAR products include: determination of sound reflection according to HRS CEN/TS 16272-5:2014, determination of insertion loss according to HRN EN ISO 10847 and measurement of environmental noise according to HRN ISO 1996-2. Realisation of the tests on RUCONBAR noise protection walls provides: possibilities for additional optimization of the RUCONBAR noise barrier system, the possibility for participating in an increasing number of tenders for the installation of noise protection systems on railway infrastructure in the Republic of Croatia and other EU members and a competitive edge compared to products without confirmation of properties according to the above mentioned standards.

# COMPETITIVENESS AND COHESION 2014 – 2020

## EUROPEAN SOCIAL FUND

# **CPD4GB** – Continuous Professional Development for Green Building

| | |
|---|---|
| Duration | 01/03/2018 – 29/02/2020 |
| Overall budget | € 153,247 |
| Source of funding | European Social Fund |
| Project coordinator | Croatian Engineering Association |
| Partner | Croatia Green Building Council, the Croatian Association of Civil Engineers, and the following higher education institutions of the University of Zagreb: Faculty of Architecture, Faculty of Civil Engineering, Faculty of Forestry, and Faculty of Agriculture |
| Project leader at the Faculty | Prof. Ivana Banjad Pečur, PhD |

CPD4GB
RAZVOJ PROFESIONALNIH KOMPETENCIJA ZA ZELENU GRADNJU
CONTINUOUS PROFESSIONAL DEVELOPMENT FOR GREEN BUILDING

Web page: cpd4gb.com.hr/en/

## PROJECT DESCRIPTION

The main objective of the project is to enable students to work in the field of green building, to establish a sustainable program of socially useful learning, and to strengthen professional and analytical capacities of partner associations.

The objectives of the project were: to train teachers, through acquisition of knowledge from globally recognized experts in the field of green building, so that they can transfer this knowledge to students; to establish cooperation on educational programs between professional associations and higher education institutions; and to involve volunteers / young experts in solving local community problems in specific areas of sustainability.

## PROJECT OUTCOMES

40 students from different parts of the University of Zagreb were trained in the scope of the project. These students developed competencies in the planning, design, construction and management of buildings according to the principles of green building, and thus acquired the basic knowledge to meet the challenges of sustainability and environmental protection in construction. A program of socially useful learning for green building was developed in cooperation with all project partners (associations and higher education institutions).

# **GRASP** – Student Internship at the Faculty of Civil Engineering

| | |
|---|---|
| Duration | 09/03/2020 – 08/03/2023 |
| Contract value | € 498,237 |
| Source of funding | European Social Fund |
| Project holder | University of Zagreb Faculty of Civil Engineering |
| Project leader | Assoc. Prof. Domagoj Damjanović, PhD |

Web page: www.grad.unizg.hr/ck/projektgrasp

GRASP
Stručna praksa na Građevinskom fakultetu

## PROJECT DESCRIPTION

The main goal of the GRASP Project is to improve the study programme by developing a student internship model. The new model includes elective courses entitled *Undergraduate Student Internship and Graduate Student Internship* – both internships lasting twenty working days. The introduction of the new elective courses, the content of which will be defined in cooperation with employers taking into account the needs of the labour market, will provide the students with practical knowledge and facilitate their inclusion in the labour market. The cooperation of the Faculty of Civil Engineering with employers will result in joint innovative activities, and will enable employers to revise their knowledge through a mentoring programme.

## PROJECT OUTCOMES

- Career counselling service established through the Career Centre.
- A digital platform developed for the student internship programme.
- Networking between students of the Faculty of Civil Engineering and potential employers/mentors through the GRADify job fair and student internship.
- Improved student programme and curriculum.
- Improved teaching and non-teaching staff's mentoring and training skills.
- Fully equipped training rooms for development of digital and professional skills.
- Increased employability of graduates, which will have a positive impact on all target groups of the project: undergraduate and graduate students, employers, and teaching and non-teaching staff of the Faculty of Civil Engineering.

# **raSTEMo**: STEM popularization under civil society organizations

| | |
|---|---|
| Duration | 12/05/2021 – 12/11/2022 |
| Overall budget | € 369,360 |
| Source of funding | European Social Fund |
| Coordinator | GTF-Initiative for Sustainable Growth |
| Partners | University of Zagreb Faculty of Civil Engineering; Prvi klaster žena poduzetnica RH „Kolo – kako osnažiti lokalno okruženje" |
| Project leader at the Faculty | Ivana Carević, PhD |



## PROJECT DESCRIPTION

The STEM area has an important role in the application of new knowledge and technologies, especially for achieving the smart and sustainable growth based on knowledge and information. One way to popularize STEM is through civil society organizations. Therefore, the purpose of the project is to strengthen the capacity of civil society organizations in STEM area with an active involvement of children, youth and general population in the popularization program.

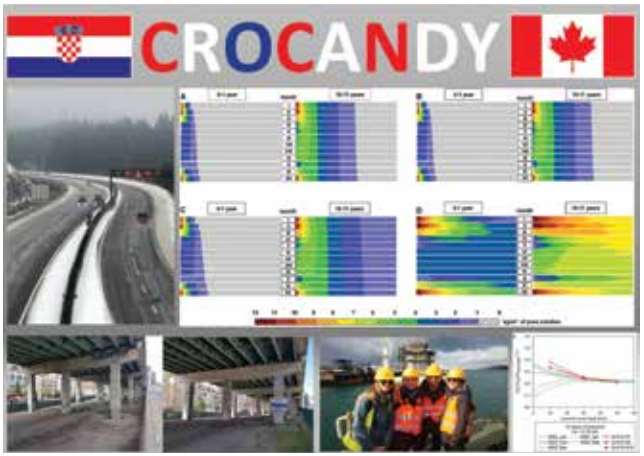
## PROJECT OUTCOMES

The result of the project is the popularization of STEM in the area of construction and reuse of materials for target groups: children, young people, and women through workshops, summer camps, and festivals. The concept varies by target group: workshops and camps for children and young people are designed as outdoor schools where children and young people will learn about sustainable construction and sustainable materials. Innovation camps for women will emphasize the opportunities that STEM area provides in the application of sustainable construction and materials to start their own business.

# BILATERAL COOPERATION

# **CROCANDY**: Durability of reinforced concrete structures – Croatian and Canadian practices

| | |
|---|---|
| Duration | 01/04/2019 – 31/03/2020 |
| Overall budget | € 5,861 |
| Source of funding | Prof. Jasna Šimunić-Hrvoić Foundation Fellowship |
| Coordinator | Faculty of Applied Science and Engineering at the University of Toronto |
| Partners | University of Zagreb Faculty of Civil Engineering; Rijeka – Zagreb Motorway Ltd.; University of Stuttgart Institute for construction materials |
| Project leader at the Faculty | Asst. Prof. Marija Kušter Marić, PhD |




## PROJECT DESCRIPTION

This project analysed the problems of durability of reinforced concrete structures, especially bridges exposed to chlorides from de-icing salts. Bridges on the mountain section of the Rijeka-Zagreb highway, and bridges at the Gardiner Highway in Toronto, Canada, were compared. The following real-world data were analysed and compared: the use of de-icing salt, maintenance and bridge repair methods on Canadian and Croatian bridges. Models for the service life of structures were applied to existing bridges, taking into account damage to structures, but also actual environmental effects (drying - wetting processes, and uneven amounts of water and chloride throughout the year). Numerical results were compared with measurements on structures.

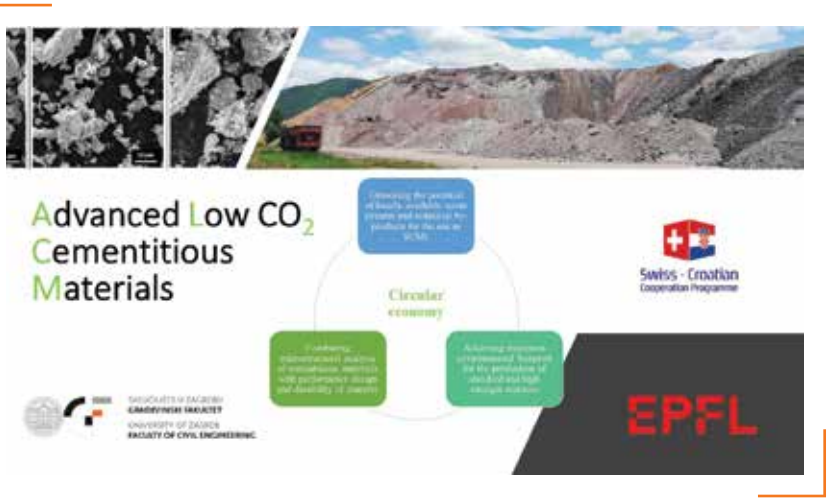
## PROJECT OUTCOMES

- Identification and quantification of various mechanical and environmental factors and their role in the service life of concrete bridges
- Analysis of various bridge rehabilitation methods used in Canadian and Croatian practice.
- Development of a methodology for a more realistic prediction of service life of structures, taking into account damage to structures and actual environmental effects

# **ACT** – Advanced Low $CO_2$ Cementitious Materials

| | |
|---|---|
| Duration | 01/04/2019 – 01/04/2022 |
| Overall budget | € 180,053 |
| Source of funding | Croatian Science Foundation and Swiss National Science Foundation |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | Swiss Federal Institute of Technology Lausanne – Laboratory of Construction Materials |
| Project leader | Asst. Prof. Marijana Serdar, PhD |

Web page: www.grad.hr/latom/index.php/projects/act/




## PROJECT DESCRIPTION

The aim of the project is to optimize the composition of cement and concrete based on partial replacement of cement clinker with locally available waste materials and industrial by-products. This creates a double benefit, i.e., $CO_2$ emissions from the production of ordinary cement clinker are reduced, and the use is made of material that would otherwise be disposed of in landfills. The project focuses on two different aspects of sustainable concrete development researched by two PhD students. On the one hand, it is studied how to achieve minimal impact on the environment in the production of concrete of wide application (strength in the range of 20 to 40 MPa) without special durability requirements. On the other hand, the subject of the analysis is the high-performance concrete for use in buildings exposed to aggressive environments, such as maritime conditions.

