Barcelona School of Civil Engineering is an active member of the Cluster network, which brings together the best technological universities in Europe. The numerous research groups linked to the departments promote and carry out research projects, often in collaboration with national and international organizations and companies.

The quality of the research maintains a direct relationship with the excellence of the doctorate program and with the studies taught in the school, which range from civil engineering to geological and environmental engineering. In addition, the research carried out at the school is integrated into the research activity of the UPC, which allows us to take advantage of synergies and boost the transfer of technology.
Summary

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Introduction

This document reflects the will of the Universitat Politècnica de Catalunya (UPC) to identify the activity of the research groups at the Barcelona School of Civil Engineering.

The portfolio is divided into different study areas with the aim of clearly identifying the research field of each research group that integrates the School. Starting with a brief description of research groups and ending with a compilation of some competitive projects, agreements, patents and spinoffs that the group has in any field.

The information collected in this document has been mainly compiled through the web pages of the UPC research groups.

The result of this effort is this document, which briefly and synthetically collects a first approach to the Barcelona School of Civil Engineering Research Map.
Thematic Classification of research groups

- Civil Engineering and Infrastructure: 7%
- Computational Mechanics: 4%
- Data Analysis: 7%
- Earthquake engineering: 2%
- Energy: 9%
- Environment: 16%
- Failure Mechanisms: 2%
- Geophysics and Geomechanics: 16%
- Mobility: 4%
- Materials: 11%
- Hydrogeology: 9%
- Numerical Analysis and Modelling: 13%
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Research Groups

ANiComp

RESEARCH CENTRE/GROUP

Name: Numerical analysis and scientific computation
Web: https://futur.upc.edu/ANiComp

GENERAL DESCRIPTION OF THE ACTIVITY

The Numerical analysis and scientific computation (ANiComp) group has worked on several issues related to the simulation of complex problems in computer science and engineering governed by equations in partial derivatives.

The group has worked on the development of highly scalable multi-level gradient decomposition algorithms that can efficiently exploit the largest supercomputers in the world, positioning the group’s scientific code in the High-Q Club of the most scalable codes of the world.

This group has also worked on the additive manufacturing simulation.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by ANiComp group:

- Computational engineering.
- Finite elements.
- Numerical analysis.
- Parallel computation.
- Scientific calculation.
- Simulation.

COMPETITIVE PROJECTS

A current project to be highlighted is:

*ExaQute, EXAscale Quantification of Uncertainties for Technology and Science Simulation.*

The ExaQUte project aims at constructing a framework to enable Uncertainty Quantification (UQ) and Optimization Under Uncertainties (OUU) in complex engineering problems using computational simulations on Exascale systems. This will include the quantification of uncertainties in the response of civil engineering structures to the wind action, and the shape optimization taking into account uncertainties related to wind loading, structural shape and material behaviour. All developments in ExaQUte will be open-source and will follow a modular approach, thus maximizing future impact.

UPC’s amount: **257.000,00 €.**
Competitive Project 1

Competitive Project 2

KEY WORDS
• Computational engineering.
• Finite elements.
• Numerical analysis.
• Parallel computation.
• Scientific calculation.
• Simulation.

RESEARCH TEAM
• 6 researchers.
• 6 PhD students.

CONTACT
☑ C/ Jordi Girona 3, 08034, Barcelona. Campus Nord.
☑ Person in charge: Badia Rodriguez, Santiago I (sbadia@cimne.upc.edu). Phone: (+34) 93 413 41 08.
**ATEM**

**RESEARCH CENTRE/GROUP**

Name: Structural and Materials Technology  
Web: https://futur.upc.edu/ATEM

**GENERAL DESCRIPTION OF THE ACTIVITY**

The **Structural and Materials Technology (ATEM)** is funded by the Catalan Government and carries out research and technology transfer in the field of analysis, design and construction of civil engineering structures. ATEM offers consultancy to companies and professionals, by developing new products (novel materials, construction details, advanced analysis software), innovative experimental procedures and technical solutions for structural engineering.

The research fields of the group are: **Analysis & Design of Concrete Structures**, it consists in experimental and theoretical research on the behaviour, numerical analysis and development of conceptual models for safe and sustainable design of reinforced and restressed concrete structures. **Historical and Masonry Structures**, it deals with structural analysis and conservation of existing buildings, with focus on historical and heritage ones. **Steel & Composite Structures**, it covers experimental, numerical and theoretical studies on the behaviour and analysis for safe and sustainable design of steel and composite structures.

**SPECIFIC AREAS OF RESEARCH**

The following activities define the priorities currently pursued by ATEM group:

- Analysis, design and construction of civil engineering structures.
- Development of conceptual and numerical models.
- Sustainability of the constructive procedures and the recycling of the structural materials.

**COMPETITIVE PROJECTS**

A current project to be highlighted is:  
**Cost reduction and increase performance of floating wind technology (COREWIND)**

The COREWIND project aims to achieve significant cost reductions and enhance performance of floating wind technology through the research and optimization of mooring and anchoring systems and dynamic cables.

COREWIND aims to strength the European Leadership on wind power technology (and specially floating). To do so, the project consortium has been designed to ensure proper collaboration between all stakeholders (users, developers, suppliers, academia, etc.) which is essential to accelerate commercialization of the innovations carried out in the project.  
**UPC’s amount: 291.625,00 €.**
Competitive Project 1

Competitive Project 2

Competitive Project 3
Valorisation of knowledge for European pre-QUALified steel JOINTS. Funding entity: Commission of European Communities Total amount: 62,021.95 € Start date: 2017-07-01; End date: 2019-06-30.

Competitive Project 4

KEY WORDS
- Analysis
- Cement
- Design
- Durability
- Factory work
- Fibre reinforced polymers (FRP)
- Historic buildings
- Large-scale tests
- Materials
- Metal Structures
- Numerical models
- Offshore structures
- Pre-stressed Concrete
- Recycled concrete
- Reinforced concrete
- Reinforcement
- Resilience
- Shape memory alloys (SMA)
- Steel
- Structures
- Sustainability

RESEARCH TEAM
- 12 researchers.
- 1 administrative staff.

CONTACT
- C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building C1 Office 201C.
- Person in charge: Mari Bernat, Antonio Ricardo (antonio.mari@upc.edu). Phone: (+34) 93 401 65 08.
The Barcelona Innovative Transportation (BIT) man objectives are to generate knowledge on transport, mobility and logistics and to transmit this knowledge to society through research, innovation, and education and technology transfer activities.

All team members have similar background, but every one of them has specialized in some of the branches of transportation.

Their main research interest are mobility as a service including airports, appraisal, autonomous vehicles, bicycles, bus, concessions, demand, freight transportation, funding, logistics, management, maritime transportation, operations and optimization, pedestrians, ports, pricing, public transport, railways, regulation, road safety, smart cities, taxi tramway and traffic science.

The following activities define the priorities currently pursued by BIT group:

- Transport engineering.
- Mobility.
- Logistics.

A current project to be highlighted is:

Copernicus Evolution and Applications with Sentinel Enhancements and Land Effluents for Shores and Seas (CEASELESS).

The CEASELESS project will demonstrate how the new Sentinel measurements can support the development of a coastal dimension in Copernicus by providing an unprecedented level of resolution/accuracy/continuity with respect to present products. The project will address the multiple scales coexisting in littoral areas by developing new shallow water parameterizations, introducing them into coupled model suites (wind-wave-surge-current-land discharge) and producing new standards for coastal simulations and analyses. The mutual validation of satellite data, numerical results and in-situ observations will generate reciprocal profit for enhanced competiveness of EU coastal industries where we shall also explore the suitability for cases in third countries, opening new business opportunities for a coastal Copernicus.

UPC’s amount: 439 375, 00 €.
Competitive Project 1  
Cooperative freeway driving strategies in a mixed environment driverless and traditional vehicles.  
Funding Entity: Ministerio de Economía y Competitividad. Total amount: 141.570,00 €. Start date: 2016-12-30; End date: 2019-12-29.

Competitive Project 2  

Competitive Project 3  

KEY WORDS
- Airports
- Appraisal
- Autonomous vehicles
- Bicycles
- Bus
- Concessions
- Demand
- Emergencies
- Feasibility
- Freight transportation
- Funding
- Inter-modality
- ITS
- Logistics
- Management
- Mobility
- Mobility as a Service
- Motorbikes
- Operations
- Optimization
- Pedestrians
- Planning
- Ports
- Pricing
- Public transport
- Railways
- Regulation
- Road safety
- Smart cities
- Taxi
- Traffic
- Tramway
- Transportation

RESEARCH TEAM
- 5 researchers.
- 2 PhD students.

CONTACT

C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building B1 Office 101. E-mail: bit@upc.edu.
Person in charge: Robuste Anton, Francesc (f.robuste@upc.edu). Phone: (+34) 93 401 71 04.
CRAHI

GENERAL DESCRIPTION OF THE ACTIVITY

The Centre of Applied Research in Hydrometeorology (CRAHI) was founded as a result of an agreement between the Universitat Politècnica de Catalunya (UPC), the Catalonia Department of the Environment and the Catalan Water Agency. These entities agreed on the need of a hydro-meteorological research group in Catalonia. The CRAHI became one of the centres of the Technological Innovation Network of Catalonia.

The CRAHI focuses its activity on providing scientific and technological support in the area of hydro-meteorological management and forecasting, particularly on developing models of the processes that drive the cycle of surface waters.

The CRAHI aims to be a pioneer centre in hydro-meteorological research, which will enable it to be a leader in technology transfer and in the support of innovation in the companies in the sector.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by CRAHI group:

- Development of algorithms and models of the processes that control the surface water cycle.
- Meteorological and hydrological forecasting models of converting rain forecasts into flow forecasts.
- Techniques for measuring and quantifying rainfall, flow and other hydro-meteorological variables.
- Development of hydrological applications of meteorological radar.

COMPETITIVE PROJECTS

A current project to be highlighted is:

**Seamless probabilistic multi-source forecasting of heavy rainfall hazards for European flood awareness**

The capability to monitor and predict such events is crucial for preparedness and decision making in emergency operations.

The objective of this project is to develop improved tools for assessing and forecasting the hazards and risks induced by intense rainfall and severe storms (e.g. flash floods, urban floods, landslides) in the scales from individual towns to pan-European. This will be achieved by combining multi-instrument pan-European precipitation observations together with state of the art forecasting methods.

The output of the project is a set of tools and products for seamless probabilistic high-resolution hazard and risk forecasting for lead times from 15 minutes to 5 days.

**Total amount: 204.280,68 €.**
Competitive Project 1  
**EnhANCing emergencY management and response to extreme WeatHer and climate Events.** Funding entity: Commission of European Communities. UPC’s amount: 2.503.261,86 €. Start date: 2016-06-01; End date: 2019-12-31.

Competitive Project 2  

Competitive Project 3  
**Integrating a European Rainfall-InduCed Hazard Assessment system.** Funding entity: Commission of European Communities. UPC’s amount: 302.138,29 €. Start date: 2016-01-01; End date: 2017-08-31.

**KEY WORDS**
- Early Warning Systems
- Erosion and sedimentation
- Hydrology
- Hydrometeorology
- Floods
- Flash flood
- Hydraulics modelling
- Weather radar
- Resilience
- Warning systems
- Emergency management support
- Debris flow
- Hydrological modelling
- Hydro-meteorological forecast

**RESEARCH TEAM**
- 9 researchers.
- 4 administrative staff.

**CONTACT**
- **C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building C4.** E-mail: crahiarrobacrahi.upc.edu  
  Phone: (+34) 934 054 194.  
- **Person in charge: Sempere Torres, Daniel (sampil@cahri.upc.edu).** Phone: (+34) 934 054 194.
EC

RESEARCH CENTRE/GROUP
Name: Construction Engineering
Web: https://futur.upc.edu/EC

GENERAL DESCRIPTION OF THE ACTIVITY

The Construction Engineering (EC) group focus on the life cycle of large modern civil infrastructure projects from a global perspective, involving planning; design; construction; service life and exploitation; maintenance and dismantling and recycling, taking into account economic, social, environmental, quality and health and safety issues.

This group has a global perspective and targets to develop management methods and technology to be applied in any civil infrastructure whatsoever (including highways, railway lines, bridges, dams, channels, tunnels, underground structures and civil buildings).

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by EC group:

- Highways.
- Railway lines.
- Bridges.
- Dams.
- Channels.
- Tunnels.
- Underground structures.
- Civil buildings.

TYPE OF ACTIVITY SINCE 1978

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COMPETITIVE PROJECTS

A current project to be highlighted is:

**Smart structural BIM Models for the efficient management of infrastructures**

During infrastructure life cycle, both during construction and during service life, the contractor or the owner can measure different physical parameters (displacements, strains, service loads, temperatures, and energy consumption) in order to know if a certain project behaves in the manner envisaged at the design stage. However, few times the data obtained are associated with a certain probability of surpassing a limit state threshold.

The purpose of this project is to correct this deficiency by developing a decision support system for managing life cycle of large civil infrastructures (intelligent infrastructure such as bridges, buildings or wind turbines). This will consist of an inverse analysis tool, in which the functional adequacy of the infrastructures associated with certain reliability index (adequacy of structural systems, adequacy of loads, and adequacy of energy balance) will be identified.

UPC’s amount: 127.050,00 €.
### Competitive Project 1

### Competitive Project 2

### Competitive Project 3
*BICISENDAS. BIKE LANE: sustainable, energy self-sufficient, intelligent, decontaminating, integrated and safe.* Funding entity: FCC CONSTRUCTION, S.A. UPC’s amount: 135.000.00 €. Start date: 2019-03-01; End date: 2023-02-01.

### Key Words
- Bridges
- Buildings
- Channels
- Construction methods
- Dams
- Design
- Infrastructure management and maintenance
- Life cycle
- Material technology
- Monitoring
- Planning
- Robustness
- Structural system identification
- Sustainable construction
- Underground structure

### Research Team
- 9 researchers.

### Contact
- **C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building C1.**
- **Person in charge: Turmo Coderque, Jose (jose.turmo@upc.edu).** Phone: (+34) 93 401 72 74.
EGEO

RESEARCH CENTRE/GROUP
Name: Geomatics Engineering
Web: https://futur.upc.edu/EGEO

GENERAL DESCRIPTION OF THE ACTIVITY
The Geomatics Engineering (EGEO) group works in the transversal area of geomatics engineering. The methods and techniques are applied to other fields such as civil engineering, risk management, heritage management and representation, etc. with special attention to new sensors and techniques for the capture, processing, storage and processing of geographic information.