## PROJECT OUTCOMES

International cooperation will lead to the development of two doctorates, and the project and joint mentoring will strengthen the cooperation between the Faculty of Civil Engineering and EPFL. Joint mentoring is based on the transfer of knowledge between the two institutions implementing the project: on the one hand, basic knowledge of hydration and microstructure of cement materials provided by EPFL and, on the other, knowledge of designing the composition and durability of concrete elements provided by the Faculty of Civil Engineering. Through the dissemination activities envisaged in the scope of the project, the knowledge gathered from Switzerland will be transferred to the entire region, multiplying the benefits of the project.

# **CRICK** – Climate Resilient Concrete Paving Block

| | |
|---|---|
| Duration | 01/01/2020 – 31/12/2022 |
| Overall budget | € 5.280 |
| Source of funding | Agreement between the Government of the Republic of Croatia and the Austrian Federal Government |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | Technische Universität Wien |
| Project leader | Asst. Prof. Ana Baričević, PhD |

Web page: projekti.grad.hr/projekt/crick-betonski-oplocnik-poboljsane-trajnosti/

Recycled tyre polymer fibres

Wood biomass power plant

## PROJECT DESCRIPTION

The project builds on the results of the previous research projects „TAREC2 – Transformation of wood biomass ash into resilient construction composites", „Development of innovative building composites using biomass ash" and „ANAGENNISI – Innovative Reuse of All Tyre Components in Concrete". The main goal of the project is to improve cooperation between the Faculty of Civil Engineering of the University of Zagreb and the Vienna University of Technology. Within the project, the scientists will jointly investigate possible uses of wood biomass ash and recycled tyre polymer fibres in the development of climate-resistant concrete pavers.

## PROJECT OUTCOMES

Project activities will help build a network of researchers in the field of sustainable cementitious composite development and ensure better understanding of the impact of wood biomass ash and recycled tyre polymer fibres on the durability of cementitious composites.

# MULTILATERAL COOPERATION

# **FEHRL** – Forum of European national Highway Research Laboratories

| | |
|---|---|
| Faculty enrollment | 02/07/2019 |
| Partners/Members | AIT, Austria (+ TUV); ANAS, Italy; BASt, Germany; BFH, Switzerland; BRRC, Belgium; CDV, Czech Republic; CEDEX, Spain DNDI, Ukraine; DTI, Denmark; IBDiM, Poland; KEDE, Greece (+ NTUA); KGM, Turkey; KTI, Hungary; LNEC, Portugal; LVC, Latvia; NPRA, Norway (+ NTNU&SINTEF); PCH, Luxembourg; PWD, Cyprus; RBI, Bulgaria; RWS, Netherlands (+ TNO & TUD); TII, Ireland (+ UCD & TCD); TRL, United Kingdom; UGE – Université Gustave Eiffel; UNIZGFCE, Croatia; UZ, Slovakia; VILNIUS TECH, Lithuania; VTI, Sweden; ZAG, Slovenia |
| Associates | NETIVEI, Israel; TFHRC-FHWA, USA |
| Head of Activities at the Faculty | Prof. Stjepan Lakušić, PhD (Director), Prof. Ana Mandić Ivanković, PhD (Research Coordinator), Assoc. Prof. Mario Bačić, PhD (Research Coordinator Deputy at the Faculty level) |

Web page: www.fehrl.org/

## OVERVIEW OF ACTIVITIES

FEHRL is an international association comprising over thirty national research and technical institutes from across Europe with the mission of promoting and facilitating collaboration on transportation infrastructure research and providing high quality information and advice on technologies and policies related to roads. Associates from non-European countries provide FEHRL with strong links to the considerable research capacity available globally. Through the specification and delivery of research, FEHRL's main objectives are to:

- Provide scientific input to European and national government policy on highway engineering and road transport matters.
- Create and maintain an efficient and safe road network in Europe.
- Increase innovation in European road construction and road-using industries.
- Improve the energy efficiency of highway engineering and operations.
- Protect the environment and improve quality of life.

## DELIVERABLES

The priorities of research in the field of transport infrastructure are discussed within this association, and are then proposed to the European Commission. In addition, workshops are held and consortia are formed that plan and develop applications for European tenders such as: CEDR 2020, Horizon 2020, European Green Deal, HEU Call 2021, and HEU Call 2022. Through FEHRL membership, the Faculty also receives important information, such as the 2021 Webinar on How to prepare a successful proposal in Horizon Europe. The association also conducts internal activities such as BD Pave, Bearing Capacity Measurement at Traffic Speed, Low Noise Pavements, Connected Data for Effective Collaboration, and New Concepts for Assessment and Maintenance of Road Assets. FEHRL is one of the partners in the Horizon 2020 project SAFE-10-T Safety of Transport Infrastructure on the TEN-T Network described in the first part of the brochure.

# UNITY THROUGH KNOWLEDGE FUND (UKF)

# **CODEbridges** – Influence of concrete damage on reinforcement corrosion – computer simulation and in service performance of bridges

| | |
|---|---|
| Duration | 16/10/2017 – 15/01/2019 |
| Overall budget | € 48,214 |
| Source of funding | Unity trough knowledge fund (UKF) |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | University of Stuttgart Institute for construction materials; Croatian Motorways Ltd.; City of Zagreb; County roads of Krapina-Zagorje County; Croatian State Roads Ltd.; University of Stuttgart – Materials Testing Institute |
| Project leader | Asst. Prof. Marija Kušter Marić, PhD |

Web page: www.grad.unizg.hr/codebridges


## PROJECT DESCRIPTION

The corrosion of steel reinforcement in concrete caused by chlorides is the main cause of deterioration of reinforced concrete (RC) structures, especially bridges exposed to the sea and/or de-icing salts, and it significantly reduces the durability of the structure. In order to implement sustainable bridge management, the service life of the structures must be determined by numerical models. The main objective of the project is to improve the 3D chemo-hygro-thermomechanical (CHTM) model for a realistic simulation of the process before and after the depassivation of the reinforcing bar in concrete. The project includes a literature review, visual inspections and non-destructive testing on RC bridges, laboratory tests on the permeability of cracked concrete, and numerical modelling of transport and corrosion processes in RC structures considering cracks in concrete.

## PROJECT OUTCOMES

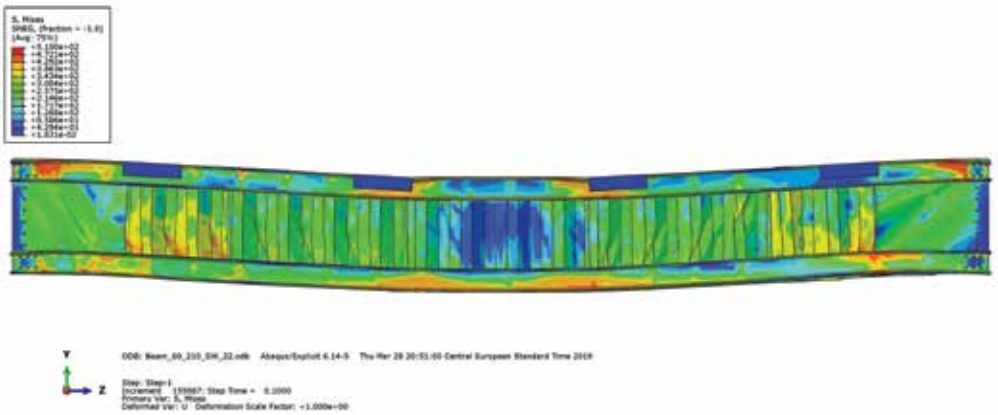
- Development of an improved model for determining the diffusion coefficient of water and chloride in concrete as a function of crack width.
- Determination of the properties of cracks and voids in concrete on structural elements of bridges.
- Determination of the structural elements of bridges that are most vulnerable to cracking and other damage.
- Determination of the structural elements of bridges that are most vulnerable to reinforcement corrosion.
- Development of an empirical model for determining the influence of concrete cracking on reinforcement corrosion.
- Development of numerical models for the simulation of transport and corrosion processes in reinforced concrete structures, including modelling of real cracks and more accurate determination of initial and boundary conditions.