SPECIFIC AREAS OF RESEARCH
The following activities define the priorities currently pursued by EGEO group:

- Areas of Geodesy, Remote Sensing, Photogrammetry and Topography.
- Geographic information and its cartography representation.
- New sensors and techniques for the capture, processing, storage and treatment of geographic information.

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COMPETITIVE PROJECTS
A current project to be highlighted is:

**Characterization and modelling of rockfalls**

The goal of this project is to develop procedures for the characterization and modelling of fragmental rock falls and provide tools for risk reduction. Based on the knowledge generated in the Rockrisk project, we will address the quantification of the fracture pattern of the rock mass, the assessment of the mobilized volume and the failure conditions and the rock fall modelling.

**UPC's amount: 145.200,00 €.**

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<td>2017-03-01</td>
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<td>Slope Mass-wasting under Climate change. Physical mechanisms, predictive modelling and possible mitigation strategies.</td>
<td>Ministerio de Economía y Competitividad</td>
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KEY WORDS

- Cartography
- Digital cartography
- Civil and environmental engineering
- Photogrammetry
- Geodesy
- Geoinformation
- Geomatics
- Laser scanner
- 3D models
- Topography

RESEARCH TEAM

- 7 researchers.
- 1 administrative staff.

CONTACT

- C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building D2. E-mail: usdi.camins@upc.edu.
  Phone: (+34) 934 017 438.
- Person in charge: Nuñez Andres, Maria Amparo (m.amparo.nunez@upc.edu). Phone: (+34) 93 405 40 19.
EnGeoModels

**RESEARCH CENTRE/GROUP**

Name: Monitoring and Modelling in Engineering Geology  
Web: [https://futur.upc.edu/EnGeoModels](https://futur.upc.edu/EnGeoModels)

**GENERAL DESCRIPTION OF THE ACTIVITY**

The **Monitoring and Modelling in Engineering Geology** (EnGeoModels) group performs research on the analysis, monitoring, and modelling in engineering geology focussing on the analysis of the characteristics and behaviour of the rock masses, and on the evaluation of geological risks. Their main areas of interest are: application of remote sensing techniques for the capture of geological data, ground 3D modelling, characterization, monitoring and modelling of failure mechanisms of the rock masses and surficial formations (particularly, landslides, torrential processes, and rockfalls), hazard, vulnerability and risk assessment and the design of early warning and alarm systems of geological processes. Scenario analyses at local and regional scale are performed using the data time-series from our monitoring sites and mitigation measures are defined for stakeholders.

**SPECIFIC AREAS OF RESEARCH**

The following activities define the priorities currently pursued by EnGeoModels group:

- Monitoring and modelling of rock mass.
- Monitoring and modelling of landslides, rockfalls and torrential processes.
- Impacts and mitigation of future climate changes for engineering geology practice.

**TYPE OF ACTIVITY SINCE 1993**

<table>
<thead>
<tr>
<th>TYPE OF ACTIVITY</th>
<th>COUNT</th>
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<td>JOURNAL ARTICLE</td>
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<td>COMPETITIVE PROJECT</td>
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<td>BOOK</td>
<td>1</td>
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<tr>
<td>AWARD OR RECOGNITION</td>
<td>4</td>
</tr>
</tbody>
</table>

**COMPETITIVE PROJECTS**

A current project to be highlighted is:

*EnhANcing emergencY management and response to extreme WeathHER and climate Events*

The ultimate purpose of ANYWHERE is to empower exposed responder institutions and citizens to enhance their anticipation and pro-active capacity of response to face extreme and high-impact weather and climate events. This will be achieved through the operational implementation of cutting-edge innovative technology as the best way to enhance citizen’s protection and saving lives.

ANYWHERE proposes to implement a Pan-European multi-hazard platform providing a better identification of the expected weather-induced impacts and their location in time and space before they occur. This platform will support a faster analysis and anticipation of risks prior the event occurrence, an improved coordination of emergency reactions in the field and help to raise the self-preparedness of the population at risk.

UPC’s amount: 2.503.261, 86€.
Competitive Project 1: Slope Mass-wasting under Climate change. Physical mechanisms, predictive modelling and possible mitigation strategies. Funding entity: Ministerio de Economía y Competitividad. UPC’s amount: 143.990,00 €. Start date: 2016-01-01; End date: 2019-12-31.

Competitive Project 2: Characterisation and modelling of rockfalls. Funding entity: Ministerio de Economía y Competitividad. UPC’s amount: 145.200,00€. Start date: 2016-12-30; End date: 2019-12-29.

**KEY WORDS**
- Climate change
- Engineering geology
- Geological risks
- Landslides
- Modelling
- Monitoring
- Remote-sensing data capture
- Rock masses
- Rockfalls
- Surficial formations
- Torrential flows

**RESEARCH TEAM**
- 6 researchers.

**CONTACT**
- C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building D2. E-mail: usdi.camins@upc.edu.
  Phone: (+34) 934 017 438.
- Person in charge: Hürlimann Ziegler, Marcel (marcel.hurlimann@upc.edu). Phone: (+34) 93 401 73 77.
EScGD

Research Centre/Group

Name: Engineering Sciences and Global Development
Web: https://futur.upc.edu/EScGD

General Description of the Activity

The Engineering Sciences and Global Development (EScGD) group contribute and network with development actors promoting research for development through the engineering practice. The group approach includes the analysis of reality and development problems with a systemic and holistic perspective, an essentially practical nature and a strong focus in the effective production and transfer of knowledge.

EScGD approach to local societies in connection with the Sustainable Development Goals 2030, with special emphasis on the most vulnerable people, communities and ecosystems.

Science, Technology, Engineering and Maths are in the basis of our work. Engineering Sciences offer the basis to transform new ideas into reality and contribute to more inclusive and sustainable societies.

Research and innovation with this aim are the main goals, and this is how EScGD work.

Specific Areas of Research

The following activities define the priorities currently pursued by EScGD group:

- **Global Development priorities:**
  - Living standards.
  - Sustainable growth.
  - Natural resource management.
  - Equality and justice.
  - Peace and security.

- **Challenges:**
  - Climate change.
  - Food security.
  - Sustainable agriculture.
  - Poverty eradication.
  - Human development.

- **Water and energy.**

<table>
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<tr>
<th>Type of Activity Since 1992</th>
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<tr>
<td>Theses: 21</td>
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<td>Journal Article: 128</td>
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<td>Competitive Project: 61</td>
</tr>
<tr>
<td>Book: 49</td>
</tr>
<tr>
<td>Award or Recognition: 7</td>
</tr>
</tbody>
</table>
A current project to be highlighted is:

**Securing future-proof environmentally compatible bioenergy chains**

SecureChain promotes a Sustainable Supply Chain Management (SSCM) that meets highest environmental quality standards and targets local biomass suppliers, energy producers and financial sector players to mobilise more biomass, maximise the share of sustainable bioenergy in the final energy consumption, and reduce the transaction costs for further market uptake of most efficient systems in six European model regions. An open call for SSCM pilot projects is launched encouraging market actors to mobilise and secure additional supplies of biomass from regional sources.

**UPC’s amount: 157 375, 00 €.**

| Competitive Project 2 | Enhancing Entrepreneurship, Innovation and Sustainability in Higher Education in Africa (EEIS-HEA). Funding entity: EACEA. UPC’s amount: 999.849,00 €. Start date: 2018-01-01; End date: 2020-12-31. |

**KEY WORDS**

- Civil engineering
- Energy engineering
- Environmental engineering
- International co-operation for development
- Mathematical modelling
- Sustainable development goals

**RESEARCH TEAM**

- 3 researchers.
- 4 PhD students.
- 3 administrative staff.

**CONTACT**

- **C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building C2.**
- **Person in charge: Pérez Foguet, Agustí (agusti.perez@upc.edu).** Phone: (+34) 93 401 10 72.
FLUMEN

Research Centre/Group

Name: River Dynamics and Hydrological Engineering
Web: https://futur.upc.edu/FLUMEN

General description of the activity

River Dynamics and Hydrological Engineering (Flumen) is an Academic Research Institute affiliated with the Universitat Politècnica de Catalunya and CIMNE (the International Center for Numerical Methods in Engineering). Generalitat de Catalunya through the order ECO/305/2012 founded FLUMEN on October 3rd (DOGC October 17th) and it is an interdisciplinary research group (SGR 1139).

The FLUMEN Institute is actively engaged in research activities, consulting, training and technology transfer in relation to hydrology and river dynamics. When first established in the 1980’s the experience of the Flumen Research Group was incorporated. These activities have been developed and perpetuated inside the framework provided by the School of Civil Engineering of Barcelona, and the Department of Civil and Environmental Engineering of UPC.

Specific Areas of Research

The following activities define the priorities currently pursued by FLUMEN group:

- River hydrodynamics.
- Urban Hydrology.
- Reservoir dynamics.
- Dam hydraulics.
- Irrigation canals exploitation.
- Development of methodologies for using remote sensing in the study of the thermal and hydrodynamic behaviour of water bodies.
- Flow-soil-structure interaction.

Competitive Projects

A current project to be highlighted is:

Hydroinformatics for water resources and water related hazards management in Europe/WaterEurope

The WaterEurope project is a Strategic Partnership under Erasmus+. Each partner has a pivotal role in the project as each contributes with its experience and competence to develop the pedagogic resources and the collaborative platform.

UPC will develop pedagogic resources (course material, exercises and data sets) dedicated to drought management and assessment of water uses in a specific catchment. These resources will be integrated within the collaborative platform and will be used by the course participants.

UPC’s amount: 48,936, 00 €.
<table>
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<tr>
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<tbody>
<tr>
<td>Competitive Project 2</td>
<td>Modelling and study of spillages in rain episodes within the Besòs Tordera Consortium. Funding entity: AGAUR. UPC’s amount: 33,960,00 €. Start date: 2017-07-03; End date: 2020-07-02.</td>
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<tr>
<td>Competitive Project 3</td>
<td>Turbulence Generated by Sparse 3D Multiscale Grid. Funding entity: Pan European Laboratory on Non Homogeneous Turbulence (ERCOFTAC). UPC’s amount: 9,880,00 €. Start date: 2017-01-03; End date: 2020-01-03.</td>
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</table>

**KEY WORDS**
- Fluvial dynamics
- Hydrological engineering
- Superficial hydrology
- Hydraulics
- Environment
- Presses
- Rivers

**RESEARCH TEAM**
- 7 researchers.
- 4 PhD students.
- 1 administrative staff.

**CONTACT**
- C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building B0 Floor S1. E-mail: flumen@upc.edu. Phone: (+34) 93 401 73 73.
- Person in charge: Blade i Castellet, Ernest. (ernest.blade@upc.edu). Phone: (+34) 93 401 70 70.
GEMMA

RESEARCH CENTRE/GROUP

Name: Group of Environmental Engineering and Microbiology
Web: https://futur.upc.edu/GEMMA

GENERAL DESCRIPTION OF THE ACTIVITY

The Group of Environmental Engineering and Microbiology (GEMMA) is located at the Department of Hydraulic, Maritime and Environmental Engineering (DEHMA) of the Universitat Politècnica de Catalunya (UPC).

The Group is dedicated to interdisciplinary research, innovation, knowledge transfer and education in environmental engineering; particularly in the fields of environmental biotechnology, water supply, wastewater and solid waste treatment, and bioenergy generation.

Also, it is specialized in investigating non-conventional wastewater and sewage sludge treatment systems, such as constructed wetlands and high rate ponds. The production of bioenergy from wastewater through anaerobic digestion and microbial fuel cells is a complementary research field. Mathematical modelling and Life Cycle Assessment (LCA) of these treatment processes are also undertaken.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by GEMMA group:

- Non-conventional wastewater.
- Production of bioenergy from wastewater.
- Mathematical modelling of processes.
- Environmental evaluation.
- Bioenergy production.
- Anaerobic digestion of algal biomass.
- Biogas production in low-cost household digesters.
- Life cycle assessment and energy balance of alternative treatment systems.

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<tr>
<th>TYPE OF ACTIVITY SINCE 1991</th>
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<tbody>
<tr>
<td>Theses</td>
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<td>Competitive project</td>
</tr>
<tr>
<td>Book</td>
</tr>
<tr>
<td>Award or recognition</td>
</tr>
</tbody>
</table>

COMPETITIVE PROJECTS

A current project to be highlighted is:

**Innovative Eco-Technologies for Resource Recovery from Wastewater**

INCOVER added-value plants will generate benefits from wastewater offering three recovery solutions: Chemical recovery (bio-plastic and organic acids) via algae/bacteria and yeast biotechnology; Near-zero-energy plant providing upgraded bio-methane via pre-treatment and anaerobic co-digestion systems; Bio-production and reclaimed water via adsorption, biotechnology based on wetlands systems and hydrothermal carbonisation. To improve added-value production efficiency, INCOVER solutions will include monitoring and control via optical sensing and soft-sensors.

*UPC's amount: 811.250,00 €.*
Competitive Project 1  

Competitive Project 2  

Competitive Project 3  

Competitive Project 4  

Competitive Project 5  
Improving sustainable sanitation and energy access in rural areas of Peru and Colombia: constructed wetlands and small-scale digesters. Funding Entity: Centre de Cooperació per al Desenvolupament 2018-U003. UPC’s amount: 10.948,00 €. Start date: 2018-05-01; End date: 2019-04-30.

KEY WORDS
- Water
- Bioenergy
- Biogas
- Depuration
- Anaerobic digestion
- Sludge
- Microalgae
- Modelling
- Microbial batteries
- Purification
- Organic residues
- Reuse
- Treatment of organic waste

RESEARCH TEAM
- 7 researchers.
- 1 PhD Student.
- 3 administrative staff.

CONTACT
- Person in charge: Ferrer Martí, Ivet (ivet.ferrer@upc.edu). Phone: (+34) 93 401 64 63.
GHS

RESEARCH CENTRE/GROUP

Name: Hydrogeology Group
Web: https://futur.upc.edu/GHS

GENERAL DESCRIPTION OF THE ACTIVITY

The Hydrogeology Group (GHS) conducts research, teaching and knowledge transfer to society in the field of hydrogeology and geochemistry. It consists of two units that complement each other, interacting and forming synergies, the Department of Civil Engineering (UPC) and the Institute of Environmental Assessment and Water Research (IDAEA-CSIC).

The GHS studies the characterisation of permeable media using hydraulic and hydrochemical data as well as environmental isotopes.

The applications developed consist in the study of groundwater resources, aquifer management, humid and swamp zones, salt-water intrusion, underground residual storage and the unsaturated zone. The quantitative methods used, such as the numerical modelling of flow and mass transport, focus on the regional or local scale. Some of the group’s members carry out numerical modelling and others work on data acquisition. The group often collaborates with the International Hydrogeology Centre.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by GHS group:

- Transport processes.
- Chemical reactions.
- Reactive transport processes.