# SPOTWELDED

## Investigations on spot welded built-up cold-formed steel beams

| | |
|---|---|
| Duration | 10/05/2019 – 10/08/2019 |
| Overall budget | € 3,729 |
| Source of funding | Unity through knowledge fund (UKF) |
| Project coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | Politehnica University of Timisoara |
| Project leader | Asst. Prof. Ivan Lukačević, PhD |

Web page: www.grad.unizg.hr/spotwelded



## PROJECT DESCRIPTION

Built-up cold-formed steel elements are efficient structural elements, very attractive due to material savings and ease of construction. The project proposes to investigate a new technological solution for built-up beams made of corrugated steel sheets for the web and thin-walled cold-formed steel profiles for the flanges, connected by economical and effective spot welding. The focus of the project is the calibration and validation of the numerical models based on experimental tests of such elements, which will be followed with parametric numerical studies. Experimental tests with web openings in beams will also provide the basis for parametric studies in the case of application in floor systems of multi-storey buildings.

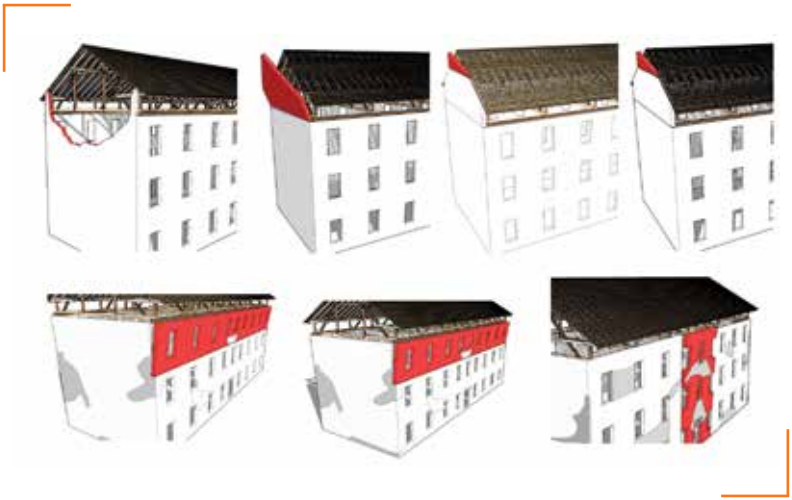
## PROJECT OUTCOMES

- Literature review.
- Preparation of specimens for experimental research.
- Experimental tests on two beams with web openings.
- Calibration of numerical models and optimisation of technical solutions.
- Design and numerical analysis of beams with larger spans.
- Evaluation and interpretation of results in terms of technical-economic performance.
- Dissemination of results.

# Seismic behaviour of multi-storey buildings

| | |
|---|---|
| Duration | 19/06/2019 – 19/09/2019 |
| Overall budget | € 4.600 |
| Source of funding | Unity through knowledge fund (UKF) |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partner | Innorenew CoE, Izola |
| Project leader | Asst. Prof. Mislav Stepinac, PhD |

Web page: www.grad.unizg.hr/earthquake



## PROJECT DESCRIPTION

The main goal of the project proposal is to collect, analyse and compare various „state-of-the-art" principles of the design and behaviour of structures in seismically sensitive areas. Modern structures will be analysed, and special attention will be given to the analysis of wooden and masonry structures.

## PROJECT OUTCOMES

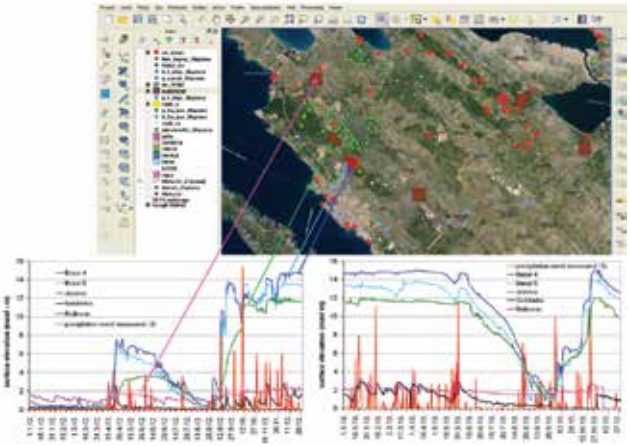
The results of the project are presented in the published scientific article:
Stepinac, M.; Šušteršič, I.; Gavrić, I.; Rajčić, V. Seismic Design of Timber Buildings: Highlighted Challenges and Future Trends. Appl. Sci. 2020, 10, 1380. https://doi.org/10.3390/app10041380

# INTERREG

# **AMIIGA** – Integrated Approach to Management of Groundwater Quality In Functional Urban Areas

| | |
|---|---|
| Duration | 01/09/2016 – 31/08/2019 |
| Overall budget | € 2,959,472 |
| Source of funding | INTERREG Central Europe |
| Coordinator | Central Mining Institute Katowice, Poland |
| Partners | City of Jaworzno, State Capital of Stuttgart, The City of Novy Bydzov, Technical University of Liberec, Lombardy Region, Polytechnic University of Milan, Parma Municipality, Geological Survey of Slovenia, Ljubljana Waterworks and Sewerage, University of Zagreb Faculty of Civil Engineering, Water supply company Zadar |
| Project leader at the Faculty | Prof. Goran Gjetvaj, PhD |

Web page:
www.interreg-central.eu/Content.Node/AMIIGA.html



Groundwater levels at Bokanjac pilot area near Zadar with water supply wells and sources of pollutants (from the GIS database)

## PROJECT DESCRIPTION

The aim of the project was to establish integrated groundwater management practices at a number of locations in Central Europe. Within the project, hydrogeological data for each individual investigated aquifer were collected and systematized, integral pumping tests were performed, and some in situ remediation methods for polluted groundwater were tested. Some experiences in groundwater remediation were exchanged during the project. The possibilities and efficiency of each treatment method were described in a series of workshops in order to introduce as many participants as possible to water management.

## PROJECT OUTCOMES

A GIS database with locations and characteristics of exploration wells in the Bokanjac-Poličnik aquifer was created within this project, and all available hydrogeological data were systematized and entered into this database in order to facilitate groundwater management. An Integral Pumping Test was performed to determine the area from which the pollutants spread. It should be noted that this test was made for the first time in Croatia, and most likely for the first time in karst. A model of groundwater flow in the investigated aquifer was made and very valuable laboratory equipment was purchased for the Zadar Waterworks Laboratory.

# **Prominent MED** – Public pROcureMent of INnovation boosting greEn growTh in MED area

| | |
|---|---|
| Duration | 01/11/2016 – 31/07/2020 |
| Overall budget | € 2,697,049 |
| Funded under | Programme 2014 – 2020 INTERREG VB Mediterranean |
| Coordinator | Sviluppumbria – Società Regionale per lo sviluppo economico dell'Umbria, Italy |
| Partners | Consorci de la Ribera; CIMBAL – Comunidade Intermunicipal do Baixo Alentejo; IrRADIARE – Science for evolution®, Lda.; Comune di Narni; Universitat Politècnica de València; Regionalna energetska agencija Sjever; Grad Koprivnica; Centre Scientifique et Technique du Bâtiment |
| Project leader at the Faculty | Asst. Prof. Bojan Milovanović, PhD |

Web page: prominent-med.interreg-med.eu

## PROJECT DESCRIPTION

The Regional Energy Agency North and the City of Koprivnica are jointly implementing the „Prominent MED" project, the main goal of which is to conduct public procurement for innovations in the field of energy renovation. Among other things, a building in Koprivnica was selected as part of the project. The building was energetically renovated in an innovative way, and guidelines for the procurement of an innovative solution were previously developed. As part of this project, An „Agreement on the implementation of a preliminary market analysis of innovative technologies for energy renovation of prefabricated buildings" was concluded in April 2017 between the Regional Energy Agency North and the Faculty of Civil Engineering – University of Zagreb.

## PROJECT OUTCOMES

- Use of the European Union (EU) innovation procurement procedures (PPI) to encourage development of the innovative energy efficiency technology systems and solutions and their market uptake.
- Study and implementation (testing) of PPI procedures that can be transferred to similar contexts of MED areas.
- The project will enable the involved areas to procure and implement innovations and encourage development of a wide range of innovative products and solutions tailored to their needs.
- Learning areas will have the opportunity to introduce or catalyze PPI procedures in their public procurement policies, thus enabling faster implementation of local strategies and plans aimed at s ustainable development through green growth. At the same time, partners and the clusters involved will have the opportunity to establish close cooperation with each other to create new networks.