COMPETITIVE PROJECTS

A current project to be highlighted is:

Managed Aquifer Recharge Solutions Training Network

Managed Aquifer Recharge (MAR) – storing water in aquifers during times of excess – is a key strategy to enrich groundwater resources in water scarce regions by providing intermediate storage, addressing the typical mismatch between water demand and availability. It can help to mitigate the effects of climate change, and to support water-related environmental services. MAR is, however, characterized by complex interaction of physical, biological and hydro-chemical processes influencing water quality and the sustainability of infiltration rates. Individual processes are in principal known, but there is a significant knowledge gap on how they are linked and affect each other. An in-depth understanding of their interplay can lead to MAR systems tailored for best performance in terms of water storage, water polishing goals, infiltration rates, economic viability, and adaptation to climatic change.

UPC’s amount: 501 809, 76€.
Competitive Project 1  | Natural attenuation of pathogens and organic pollutants in porous media during managed aquifer recharge operations. Funding entity: Agencia Estatal de Investigación. UPC’s amount: 201.960,00 € Start date: 2019-01-01; End date: 2021-12-31.

Competitive Project 2  | Mixing and dispersion in the transport of energy and solutes. Funding entity: Ministerio de Economía y Competitividad. UPC’s amount: 102.850,00 € Start date: 2016-12-30; End date: 2019-12-29.

Competitive Project 3  | Soil vadose zone hydraulic characterization for water, solute and heat movement and different applications. Funding entity: AGAUR. UPC’s amount: 33.960,00 € Start date: 2016-06-01; End date: 2019-05-31.

KEY WORDS
- Reactive transport
- Hydrogeochemistry
- Geochemistry
- Modelling
- Contamination
- Risk analysis
- Multi-phase flow
- Fraking
- Geothermal
- Stochastic hydrology
- Karst
- Marine intrusion
- Low permeability medium
- Numerical methods

RESEARCH TEAM
- 1 administrative staff.
- 9 researchers.
- 8 PhD students.

CONTACT
- C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building D2.
- Person in charge: Sanchez Vila, Francisco Javier  (xavier.sanchez-vila@upc.edu). Phone: (+34) 93 401 72 46.
Name: Geophysics and Earthquake Engineering
Web: https://futur.upc.edu/GIES

GENERAL DESCRIPTION OF THE ACTIVITY

The Geophysics and Earthquake Engineering (GIES) group's aims are research, outreach, training and results transfer in fields related to geophysics and earthquake engineering.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by GIES group:

- Geophysics.
- Earthquake engineering.

TYPE OF ACTIVITY SINCE 1964

<table>
<thead>
<tr>
<th>THESSES</th>
<th>JOURNAL ARTICLE</th>
<th>COMPETITIVE PROJECT</th>
<th>BOOK</th>
<th>AWARD OR RECOGNITION</th>
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<tr>
<td>46</td>
<td>268</td>
<td>41</td>
<td>35</td>
<td>1</td>
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</tbody>
</table>

COMPETITIVE PROJECTS

A current project to be highlighted is:

Keeping and increasing resilience opportunities and sustainability of communities against earthquakes

KalROS proposal focuses on earthquake disasters; its main purpose is to provide beyond-state-of-the-art approaches to reduce seismic risk worldwide. That is, keeping and increasing the opportunities for resilience and the sustainability of communities against earthquakes. The key to reducing seismic risk is decreasing the vulnerability of existing structures and providing new insights to improve the design of new structures. KalROS is sensitive to the gender dimension of natural disasters and a special module will investigate this issue. An open access software that can be used to assess the expected damage at urban level by considering several structural typologies and to perform cost-benefit analyses of strengthening measures, amongst many other possibilities, will be created and promoted. Special attention will be devoted to dissemination so that policymakers and stakeholders can benefit from KalROS.

UPC’s amount: 170,121,60 €.

<table>
<thead>
<tr>
<th>Competitive Project 1</th>
<th>For a seismic risk culture. Funding entity: Commission of European Communities. UPC’s amount: 79,300,00 € Start date: 2018-01-01; End date: 2021-12-31.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive Project 3</td>
<td>The urban heat island: effects on climate change and modelling towards strategies of territorial and urban planning. Application to the Metropolitan Region of Barcelona. Funding Entity: Ministerio de Economía y Competitividad. UPC’s amount: 104,060,00 €. Start date: 2016-01-01; End date: 2019-12-31.</td>
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</table>
KEY WORDS

- Seismic engineering
- Structure analysis
- Inelastic attenuation
- Climatology
- Energy dissipaters
- Seismological engineering
- Earth physics
- Numerical modelling of buildings and constructions
- Investment methods
- Electromagnetic prospecting
- Geophysical prospecting
- Seismic protection
- Soil response
- Seismic risk
- Seismic tomography
- Vibrations
- Seismic vulnerability and fragility

RESEARCH TEAM

- 8 researchers.

CONTACT

Av/ Eduard Maristany 16, 08019, Barcelona. Campus Besòs Building A.

Person in charge: González Drigo, José Ramón (jose.ramon.gonzalez@upc.edu). Phone: (+34) 93 413 73 32.
GMNE

RESEARCH CENTRE/GROUP

Name: Numerical Methods in Engineering Group
Web: https://futur.upc.edu/GMNE

GENERAL DESCRIPTION OF THE ACTIVITY

The Numerical Methods in Engineering Group (GMNE) develops activities of research, development and innovation in different fields such as the application of the finite element method in fluid and solids mechanics, in addition, resolution of interaction problems by using the numerical methods for fluid structure. GMNE also analyse the flow of particles and different structures of composite materials.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by GMNE group:

- Finite element method in fluids and solids mechanics.
- Finite element methods for composite structures.
- Particle flow analysis.
- New methods of finite and discrete elements.
- Robust optimization methods.

COMPETITIVE PROJECTS

A current project to be highlighted is:

**AVINT - Estratègies de mecanitzat i predicción de la rugositat per a una integritat superficial òptima**

The main objective of the AVINT project is to increase the efficiency and competitiveness of the processes by producing pieces with optimum surface roughness and integrity, predicting the roughness before the production of the pieces and acting in the design phase, before the Its production, thus avoiding the generation of defective pieces.

The project is divided into three parts:

OG1. Increase the efficiency of the processes of machining for the increase of surface quality and the reduction of defective parts by developing an application to predict roughness.
OG2. Increase the efficiency of machining processes through innovation in machining strategies that allow optimization of surface integrity.
OG3. Increase the competitiveness of machining processes for the acquisition of pieces of greater added value.

Total amount: **125.158,44 €**.
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**KEY WORDS**
- Numerical methods
- Structural calculation
- Engineering
- Composite materials
- Mechanics of solids and fluids
- Problems of fluid-structure interaction

**RESEARCH TEAM**
- 9 researchers.

**CONTACT**
- C/ Gran Capitán s/n, 08034, Barcelona. Campus Nord, Building C1.
- Person in charge: Oñate Ibáñez de Navarra, Eugenio (onate@cimne.upc.edu). Phone: (+34) 93 401 60 35.
GENERAL DESCRIPTION OF THE ACTIVITY

The Numerical Methods for Applied Sciences and Engineering (LACÀN) group's research is focused on mathematical modelling and computational mechanics. More precisely, it strives on: development and analysis of computational methods and applications in applied sciences and engineering that provide significant added value (high-fidelity simulations, reduced order models (viz. PGD) for generalized parametric solutions, data assimilation and data-driven models and automatic generation of high-order meshes). This includes disciplines embracing engineering and mathematics. This is reflected in the composition of the group, the nature of the research projects and the pattern of publications.

New models and technologies are developed for the resolution of partial differential equations that complement traditional methods such as finite element. This computational expertise allows significant impact in different areas. The applications of these techniques include automotive, civil and mechanical engineering, as well as aerospace and energy.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by LACÀN Group:

- Computational methods and tools.
- Natural and engineered materials and structures.

COMPETITIVE PROJECTS

A current project to be highlighted is:

*Enabling flexoelectric engineering through modelling and computation*

Piezoelectric materials transduce electrical voltage into mechanical strain and vice-versa, which makes them ubiquitous in sensors, actuators, and energy harvesting systems. Flexoelectricity is a related but different effect, by which electric polarization is coupled to strain gradients, i.e. it requires inhomogeneous deformation. Flexoelectricity is present in a much wider variety of materials, including non-polar dielectrics and polymers, but is only significant at small length-scales.

UPC’s amount: 1.500.000, 00 €.
Competitive Project 1

A computational tool to elucidate the mechanobiological regulation of limb development. Funding entity: Commission of European Communities. UPC’s amount: 245,732,16 € Start date: 2019-05-06; End date: 2022-05-05.

Competitive Project 2

In vivo simulation of the effect of hypoxia and drug dosis in glioblastoma growth. Funding entity: Agencia Estatal de Investigación. UPC’s amount: 60,500,00 € Start date: 2019-01-01; End date: 2021-12-31.

Competitive Project 3

Enabling Flexo-Photovoltaics through modeling and computation. Funding entity: Agencia Estatal de Investigación. UPC’s amount: 181,500,00 € Start date: 2019-01-01; End date: 2021-12-31.

Competitive Project 4

Reduction numerical techniques for minimisation of geometrical errors in car body tooling industry. Funding entity: AGAUR. UPC’s amount: 33,960,00 € Start date: 2018-09-12; End date: 2021-09-12.

Competitive Project 5

Development of a design-through-analysis methodology based on a coupled isogeometric-maximum entropy approach. Funding entity: Commission of European Communities. UPC’s amount: 158,121,60 € Start date: 2018-10-01; End date: 2020-09-30.

KEY WORDS

- Adaptability
- Cell and tissue mechanics
- Computational mechanics
- Damage and fracture mechanics
- Electromechanical materials
- Finite element mesh generation
- Geophysical and geodynamics
- High order approaches
- Mechanobiology
- Models of reduced order
- Partial derivative equations
- Verification and validation
- Vibroacoustics

RESEARCH TEAM

- 30 researchers.
- 14 PhD students.
- 2 administrative staff.

CONTACT

C/Jordi Girona 1, 08034, Barcelona. Campus Nord Building C2. E-mail: contact.lacan@upc.edu.
Phone: (+34) 93 401 60 92.
Person in charge: Diez Mejia, Pedro (pedro.diez@upc.edu). Phone: (+34) 93 401 72 40.
LESEC

RESEARCH CENTRE/GROUP
Name: Civil Engineering Social Studies Laboratory
Web: https://futur.upc.edu/LESEC

GENERAL DESCRIPTION OF THE ACTIVITY

The Civil Engineering Social Studies Laboratory (LESEC) research group aims to support civil engineering intervention processes from the analysis of socio-environmental and territorial impacts and the understanding of conflicts associated with sustainability, lifestyles, the economy, urbanization models, the organization of work and leisure time.

LESEC group aims to deep in the relationships between urban and infrastructure projects, environmental values, social needs and the distribution between costs and benefits.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by LESEC group:

- Strategic environmental assessment.
- Socio-environmental impact assessment.
- Territorial conflicts.
- Sustainability.
- Urbanism.

COMPETITIVE PROJECTS

A current project to be highlighted is:

Adaptation pathways to Climate Change in the Spanish Mediterranean coastal zone. Beyond adaptability limits.

There is a need to develop adaptation strategies for the coastal zone based on the concept of adaptive planning in which different adaptation measures are combined to achieve a set objective under a given climatic scenario. Such strategies are very dependent on the physical, socio-economic and dynamic characteristics of the coastal zone of interest. Consequently, it is important to progress in their development for different types of coast. In this context, the general objective of this subproject is to:

- Analyse the adaptability to the Climate Change of the Spanish Mediterranean coast.
- Propose a response strategy based on the design of specific adaptation pathways for management units representative of the Mediterranean coast that can be adapted locally.
- Contribute to the evaluation of the adaptability integrating coastal processes with the extreme hydro-meteorological risks of terrestrial origin as flash floods.

UPC’s amount: 133.100,00 €.
**Competitive Project 1**

The coastal risk landscape in the Catalan littoral zone. The influence of climate change

**Funding**
entity: Ministerio de Economía y Competitividad. UPC’s amount: 54.450,00 €
Start date: 2015-01-01; End date: 2018-04-30.

**KEY WORDS**

- Actors
- Institutional analysis
- Strategic environmental assessment
- Socio-environmental impact assessment
- Territorial conflicts
- Eco-neighbourhoods
- Polls
- Interviews
- Social impacts
- Sustainable mobility
- Perception
- Sustainability
- Urbanism

**RESEARCH TEAM**

- 4 researchers.
- 2 PhD students.

**CONTACT**

- Person in charge: Roca Bosch, Elisabet (elisabet.roca@upc.edu). Phone: (+34) 93 401 71 05.
The **Maritime Engineering Laboratory** (LIM/UPC) of the *Universitat Politècnica de Catalunya* (UPC) has long-standing experience in the field of maritime engineering. It is a unit of the Department of Civil and Environmental Engineering of the School of Civil Engineering of Barcelona.

The LIM/UPC is made up of a team of highly qualified professionals who have solid experience and come from different technical and scientific disciplines (mathematics, physics, geology, civil engineering, oceanography, etc.), who are organised into specialised workgroups that are well-coordinated among themselves. This enables a naturally multidisciplinary approach to the services offered.

The basic aims are to undertake basic and applied research, to develop oceanographic and maritime technology, to draw up training programmes for different levels and to organise dissemination activities in the maritime and coastal engineering fields. The main research lines are coastal and estuarine hydrodynamics, maritime environment climate.

### Specific areas of research

The following activities define the priorities currently pursued by LIM/UPC group:

- Coastal oceanography and oceanographic engineering.
- Functional and robust analysis of port and coastal structures.
- Physicochemical quality coastal waters.
- Maritime climate: climate variability.
- Acoustic emission.

### Competitive projects

A current project to be highlighted is:

**Amending the Design criteria of URban defences in LECZs through Composite-modelling of WAVE overtopping under climate change scenarios**

DURCWave project aims to identify new design criteria for wave action by modelling wave overtopping and post-overtopping processes of urban defences (storm walls, stilling wave basins, buildings along coastal boulevards).

The project will implement a composite-modelling approach, consisting of both physical and numerical modelling. Physical model tests will be carried out in two different wave flume facilities at the host organization (UPC), meanwhile the numerical modelling will be performed through the secondment at the partner organization (UVigo).

**UPC’s amount:** 170.121,60 €.
Competitive Project 1  Tracking of Plastic in Our Seas. Funding entity: European Research Council. ERC-2016-STG. UPC’s amount: 199,183.75 € Start date: 2018-03-01; End date: 2022-03-30.