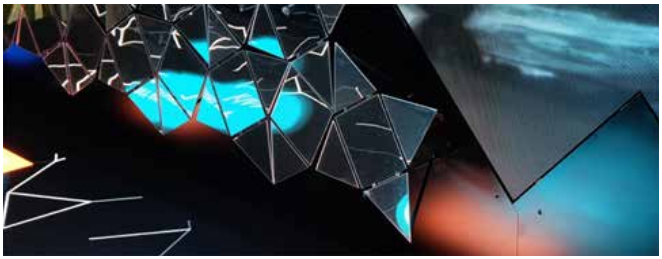
# COST ACTIONS

# COST Action TU1403

## „Adaptive Facades Network"

| | |
|---|---|
| Duration | 28/10/2014 – 30/11/2018 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | Lucerne University of Applied Science and Arts, Horw, Switzerland |
| Coordinators at the Faculty | Prof. Vlatka Rajčić, PhD (member of the management board), Asst. Prof. Mislav Stepinac, PhD and Nikola Perković (substitute members of the Management Board) |

Web page: tu1403.eu/?page_id=209



## PROJECT DESCRIPTION

Multi-purpose and adaptable building envelopes can provide gradual improvements in the energy efficiency and economic value of new and refurbished buildings, while improving the well-being of building occupants. They therefore represent a significant and sustainable contribution to meeting the EU 2020 targets. There is a critical mass of European knowledge, expertise, resources and skills in the areas relevant to adaptive facades, but research efforts on multidisciplinary topics and a wide range of new technologies are scattered across several R&D centres in Europe. This action aims to use this knowledge and thus generate new ideas and concepts at the basic level and the level of product / system development. This will be achieved by creating a research network with a strong multidisciplinary approach, including academics, façade supply chain industry partners, and other stakeholders. The COST action will facilitate the exchange of experimental data, the development of modelling and simulation techniques, and the sharing of common evaluation methods. The work of this COST action is expected to be the basis for leveraging recent technological advances in adaptive facades and energy efficient buildings, and will help train the next generation of facade research and development professionals in Europe.

## PROJECT OUTCOMES

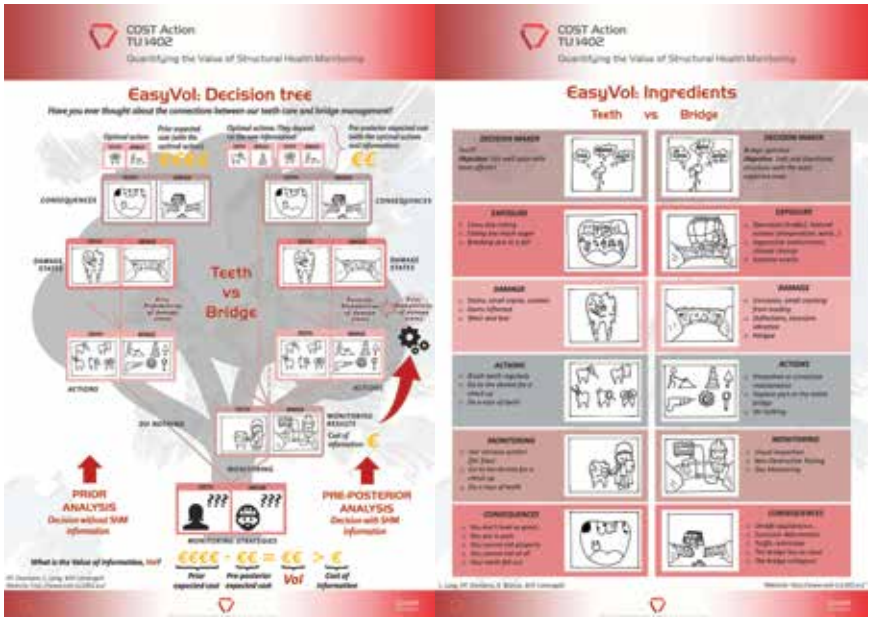
Increased exchange of knowledge between various European research centres and between these centres and industry. Development of new concepts and technologies and / or new combinations of existing technologies for adaptive facades. Development of new knowledge such as effective evaluation tools / adaptive facade design methods. The beginning of new collaborations and research projects in the field of adaptive facade technologies that will continue after the end of this action.

# COST Action TU1402

## „Quantifying the Value of Structural Health Monitoring (SHM)"

| | |
|---|---|
| Duration | 13/11/2014 – 30/04/2019 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Project coordinator | DTU – Technical University of Denmark |
| Coordinators at the Faculty | Prof. Ana Mandić Ivanković, PhD (vice chair) and Prof. Vlatka Rajčić, PhD (MC member for Croatia) |

Web page:
www.cost-tu1402.eu/




## PROJECT DESCRIPTION

The main objective of the Action has been to facilitate sustainable societal developments through improvements of resource efficiency, productivity, robustness, reliability and safety in the design and assets management for structures and infrastructure systems by optimised Structural Health Monitoring (SHM) systems. The Value of Information (VoI) analysis is used as a primary tool for quantification and verification.

## DELIVERABLES

Theoretical framework for VoI analysis is developed, which can be applied on numerous SHM monitoring tools and structure types. The analysis is conducted prior to the implementation of SHM to quantify the cost-benefit of the retrieved data. This framework was applied on several Case Study structures, one of which was proposed and analysed by the Faculty of Civil Engineering – University of Zagreb.

# COST Action TU1404

## „Towards the next generation of standards for service life of cement-based materials and structures"

| | |
|---|---|
| Duration | 18/11/2014 – 17/11/2018 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | University of Minho, Portugal |
| Coordinator and members at the Faculty | Asst. Prof. Marijana Serdar, PhD (leader of working group WG1, MC Croatia), Assoc. Prof. Ivan Gabrijel, PhD (MC Croatia), Martina Grubor (participant) |

Web page: www.tu1404.eu/

# COST ACTION TU1404

## TOWARDS THE NEXT GENERATION OF STANDARDS FOR SERVICE LIFE OF CEMENT-BASED MATERIALS AND STRUCTURES

### PROJECT DESCRIPTION

The main goal of the project is to develop a new generation of guidelines / recommendations for predicting the service life of materials and structures in Europe by integrating the latest developments in experimental and numerical approaches, with special emphasis on concrete properties from an early age. These guidelines will focus on the behaviour of materials and structures, and on recently developed design assistance tools at two levels: (i) experimental methods; and (ii) numerical simulation methods.

### PROJECT OUTCOMES

Better understanding of existing experimental methods for characterization of properties of cement composites and their complementary relationships, through activities of joint interlaboratory tests (working group WG1). Validation of numerical models for predicting behaviour from an early age that have been identified as having a significant impact on life expectancy (WG2 working group). Guidelines and proposals for improving existing standards with regard to the impact of deformations and loads on the durability of concrete structures (Working Group WG3).

# COST Action FP1402

## „Basis of structural timber design – from research to standards"

| | |
|---|---|
| Duration | 25/11/2014 – 25/11/2018 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | Technische Universität München, Germany |
| Coordinator and members at the Faculty | Prof. Vlatka Rajčić, PhD (member of the management board), Asst. Prof. Mislav Stepinac, PhD and Jure Barbalić (substitute members of the Management Board), Nikola Perković, member of Working Group 4 |

Web page: www.costfp1402.tum.de/

## PROJECT DESCRIPTION

The foundation of scientific knowledge in wood engineering has developed tremendously over the last two decades. Although the results are documented, they are inhomogeneous and fragmented, and as such do not provide the wood engineering community with relevant information that would enable the reliable and safe application of newly developed wood products in construction. The aim of the action is to bridge the gap between widely available scientific results and specific information needed by designers, industry, and competent authorities, providing a transfer for the practical application of wood design. This will be achieved by coordinating, consolidating, harmonizing and disseminating recent research and development aimed at improving existing or deriving new design methods and rules for timber structures. The results of this action will contribute to the development of new regulations, and ensure the end-users' safe, durable and efficient use of wood in buildings, and consequently increase its acceptance and use in building design.

## PROJECT OUTCOMES

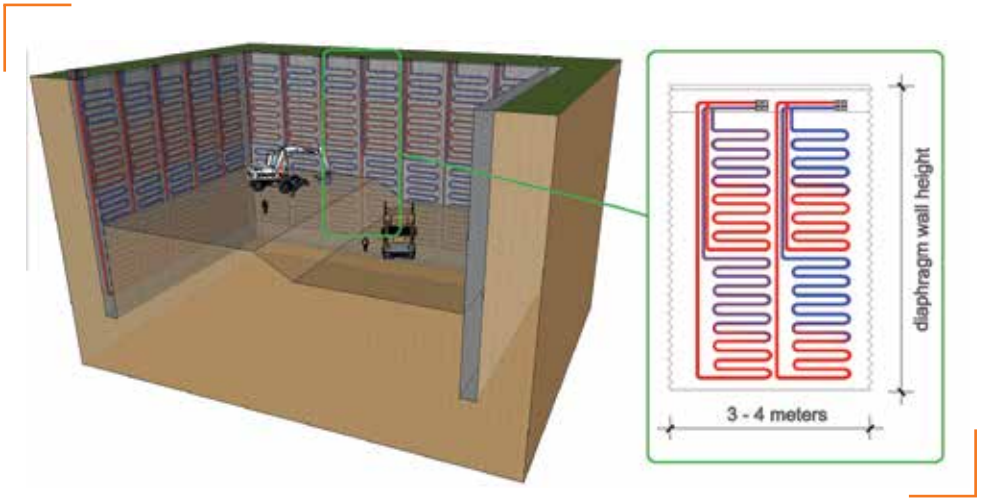
Create a link between the principles of semi-probabilistic design and recent advances in timber construction technology. Develop a framework and procedure on how existing and new technologies can be consistently implemented in design formats. Collect and pre-process information on recent advances in key technologies „Solid wood", „Connections" and „Hybrid timber structures" to be implemented in regulations for the design of timber structures. Encourage communication and optimize collaboration between scientists, industry and all other stakeholders. Promote complementary research, avoiding duplication of research and thus enabling better use of national and European funding.

# COST Action TU1405

## „European network for shallow geothermal energy applications in buildings and infrastructures (GABI)"

| | |
|---|---|
| Duration | 09/03/2015 – 08/03/2019 |
| Funding programme | COST – European Cooperation in Science & Technology |
| Action coordinator | IFSTTAR, France |
| Coordinator and members at the Faculty | Prof. Meho Saša Kovačević, PhD and Assoc. Prof. Mario Bačić, PhD (MC members for Croatia), Asst. Prof. Lovorka Librić, PhD (MC substitute member for Croatia) |

Web page: www.cost.eu/actions/TU1405/




## PROJECT DESCRIPTION

The aim of the project is to develop a European network of researchers and engineers in the field of thermoactive geotechnical structures, such as energy piles, energy retaining walls, and energy tunnels. This network represents an open platform for scientific discussion and definition of European best practices for thermoactive geotechnical structures, and promotes awareness and confidence in this innovative application of geotechnical structures.

## PROJECT OUTCOMES

Developed research network in the field of thermoactive geotechnical structures, publication of several articles in high-impact journals to detect current challenges and promote thermoactive structures technology, application of theoretical approach to several real Case Studies, development of a basis for implementing thermoactive structures in European standards ( Eurocode in particular).

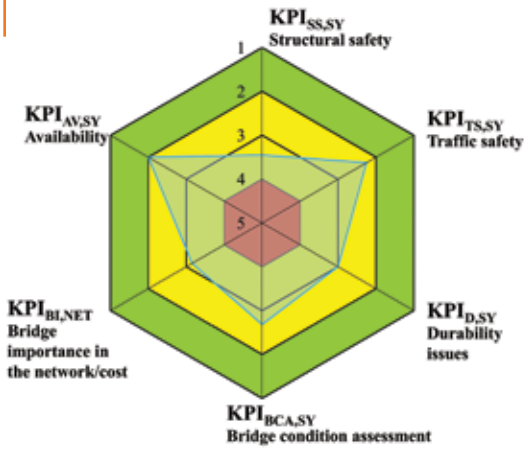
# COST Action TU1406

## „Quality specifications for roadway bridges, standardization at a European level (BridgeSpec)"

| | |
|---|---|
| Duration | 16/04/2015 – 15/04/2019 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Project coordinator | University of Minho, Braga, Portugal |
| Coordinator and members at the Faculty | Prof. Ana Mandić Ivanković, PhD and Asst. Prof. Marija Kušter Marić, PhD (both MC members for Croatia) |

Web page: www.cost.eu/actions/TU1406/
eurostruct.org/

TU1406
COST ACTION




| Indiv. Parts | $KPI_{SS,IP}$ | $KPI_{TS,IP}$ | $KPI_{D,IP}$ | $KPI_{BCA,IP}$ |
|---|---|---|---|---|
| Sidewalk | 2.00 | **2.25** | **3.00** | 2.33 |
| Pavement | 0.69 | 2.08 | 2.08 | 1.72 |
| Girder structure | 2.00 | 2.00 | 1.00 | 2.00 |
| Arch structure | 3.00 | 0.75 | 1.50 | 2.33 |
| Abutment | 0.00 | 0.00 | 0.00 | 0.00 |
| Pillar | **3.45** | 0.86 | 1.73 | **2.68** |
| Drainage | 0.67 | 1.50 | 2.00 | 1.50 |
| **System** | $KPI_{SS,SY}$ | $KPI_{TS,SY}$ | $KPI_{D,SY}$ | $KPI_{BCA,SY}$ |
| Bridge | **3.45** | **2.25** | **3.00** | **2.68** |

## PROJECT DESCRIPTION

The Action aims to bring together, for the first time, both research and practicing community in order to accelerate establishment of a European guideline on the subject of standardization of performance indicators that are used in the assessment of existing bridges.

## DELIVERABLES

Creation of a database of national codes and guidelines and establishment of the corresponding performance indicators for use in bridge assessment and evaluation. Six key performance indicators (KPI) are defined as a means for evaluating bridge parameters such as reliability, serviceability, durability, accessibility, etc. Furthermore, management strategies are defined with different approaches to bridge maintenance actions. As a continuation of the project, the EUROSTRUCT association was founded with the intent to upgrade the project results.

# COST Action CA15125

## „Designs for Noise Reducing Materials and Structures (DENORMS)"

| | |
|---|---|
| Duration | 09/03/2016 – 08/03/2020 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | CNRS – Laboratoire d 'Acoustique de l'Université du Maine, Le Mans, France (Action Chair) |
| Coordinator at the Faculty | Prof. Stjepan Lakušić, PhD |

Web page: denorms.eu/
www.cost.eu/actions/CA15125

## PROJECT DESCRIPTION

The project is implemented to gather together scientists and industry partners dealing with meta materials, meta-surfaces, sonic crystals and conventional porous materials with a goal of developing innovative, light, slim and multifunctional noise reduction materials with enhanced mechanical and thermal properties, and to define objective and subjective methods and standards for the characterisation of performance and exploitation.

## PROJECT OUTCOMES

The DENORMS Action is divided into 3 interacting Working Groups (WG), which complement each other. Each of them aims at specific breakthroughs: WG1. Modelling of sound interaction with noise reducing materials and structures, WG2. Experimental techniques, and WG3. Industrial applications. Numerous laboratory experiments have been performed for the determination of physical, acoustical and other noise reducing properties of materials. New applications of innovative materials have been proposed. Five training schools and eight workshops have been organized, and 46 short term academic visit grants have been awarded.

# COST Action CA15202

## „Self-healing As preventive Repair of COncrete Structures"

| | |
|---|---|
| Duration | 30/09/2016 – 28/03/2021 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | Universitat Politecnica Valencia |
| Members | Prof. Tomislav Kišiček, PhD and Asst. Prof. Mislav Stepinac, PhD (MC members) |

Web page: www.cost.eu/actions/CA15202/

## PROJECT DESCRIPTION

The search for smart self-healing materials and preventive repair methods is justified by the increasing sustainability and safety requirements for structures. The appearance of small cracks in concrete is unavoidable, not necessarily causing a risk of collapse for the structure, but certainly accelerating its degradation and diminishing the service life and sustainability of structures. That loss of performance and functionality leads to an increasing investment in maintenance and/or to intensive repair/strengthening works. The critical nature of such requirements is recognised by their inclusion as priority challenges in the European Research Program.

## PROJECT OUTCOMES

Development of external healing methods for the repair of new and existing reinforced concrete elements.

# COST Action CA15206

## „Payments for Ecosystem Services (Forests for Water)"

| | |
|---|---|
| Duration | 18/10/2016 – 17/04/2021 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Project holder | Forest Research NRS, Roslin, the United Kingdom (Dr. Gregory Valatin) |
| Member | Asst. Prof. Kristina Potočki, PhD (MC member for Croatia) |

Web page: www.cost.eu/actions/CA15206/
www.forestresearch.gov.uk/research/pesforw

## PROJECT DESCRIPTION

The objective of the PESFOR-W COST Action is to synthesize knowledge, provide guidance, and foster collaboration to improve the ability to use Payments for Ecosystem Services in Europe so as to achieve the objectives of the Water Framework Directive by incentivizing forest planting to reduce the delivery of diffuse pollutants from agriculture to water.

## PROJECT OUTCOMES

Establish and publish a spatial repository of forest areas that serve as „water payments for ecosystem services schemes„ (https://www.forestresearch.gov.uk/research/pesforw/casestudies/). Creation and publication of the PESFOR-W Handbook in several European languages (https://www.forestresearch.gov.uk/research/pesforw/user-manual/), leading the UK government to support the development of the Woodland Water Code as part of the England Tree Planting Action Plan 2021-2024, based on the participation of Action members from 40 countries.

# COST Action CA16114

## „REthinking Sustainability TOwards a Regenerative Economy„ (RESTORE)

| | |
|---|---|
| Duration | 09/03/2017 – 30/04/2021 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Project coordinator | Grant Holder: Eurac Resarch, Bolzano, Italy;<br>Action Chair: Carlo Battisti carlo.battisti@living-future.org,<br>Action Vice Chair: Martin Brown fairsnape@gmail.com |
| Coordinator at the Faculty | Asst. Prof. Jelena Bleiziffer, PhD (MC substitute) |


Web page: www.eurestore.eu/



## PROJECT DESCRIPTION

The aim/objective of the RESTORE COST Action was to effect a paradigm shift towards restorative sustainability for new and existing buildings and space design across Europe.