Competitive Project 2  Nature based solutions for coastal management. Funding entity: Agencia Estatal de Investigación. UPC’s amount: 175,450,00 € Start date: 2018-01-01; End date: 2020-12-31.

Competitive Project 3  Approach and Criteria for Observing and Simulating Integrated Transdisciplinary Solutions for Marine Ecosystems in Coastal Bays. Funding entity: Agencia Estatal de Investigación. UPC’s amount: 168,190,00 € Start date: 2018-01-01; End date: 2020-12-31.

Competitive Project 4  Adaptation pathways to Climate Change in the Spanish Mediterranean coastal zone. Beyond adaptability limits. Funding entity: Agencia Estatal de Investigación. UPC’s amount: 133,100,00 € Start date: 2018-01-01; End date: 2020-12-31.

Competitive Project 5  Preparatory phase for the pan-European research infrastructure DANUBIUS-RI: the international center for advanced studies on river-sea systems. Funding entity: Commission of European Communities H2020-INFRADEV-2016-2. UPC’s amount: 168,000,00 € Start date: 2016-12-01; End date: 2019-11-30.


KEY WORDS
- Coasts
- Hydraulic modelling
- Hydrodynamics
- Maritime climate
- Morph-dynamics
- Numerical modelling
- Water quality

RESEARCH TEAM
- 14 researchers.
- 11 administrative staff.

CONTACT
📍 C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building D1. E-mail: info.lim@upc.edu. Phone: (+34) 93 401 64 68.
📍 Person in charge: Sanchez-Arcilla Conejo, Agustin (agustin.arcilla@upc.edu). Phone: (+34) 93 401 64 72.
MATCAR

RESEARCH CENTRE/GROUP

Name: Construction Materials and Roads
Web: https://futur.upc.edu/MATCAR

GENERAL DESCRIPTION OF THE ACTIVITY

The Construction Materials and Roads (MATCAR) research group carries out research on different fields such as the assessment and development of durable and sustainable construction materials as applied in construction of roads, buildings and civil structures.

In addition, the group studies the minimisation of the environmental impact and the use of waste and by-products. Finally, the group also surveys and maintains roads and structures.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by MATCAR group:

- Assessment and development of durable and sustainable construction materials.
- Minimisation of the environmental impact.
- Surveying and maintenance of roads and structures.

COMPETITIVE PROJECTS

A current project to be highlighted is:

**New universal procedure to evaluate the ductility of all kind of asphalt binders at a wide range of temperatures. Ductility Asphalt Test (DAst)**

The aim of this project is to develop a new test procedure that is able to measure successfully the ductility of wide range of types of asphalt binders at a wide range of temperatures. This new procedure will help stabilish the range of service temperatures of the binder according to the environmental conditions, in similar manner the SUPERPAVE procedure does but with the main advantage of using only one test and requiring a much simpler test equipment. A new test geometry will be proposed based on an existing test procedure that has had great success on characterizing cracking behaviour on asphalt mixtures, the Fenix test. This new procedure will be able to show differences between ductile and/or modified binders, covering the gap left by the existing ductility related procedures. The better characterization of ductile binders will help improve the design of asphalt mixtures. This should translate in higher durability of mixtures in the field, which should suppose an important reduction in conservation costs, consumption of raw materials and emission of greenhouse gases.

UPC’s amount: 169.400,00 €.
### Competitive Project 1

**ICT platform for the management of safe and efficient roads/PAVIRE/**
- Funding entity: Agencia Estatal de Investigación.
- UPC's amount: 106,865,92 €
- Start date: 2018-01-01; End date: 2020-12-31.

### Competitive Project 2

**New market niches for the Pulp and Paper Industry waste based on circular economy approaches.**
- Funding entity: Commission of European Communities H2020-CIRC-2016TwoStage.
- UPC's amount: 486,562,50 €
- Start date: 2017-06-01; End date: 2021-05-31.

### Competitive Project 3

**Sprayed lightweight material for the strengthening and restoration of urban patrimony.**
- Funding entity: Programa Estatal de Investigación.
- UPC's amount: 80,000,00 €
- Start date: 2016-12-30; End date: 2019-12-29.

### Key Words

- Asphalt bitumen
- Bituminous mixtures
- Cement
- Concrete
- Conservation
- Construction materials
- Durability
- Environmental impact
- Floors
- Management
- Pavements
- Recycling
- Reuse of waste
- Roads
- Sustainability

### Research Team

- 7 researchers.

### Contact

- **C/ Jordi Girona 3, 08034, Barcelona. Campus Nord Building B1.**
- Person in charge: Miro Recasens, José Rodrigo (r.miro@upc.edu). Phone: (+34) 93 401 73 69.
GENERAL DESCRIPTION OF THE ACTIVITY

The UPC Computational Continuum Mechanics ((MC)²) is a research group that promotes research in the field of structures and continuum mechanics in addition to computational mechanics. Its strategic objectives are to make its potential visible in national and international levels in different areas of continuous media mechanics, computational mechanics and structural analysis, and the group encourages continuous training and internal dissemination of knowledge to make possible the collaboration between researchers.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by (MC)² group:

- Structural Analysis.
- Continuum Mechanics.
- Computational Mechanics.

A current project to be highlighted is:

**AVINT - Estratègies de mecanitzat i predicció de la rugositat per a una integritat superficial òptima**

The main objective of the AVINT project is to increase the efficiency and competitiveness of the processes by producing pieces with optimum surface roughness and integrity, predicting the roughness before the production of the pieces and acting in the design phase, before the Its production, thus avoiding the generation of defective pieces.

The project is divided into three parts:

OG1. Increase the efficiency of the processes of machining for the increase of surface quality and the reduction of defective parts by developing an application to predict roughness.

OG2. Increase the efficiency of machining processes through innovation in machining strategies that allow optimization of surface integrity.

OG3. Increase the competitiveness of machining processes for the acquisition of pieces of greater added value.

**UPC's amount: 125.158,44 €.**
### Competitive Project 1
Filtered adjoint-based techniques for mesh optimization to enable predictive wind field assessment in complex environments. Funding Entity: Technische Universität München. Start date: 2018-03-01; End date: 2021-03-31.

### Competitive Project 2

### Key Words
- Computational mechanics
- Finite elements
- Material design
- Numerical analysis
- Numerical Methods
- Numerical modelling
- Parallel calculus
- Pre-conditioners
- Structural analysis
- Turbulence

### Research Team
- 33 researchers.
- 4 PhD student.

### Contact
- Person in Charge: Agelet de Saracibar Bosch, Carlos (agelet@cimne.upc.edu).
- Phone: (+34) 93 401 64 95.
MECMAT

Research Centre/Group

Name: Mechanics of Materials
Web: https://futur.upc.edu/MECMAT

General Description of the Activity

The Mechanics of Materials (MECMAT) group carries out its research on the study of engineering materials on various scales, from nano to macro. The group emphasizes on the material mechanical behaviour, diffusion, deterioration, durability and coupled processes by using numerical and experimental techniques, as well as the corresponding groundwork and theoretical study.

MECMAT research group is mainly specialized in mechanics of unsaturated, explosive and collapsible soil. Numerical, experimental and theoretical studies are applied in order to solve problems with practical importance such as high-intensity nuclear waste storage, land and soil dams in countries with dry climates.

In addition, the group works on the quasi-fragile materials by modelling them from concepts of damage and fracture, and the numerical modelling of mechanical and environmental deterioration processes.