## PROJECT OUTCOMES

Contribution to defining the correct terminology regarding sustainability in the built environment, harmonising this awareness through continuous knowledge transfer among the 100+ organisations (mostly universities and research centres) involved. From a capacity building perspective, collaboration among different types of actors, such as research centres, universities, education entities, companies, NGOs, was increased in the scope of the project. A new 'body of knowledge' was set up, including a number of publications, frameworks, and tools, to be used both by researchers and practitioners to advance the progress in addressing the climate emergency through the built environment. The Action addressed different stages throughout the life of a building as is systematically presented in a series of publications (and by organizing a training school for each of the stages, 5 of them in total), 30 Short Term Scientific Missions were carried out and a tool „Atlas of Solutions" was set up on the web. 8 books were published. In line with the RESTORE regenerative objectives, the Action managed to achieve carbon neutrality.

# COST Action CA16209

## „Natural Flood Retention on Private Land"

| | |
|---|---|
| Duration | 14/09/2017 – 13/03/2022 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | University of Jan Evangelista, Ústí nad Labem, the Czech Republic |
| Coordinator and members at the Faculty | Assoc. Prof. Damir Bekić, PhD (MC member for Croatia), Asst. Prof. Kristina Potočki, PhD (MC Substitute for Croatia, WG member), Martina Lacko, MSc (MC Substitute for Croatia, WG member). |

Web page: www.cost.eu/actions/CA16209/
www.land4flood.eu/

## PROJECT DESCRIPTION

: The main objective of the Action is to establish a common knowledge base and collaboration among scientists, regulators, land owners and other stakeholders in field in implementing „Nature-based solutions" such as Natural Water Retention Measures. These measures are primarily applied on private lands. Thus, the mission of the LAND4FLOOD action is to coordinate flood risk management and land management from different perspectives: clarifying economic issues, property rights issues (e.g., how to allow temporary flood storage on private land), public participation issues (e.g., how to ensure involvement of private landowners), and public subsidy issues (e.g., how to integrate flood retention in agricultural subsidies).

## PROJECT OUTCOMES

In the first four years, 34 different publications were published, including books, articles, and special issues of the journal; proposals and recommendations were prepared for decision-makers and citizens; 16 meetings and workshops were held; a research network was established to continue collaboration after completion of the project.

# COST Action CA17107

## „European Network to connect research and innovation efforts on advanced Smart Textiles (CONTEXT)"

| | |
|---|---|
| Duration | 11/10/2018 – 11/10/2022 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | Associació Agrupació d'Empreses Innovadores Tèxtils, Spain |
| Coordinator at the Faculty | Prof. Vlatka Rajčić, PhD (member of the management board, member of the working group WG4 Smart Textiles for building and living applications) |

Web page:
www.context-cost.eu/page/2/?et_blog


## PROJECT DESCRIPTION

The aim of the action is to create a network of European researchers and major stakeholders in order to develop common ideas and initiatives that can be transformed into advanced smart textile products. A smart textile material is a „functional textile material that actively interacts with its environment, i.e., reacts to or adapts to changes in the environment." Textile products find application in all sectors, especially in the health and medicine, automotive and aeronautical sectors, personal protective equipment, sports and wearables, and the building and interior design sector. Although several R&D projects have in recent years been carried out in this area, most of the prototypes obtained did not reach the market for a number of reasons, such as the product reliability, cost-effectiveness, lack of proven use and / or value proposition. In this sense, CONTEXT aims to launch research and innovation projects (with a high expected TRL) by pooling, within the same network and through working groups, various experts with the right competencies and experience from the academia and industry.

## PROJECT OUTCOMES

Providing a centre to combine existing knowledge and identify common problems to develop new smart textiles, production technologies, services, and business models. Promote development of a joint research plan in line with the Strategic Innovation and Research Program for the European textile and clothing industry and other related ETPs in order to increase the efficiency and effectiveness of the innovation process.

# COST Action CA18109

## „Accelerating Global science In Tsunami HAzard and Risk analysis"

| | |
|---|---|
| Duration | 18/03/2019 – 17/03/2023 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | Universitet Hamburg, Njemačka |
| Members | Asst. Prof. Mislav Stepinac, PhD (MC member), Prof. Josip Atalić, PhD (MC member) |

Web page:
www.agithar.uni-hamburg.de/

## PROJECT DESCRIPTION

Large tsunamis are low-frequency but potentially very high-impact events that can cause extreme numbers of casualties as well as very large economic losses, as recently demonstrated by the Sumatra-Andaman Tsunami in December 2004 and the Japan Tsunami of March 2011. In both cases, the scale of actual disaster surpassed by far the anticipated magnitudes. One of the reasons for the underestimated risk potential can be identified as the lack of rigorous, robust and standardized hazard and risk analysis methods and associated uncertainties. While a large number of probabilistic as well as deterministic methods has been proposed and used in the past, a consolidation process is dearly overdue and will require to bring together the experts from diverse areas of science specialising in tsunami hazard and risk analysis.

## PROJECT OUTCOMES

AGITHAR is a network for improving, standardizing, and promoting tsunami research. It uses specific COST tools – workshops, networking, exchange of experts – in order to:

- Assess current approaches in tsunami hazard and risk analysis, and evaluate them quantitatively by means of common metrics and benchmarks.
- Determine gaps in scientific knowledge, methodological approaches and tools in order to achieve robust tsunami hazard and risk analysis across a variety of tsunami sources, including earthquakes, landslides, volcanoes, and meteorological events.
- Derive and agree on best practices and standards for probabilistic tsunami hazard and risk analysis, through discussion by a large group of practitioners.
- Identify issues and challenges to properly orient future research.
- Disseminate the acquired knowledge among hazard and risk practitioners and end-users.

# COST Action CA18120

## „Reliable roadmap for certification of bonded primary structures"

| | |
|---|---|
| Duration | 04/04/2019 – 03/04/2023 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Project coordinator | Delft University of Technology, The Netherlands |
| Voditelji projekta na fakultetu | Prof. Vlatka Rajčić, PhD (MC member),<br>Prof. Davor Skejić, PhD (MC member) |
| Work group members at the Faculty | Asst. Prof. Mislav Stepinac, PhD, Asst. Prof. Ivan Ćurković, PhD, Nikola Perković, MCE, Ivan Čudina, MCE, Anđelo Valčić, MCE |

Web page: certbond.eu/

CertBond
COST Action CA18120


## PROJECT DESCRIPTION

With an increasing pressure to meet unprecedented levels of eco-efficiency, the aircraft industry aims for superlight structures, and, towards this aim, composites are replacing conventional aluminium. The same trend is being followed by the civil, automotive, wind energy, naval and offshore industries, in which the combination of steel and composites, or replacement of steel with composites, can increase the strength-to-weight ratio. However, the joining design is not following this transition. Currently, composites are being assembled using fasteners. This leads to a reduction in load-bearing capacity and is a huge weight penalty for composites, since holes cut through the load carrying fibres and destroy the load path. Adhesive bonding is the most promising joining technology in terms of weight reduction and performance. However, its lack of acceptance is limiting its application to secondary structures, whose failure is not detrimental to structural safety. In primary (load-bearing) structures, fasteners are always included along bondlines, as „back-up" in case the bond fails. The main reasons for this lack of acceptance are the limited knowledge of their key manufacturing parameters, non-destructive inspection techniques, damage tolerance methodology, and reliable diagnosis and prognosis of their structural integrity.

## PROJECT OUTCOMES

The goal of the Action is to provide a reliable background for the certification of bonded joints in primary (load-bearing) composite structures. Despite the motivation being aircraft structures, which are believed to have the most demanding certification, it will directly involve other application fields in which similar needs are present. This Action will tackle the scientific challenges at the different stages of the life cycle of bonded structures through the synergy of multidisciplinary fields and knowledge transfer.

# COST Action CA18203

## „Optimising Design for Inspection (ODIN)"

| | |
|---|---|
| Duration | 02/10/2019 – 01/10/2023 |
| Source of funding | COST – European Cooperation in Science & Technology, H2020 FP EU |
| Coordinator | Cardiff University, Cardiff, Wales, UK |
| Coordinator at the Faculty | Prof. Vlatka Rajčić, PhD (substitute Member of the Management Board for the Republic of Croatia) |

Web page: odin-cost.com/


## PROJECT DESCRIPTION

Non-destructive assessment methods based on ultrasonic techniques, electro-mechanical device techniques, and wireless network sensors, have proven to be very effective in monitoring aircraft component damage in laboratory conditions (TRL 3). However, it is necessary to integrate this approach and techniques into the initial research and design. This COST action brings together top European experts from various related fields of research to support the development of an integrated framework for optimized self-sensing structures capable of analysing and projecting structure behaviour, and together with case studies and educational activities, including training programs, will ultimately seek toward a cleaner and safer sky.

## PROJECT OUTCOMES

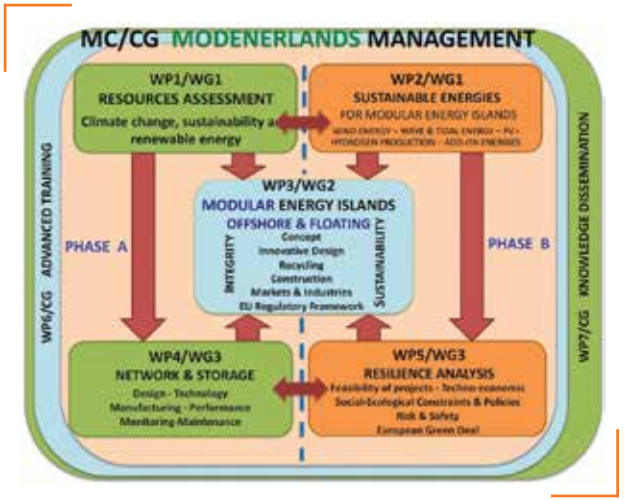
Optimization (sensor / structure), computational modelling, advanced signal processing, and advanced design approaches, will be integrated to produce a new access framework, design tools, and guidelines for the delivery of the first generation of self-sensing aircraft capable of delivering accurate structure behaviour projections. This will improve maintenance strategies, bridge the gap between the research and industry, enable increased use of advanced materials, reduce operating costs, and ultimately deliver safer and greener air transport solutions.

# COST Action CA20109

## „Modular energy islands for sustainability and resilience (MODENERLANDS)"

| | |
|---|---|
| Duration | 1/10/2021 – 10/10/2025 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Project coordinator | ACIV Associação para o Desenvolvimemto da Engenharia Civil |
| Coordinator at the Faculty | Asst. Prof. Ivan Lukačević, PhD (MC member for Croatia) |
| Members of working groups at the Faculty | Prof. Davor Skejić, PhD (WG2), Asst. Prof. Ivan Lukačević, PhD (WG2), Anđelo Valčić (WG3) |

Web page: www.cost.eu/actions/CA20109/




## PROJECT DESCRIPTION

The MODENERLANDS Action aims to merge and systematise the efforts of the European Research and Development (R&D) groups working on Sustainable Energy and the related technologies, wind and wave energy sources in particular, by proposing pathways for incorporation, and by promoting relevant synergies in Research, Education and Training, in order to enhance Sustainability in the built environment. MODENERLANDS will work with Modularised Construction of Offshore Floating Platforms aiming at easily extending their size and capacity according to future energy needs. The Modular Energy Island concept will act as a platform to maximise collection and conversion of the renewable energy sources, and to efficiently transfer them to the network, exploring the cutting-edge Green Hydrogen related technologies for efficient energy storage and transportation.

## PROJECT OUTCOMES

MODENERLANDS revisits safe, smart, modular, cost-effective, and socially valuable high-performance sustainable Energy Islands for consideration in the plans, design and development of the future sustainable energy infrastructure. The Action will promote synergies that will offer breakthrough scientific developments leading to new concepts and R&D outcomes, thereby strengthening the European research and innovation capacities.

# COST Action CA20139

## „Holistic design of taller timber buildings (HELEN)"

| | |
|---|---|
| Duration | 12/10/2021 – 11/10/2025 |
| Source of funding | COST – European Cooperation in Science & Technology |
| Coordinator | InnoRenew CoE – Research and Innovation Centre of Excellence, Izola, Slovenia |
| Coordinator at the Faculty and members | Asst. Prof. Mislav Stepinac, PhD (MC member, Grant Awarding Coordinator), Prof. Vlatka Rajčić, PhD (MC member for the Republic of Croatia), Jure Barbalić, Nikola Perković (MC substitutes for the Republic of Croatia) |

Web page: www.cost.eu/actions/CA20139/

## PROJECT DESCRIPTION

A shift towards sustainable and renewable construction techniques is necessary as the world construction sector is responsible for one third of carbon dioxide emissions, as well as for forty percent of the world energy use and waste production. Structural wood, the champion of sustainable building materials, has evolved to a stage that allows the construction of not only family housing but also taller buildings that are usually built of concrete or steel. While different designers of concrete and steel buildings (architects, construction engineers, fire engineers, acoustic engineers, etc.) can work almost independently, the design of taller wooden buildings needs to be done with an intensive cooperation of members of the design team. Therefore, it is crucial to solve the problem of multi-storey wooden buildings from a common and interdisciplinary perspective, taking into account the static, dynamic, fire and acoustic aspects, human health and other aspects simultaneously and not separately.

## PROJECT OUTCOMES

Only through interdisciplinary analysis and interaction can a set of holistic design guidelines be developed that will enable safe construction of taller wooden buildings, as well as the respect of requirements for human well-being. This Action aims to achieve this through intensive interdisciplinary work and interaction between different approaches and bases, as well as between the academic and design experts.

# COST Action CA19139

## „Process-based models for climate impact attribution accross sectors"

| | |
|---|---|
| Duration | 27/10/2020 – 26/10/2024 |
| Source of finance | COST – European Cooperation in Science & Technology |
| Project holder | Potsdam Institute for Climate Impact Research, Potsdam, Germany |
| Members of working groups at the Faculty | Asst. Prof. Kristina Potočki, PhD (MC member for Croatia), Prof. Vlatka Rajčić, PhD (MC Substitute for Croatia, WG member), Martina Lacko, MSc (MC Substitute for Croatia, WG member) |

Web page: www.cost.eu/actions/CA19139/
proclias.eu/


## PROJECT DESCRIPTION

In Europe, there are many complex process-based models for predicting future climate impacts. Nevertheless, the current research community on climate impacts is fragmented and focused on a single system modelling. The integration of climate impacts across different natural and social sectors is gaining acceptance albeit at a very slow pace. Although climate change is already evident, the attribution of climate change to other causes has not been adequately explored, and more lawsuits are being filed over climate impacts, while policy debates over damages and losses are increasing. PROCLIAS aims to develop common protocols, harmonised datasets, and a shared understanding of how to conduct cross-sectoral studies of climate change impacts at regional and global scales, so as to enable attribution of recent climate change impacts and robust projections of future climate impacts.

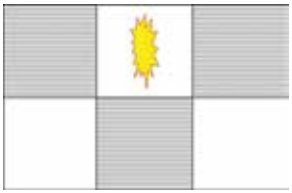
## PROJECT OUTCOMES

Build a scientific community of climate impact models that transcends disciplinary and sectoral boundaries and is to continue beyond the Action duration period. Support provision of harmonized datasets for global and regional climate impact simulations. Provide common protocols for cross-sector climate impact simulations. Assist in improving methods for conducting and analysing cross-sectoral simulations and attribution studies. Outreach to potential stakeholders through a variety of channels.

# UNIVERSITY OF ZAGREB AND MINISTRY OF SCIENCE AND EDUCATION

# Effect of explosive action on reinforced concrete bridge slabs

| | |
|---|---|
| Duration | 15/01/2020 – 14/07/2021 |
| Overall budget | € 2,645 |
| Source of funding | University of Zagreb |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | Croatian Military Academy „Dr. Franjo Tuđman", Armed Forces of the Republic of Croatia |
| Project leader | Asst. Prof. Marija Kušter Marić, PhD |



## PROJECT DESCRIPTION

This project analysed the effects of blasting on the damage and changes in the properties of six different types of reinforced concrete slabs. The difference between the samples is reflected in the differing concrete grades (C30/37 – C50/60) and the material of the added fibres (steel and synthetic fibres). Visual inspection and non-destructive measurements with the Schmidt hammer, resipod, and ultrasound were performed before and after the explosion to determine the extent of external and internal damage after the explosion.

## PROJECT OUTCOMES

- Development of a methodology to determine the influence of an external explosive on RC slabs.
- Analysis of the influence of an external explosive on RC slabs with or without microfibres.
- Analysis of the influence of the amount of external explosive on RC slabs with the addition of steel fibres.

# Sediment transport analysis of the Danube River

| | |
|---|---|
| Duration | 01/01/2021 – 31/12/2023 |
| Overall budget | € 13,000 |
| Source of funding | Ministry of Science and Education |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Project leader | Asst. Prof. Gordon Gilja, PhD |

## PROJECT DESCRIPTION

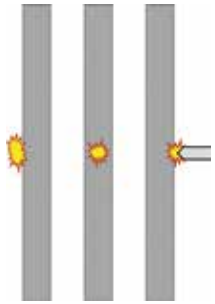
The aim of the research is to develop, test, and apply innovative, scientifically based methods of sediment regime monitoring that can provide crucial information on the sediment transport along the Danube river. The main idea of the project is to work in parallel on the development of innovative methods of data analysis on water and sediment regime in partner institutions. In the testing phase of the effectiveness of the developed methods, a joint field campaign will be carried out on the Danube River.

## PROJECT OUTCOMES

The main outcomes of the project are the development of an innovative method for bedload sediment transport and its testing at pilot sites, and publication of joint scientific publications.

# Influence of different types of explosive action on reinforced concrete bridge piers

| | |
|---|---|
| Duration | 15/01/2021 – 14/07/2022 |
| Overall budget | € 2,808 |
| Source of funding | University of Zagreb |
| Coordinator | University of Zagreb Faculty of Civil Engineering |
| Partners | Croatian Military Academy „Dr. Franjo Tuđman", Faculty of Mining, Geology and Petroleum Engineering, Armed Forces of the Republic of Croatia |
| Project leader | Asst. Prof. Marija Kušter Marić, PhD |



## PROJECT DESCRIPTION

The effects of various types of explosive action on reinforced concrete piers of bridges are investigated in the scope of this project. A total of six 3,0 m high reinforced concrete piers were analysed, three of them for two different cross sections: square and rectangular. The dimensions and weight of the samples correspond to the possibilities of delivering and testing the samples at the military training area. Three types of explosive charges were placed on the samples: external, internal, and cumulative. Visual inspections and non-destructive measurements were performed before and after the blast to determine the extent of external and internal damage after the explosion.