Specific Areas of Research

The following activities define the priorities currently pursued by MECMAT group:

- Geotechnics.
- Mechanics of materials.
- Soil Mechanics.

Competitive Projects

A current project to be highlighted is:

**Physical soil deterioration due to environmental actions: technological solutions for risk mitigation**

This research project focuses on the study of techniques to mitigate the physical deterioration of soil undergoing drying processes. The most important benefit of the project is the development of technologies to reduce or mitigate the impact of soil deterioration on infrastructure, agriculture and natural heritage.

The objective is to reproduce the physical processes involved and simulate the evolution of the variables measured in the tests. An important element for this is the atmospheric boundary condition, including solar radiation and wind velocity, in the heat and water vapour (evaporation) flows on the ground surface. Experience has shown that soil shrinkage and subsequent cracking are highly dependent on evaporation rate, soil type and boundary conditions. The incorporation of geosynthetics in the soil mass clearly conditions these aspects.

UPC’s amount: 128,260,00 €.
### Competitive Project 1

**Degradación de cementos de pozos por ataque ácido en almacenamiento de CO2, estudio experimental y simulación numérica.** Funding entity: Ministerio de Educación y Ciencia. UPC’s amount: 109.000,00 €. Start date: 2016-12-30; End date: 2020-12-29.

### Competitive Project 2

**Integrated rooftop greenhouses: symbiosis of energy, water and CO2 emissions with the building Towards urban food security in a circular economy.** Funding entity: Ministerio de Economía y competitividad. UPC’s amount: 96.800,00 €. Start date: 2016-12-30; End date: 2019-12-29.

### Key Words

- Breakage
- Concrete
- Constructive equations
- Cracking
- Fracture
- Fragile materials
- Instability
- Laboratory
- Models
- Non-saturated soils
- Particle method
- Rock mechanics
- Soil mechanics

### Research Team

- 4 researchers.

### Contact

- **C/ Jordi Girona, 3, 08034, Barcelona. Campus Nord Building D2.**
- **Person in Charge: Carol Vilarasau, Ignacio (ignacio.carol@upc.edu).** Phone: (+34) 93 401 65 09.
MSR

Name: Soil and Rock Mechanics
Web: https://futur.upc.edu/MSR

GENERAL DESCRIPTION OF THE ACTIVITY

The Soil and Rock Mechanics (MSR) research group carries out research in soil and rock mechanics in the field of geomechanics. The group is also active in a wide range of geological and geotechnical engineering fields such as slope stability, foundations, excavations, tunnels, the evaluation of geological risks and waste disposal.

One widely recognised activity of the group is these in unsaturated soil mechanics and in the application in advanced numerical methods.

SPECIFIC AREAS OF RESEARCH

The following activities define the priorities currently pursued by MSR group:

- Geomechanics.
- Geological and geotechnical engineering.

TYPE OF ACTIVITY SINCE 1974

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<thead>
<tr>
<th>Type of Activity</th>
<th>Quantity</th>
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<tr>
<td>Theses</td>
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COMPETITIVE PROJECTS

A current project to be highlighted is:

*Physical soil deterioration due to environmental actions: technological solutions for risk mitigation*

This research project focuses on the study of techniques to mitigate the physical deterioration of soil undergoing drying processes. The most important benefit of the project is the development of technologies to reduce or mitigate the impact of soil deterioration on infrastructure, agriculture and natural heritage. The project includes two lines of action, one experimental and another theoretical-numerical. In both, the study of compacted soils, instead of the soil with excess water from previous projects, is proposed. This is intended to better reproduce applications in engineering, which are always with compacted soils.

**UPC’s amount: 128.260, 00 €.**

Competitive Project 2  
High Temperature Underground Thermal Energy Storage  PCI2018-092933. Funding Entity: Agencia Estatal de Investigación. BIA2017-84752-R. UPC’s amount: 100.000,00 €; Start date: 2018-09-03; End date: 2021-09-02.

Competitive Project 3  

Competitive Project 4  
Applications of coupled termo-hydro-mechanical simulation in landfill operation and maintenance  Funding Entity: AGAUR. UPC’s amount: 220.875,00 €; Start date: 2017-06-01; End date: 2021-05-31.

KEY WORDS
- Concrete
- Constructive equations
- Cracking
- Fracture
- Fragile materials
- Instability
- Laboratory
- Models
- Non-saturated soles
- Particle method
- Rock mechanics
- Soil mechanics

RESEARCH TEAM
- 10 researchers.

CONTACT
- Person in Charge: Alonso Pérez Agreda, Eduardo (eduardo.alonso@upc.edu). Phone: (+34) 93 401 68 62.
RMEE

**RESEARCH CENTRE/GROUP**

Name: Strength of Materials and Structural Engineering Research Group  
Web: https://futur.upc.edu/RMEE

**GENERAL DESCRIPTION OF THE ACTIVITY**

The **Strength of Materials and Structural Engineering Research Group (RMEE)**'s scientific activity lies in developing computational mechanics methods for modelling engineering problems.

The Group assumes how to respond to the new needs of the industrial and business fabric that arise as a result of the changes that occur in technological and economic fields. With this objective, the group collaborates closely in the development of specific research projects that provide solutions and sustainable growth to society in general and its environment in particular. It also offers personalized services and according to the specific requirements of business services.

**SPECIFIC AREAS OF RESEARCH**

The following activities define the priorities currently pursued by RMEE group:

- Numerical modelling of industrial manufacturing processes.
- Numerical modelling of the mechanical behaviour of materials and structures.
- Advanced tools for the computational design of engineering materials.

**COMPETITIVE PROJECTS**

A current project to be highlighted is:

**ExaQute, EXAscale Quantification of Uncertainties for Technology and Science Simulation**

The ExaQute project aims at constructing a framework to enable Uncertainty Quantification (UQ) and Optimization Under Uncertainties (OUU) in complex engineering problems using computational simulations on Exascale systems.

New theoretical developments will be carried out to enable its combination with adaptive mesh refinement, considering both, octree-based and anisotropic mesh adaptation.

The methods and tools developed in ExaQute will be applicable to many fields of science and technology. The chosen application focuses on wind engineering, a field of notable industrial interest for which currently no reliable solution exists. This will include the quantification of uncertainties in the response of civil engineering structures to the wind action, and the shape optimization taking into account uncertainties related to wind loading, structural shape and material behaviour.

UPC’s amount: 257.000,00 €.
Competitive Project 1  |  Filtered adjoint-based techniques for mesh optimization to enable predictive wind field assessment in complex environments. Funding Entity: Technische Universität München. Start date: 2018-03-01; End date: 2021-03-31.

Competitive Project 2  |  RESILTRACK - Resilience of railway infrastructures against Climate Change. Funding Entity: Centro para el Desarrollo Tecnológico Industrial (CDTI). Start date: 2018-01-01; End date: 2021-12-31.

Competitive Project 3  |  AVINT - Estrategies de mecanitzat i predicció de la rugositat per a una integritat superficial óptima (Comunitat RIS3CAT Industries del Futur). Funding Entity: Agència per a la Competitivitat de l'Empresa. Total amount: 125,158,44 €. Start date: 2018-01-01; End date: 2020-12-31.

KEY WORDS

- Computational Mechanics
- Materials design
- Numerical methods
- Numerical modelling
- Structural Analysis

RESEARCH TEAM

- 25 researchers.
- 1 administrative staff.

CONTACT

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