## PROJECT OUTCOMES

- Development of a methodology to determine the effects of explosive on RC piers.
- Analysis of the effects of external, internal and cumulative explosive on RC piers.
- Analysis of the influence of the cross-section of the RC piers on the effects of external, internal and cumulative explosive.

# AGREEMENTS

## ON DEDICATED MULTI-ANNUAL INSTITUTIONAL FINANCING OF SCIENTIFIC ACTIVITIES WITH THE UNIVERSITY OF ZAGREB

# 2018

| Project code | Project leader | Title |
|---|---|---|
| GF1 | Mladen Vukomanović | Modelling the Processes for Implementing Building Information Modelling (BIM) in Construction Projects during the Project Phases of Planning and Execution |
| GF2 | Dalibor Carević | Hydromorphological changes of Croatian rivers |
| GF3 | Vesna Dragčević | Offtracking control requirements for road vehicles |
| GF4 | Anita Cerić | Communication and projects participants relationships in claims on construction projects |
| GF5 | Tatjana Rukavina | Influence of wide-width tensile test clamping conditions on geogrid tensile properties |
| GF6 | Mislav Stepinac | Defining the test method for glued-in rods |
| GF7 | Domagoj Damjanović | Contemporary methods dynamic monitoring of civil engineering structures |
| GF8 | Stjepan Lakušić | Effects of permanent way modification on vibration reduction induced by dynamic loads |
| GF9 | Nina Štirmer | Analysis of the impact of thermal bridges on heat losses in near-zero energy buildings |
| GF10 | Marta Šavor Novak | Seismic performance assessment of typical buildings in the City of Zagreb |
| GF11 | Tomislav Došlić | Structural and enumerative aspects of maximal matchings |
| GF12 | Dario Jukić | Non-integral statistics and applications of inequalities |
| GF13 | Goran Lončar | Establishment of methodological standard for selecting appropriate degree of purification at SWTP for agglomerations of up to 10 000 PE |
| GF14 | Marijana Serdar | Stress-strain curve of concrete based on alternative binders |
| GF15 | Meho Saša Kovačević | Assessment of linear infrastructure assets by utilizing multi-geophysical approach |
| GF16 | Vlatka Rajčić | Reliability index of rehabilitated and reinforced structures |
| GF17 | Ivana Burcar Dunović | Influence of stakeholders on the success of investment projects |

# 2019

| Project code | Project leader | Title |
|---|---|---|
| GF1 | Mario Uroš | Seismic performance assessment of typical buildings in the City of Zagreb. |
| GF2 | Vesna Dragčević | Offtracking control requirements for road vehicles |
| GF3 | Meho Saša Kovačević | Assessment of linear infrastructure assets by utilizing multi-geophysical approach |
| GF4 | Damir Lazarević | Efficiency assessment of iterative procedures for the design of spatial truss systems |
| GF5 | Tatjana Rukavina | Influence of dielectric constant on the reliability of GPR measurement results |
| GF6 | Anita Cerić | The role and importance of communication risk in construction projects |
| GF7 | Goran Lončar | Establishment of methodological standard for selecting appropriate degree of purification at SWTP for agglomerations of up to 10 000 PE |
| GF8 | Mladen Vukomanović | Key Success Factors for Integrating Building Information Modelling (BIM) with Enterprise Resource Planning (ERP) in Contractor Organizations |
| GF9 | Dalibor Carević | Hydromorphological changes of Croatian rivers |
| GF10 | Nina Štirmer | In-situ determination of heat losses through building elements |
| GF11 | Mislav Stepinac | Modelling of joints with glued-in rods |
| GF12 | Ana Mandić Ivanković | Key performance Indicators of existing bridges |
| GF13 | Ana Baričević | Repair of historical buildings with ecological mortars |
| GF14 | Vlatka Rajčić | Reliability index of rehabilitated and reinforced structures |
| GF15 | Ivana Burcar Dunović | Influence of stakeholders on the success of investment projects |
| GF16 | Tomislav Došlić | Structural and enumerative aspects of maximal matchings |
| GF17 | Stjepan Lakušić | Performance of permanent way with implemented elastic elements |

| Project code | Project leader | Title |
|---|---|---|
| GF18 | Domagoj Damjanović | Contemporary methods for dynamic monitoring of civil engineering structures |
| GF19 | Dario Jukić | Non-integral statistics and applications of inequalities |
| GF20 | Marijana Serdar | Advanced testing methods for concrete based on alternative binders |

# 2020

| Project code | Project leader | Title |
|---|---|---|
| GF1 | Tatjana Rukavina | Influence of dielectric constant on the reliability of GPR measurement results |
| GF2 | Mladen Vukomanović | Key success factors for integrating Building Information Modelling (BIM) with Enterprise Resource Planning (ERP) in contractor organizations |
| GF3 | Goran Lončar | Establishment of methodological standard for selecting appropriate degree of purification at SWTP for agglomerations of up to 10 000 PE |
| GF4 | Mario Bačić | Non-destructive testing of rock bolt integrity |
| GF5 | Dalibor Carević | Hydromorphological changes of Croatian rivers |
| GF6 | Saša Ahac | Quantification and classification of urban public transport stop dwell time influential factors |
| GF7 | Ana Mandić Ivanković | Key Performance Indicators of existing bridges |
| GF8 | Anita Cerić | The role and importance of communication risk in construction projects |
| GF9 | Vlatka Rajčić | Reliability index of rehabilitated and reinforced structures |

| Project code | Project leader | Title |
|---|---|---|
| GF10 | Ana Baričević | Prediction of long-term properties of repair materials |
| GF11 | Mario Uroš | Seismic performance assessment of typical buildings in the City of Zagreb |
| GF12 | Bojan Milovanović | Modelling hygrothermal conditions in NZEB buildings |
| GF13 | Stjepan Lakušić | Noise and vibration protection on urban transport infrastructure |
| GF14 | Mislav Stepinac | FEM analyses of glued-in rods |
| GF15 | Ivica Završki | Identification, systematization, and evaluation of innovative construction technologies |
| GF16 | Marijana Serdar | Influence of pore microstructure on the behaviour of building materials |
| GF17 | Domagoj Damjanović | Contemporary methods for dynamic monitoring of civil engineering structures |
| GF18 | Damir Lazarević | Efficiency assessment of iterative procedures for the design of spatial truss systems |
| GF19 | Tomislav Došlić | Structural and enumerative aspects of maximal matchings |
| GF20 | Alan Filipin | Generalized problem of Diophantine m-tuples |
| GF21 | Dario Jukić | Non-integral statistics and applications of inequalities |

# 2021

| Project code | Project leader | Title |
|---|---|---|
| GF1 | Anita Cerić | Communication protocols and trust building risk minimisation strategies for risk caused by poor communication among project participants in construction projects |
| GF2 | Goran Lončar | Establishment of methodological standard for selecting appropriate degree of purification at SWTP for agglomerations of up to 10 000 PE |
| GF3 | Tatjana Rukavina | Quantification of moisture and fine grain content in pavement unbound granular layer by GPR |
| GF4 | Saša Ahac | Quantification and classification of urban public transport stop dwell time influential factors |
| GF5 | Mladen Vukomanović | Key Success Factors for Integrating Building Information Modelling (BIM) with Enterprise Resource Planning (ERP) in Contractor Organizations |
| GF6 | Ana Mandić Ivanković | Key Performance Indicators of existing bridges |
| GF7 | Gordon Gilja | Improvement of local scour monitoring methods |
| GF8 | Tomislav Kišiček | Ductility of hybrid reinforced concrete beams |
| GF9 | Dalibor Carević | Interaction of coastal structures and environment |
| GF10 | Mario Bačić | Determination of the liquefaction potential of soil below flood protection embankments |
| GF11 | Davor Skejić | Reliability assessment of innovative aluminium joints |
| GF12 | Vesna Dragčević | Noise and vibration protection of urban road and rail infrastructure |
| GF13 | Bojan Milovanović | Environmental impact assessment during energy renovation of buildings |
| GF14 | Nina Štirmer | Life cycle assessment of innovative precast concrete products |
| GF15 | Marijana Serdar | Calculation of ecological footprint of alternative binders for concrete |
| GF16 | Mario Uroš | Seismic performance assessment of typical buildings in the City of Zagreb |

| Project code | Project leader | Title |
|---|---|---|
| GF17 | Damir Lazarević | Application of tension-compression analogy for assessing condition of cultural heritage buildings |
| GF18 | Ivica Završki | Identification, systematization, and evaluation of innovative construction technologies |
| GF19 | Ana Baričević | Economic and ecological efficiency of cementitious composites reinforced with waste fibres |
| GF20 | Domagoj Damjanović | Contemporary methods for dynamic monitoring of civil engineering structures |
| GF21 | Tomislav Došlić | Maximal matchings and Diophantine m-tuples |
| GF22 | Dario Jukić | Non-integral statistics and applications of inequalities |

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