

## Research Areas

Structural Engineering and Materials, Geotechnical Engineering and Geosystems, Environmental Engineering and Sustainability, Urban and Architectural Planning and Design, and IT for Construction Engineering are the main research areas of the Department of Civil and Environmental Engineering at KAIST.

### □ Structural Engineering and Materials

#### - Concrete Laboratory

Main research fields are the performance improvement, investigation of the mechanical characteristics and structural analysis of the concrete which is classic material in civil engineering. The development of the new structural materials and mechanical engineering are also studied.

#### -Structural Design Laboratory

Primary research efforts in the structural design laboratory focus on the analysis, design and construction of structure including bridge. Also, propose effective and economical construction scheme based on analysis of the structural system.

#### - Structural Analysis & Materials Research Laboratory

Structural Analysis & Materials (SAM) Research Lab focuses on development of modeling and simulation, analysis of composite materials. In particular, SAM Research Lab has studied repair systems using CFRP (Carbon Fiber Reinforced Polymer) strips or sheets and SFRP (Sprayed Fiber Reinforced Polymer) for increasing flexure, load carrying capacities and ductility of damaged concrete structures. The latest researches in SAM Research Lab include an experimental study on mechanical properties of lightweight aggregate, electromagnetic shielding and radiation shielding concrete, etc.

#### - Smart Structures and Systems (SSS) Laboratory

SSS laboratory develops sensing, signal processing, and machine learning techniques relevant to the fields of Structural health monitoring (SHM) and Non-Destructive testing to assess and ensure the safety and integrity of civil infrastructure, mechanical systems, aircraft and micro devices.

#### -Structure Control and Intelligent Systems Laboratory (SCaIS Lab)

SCaIS Lab seeks to develop innovative structural control systems based on smart materials such as MR fluid/elastomer and energy harvesting techniques such as electromagnetic/piezoelectric transduction mechanism.

We also conduct research on applying advanced measurement/actuation technologies including wireless sensor network and piezoelectric sensors/actuators to civil infrastructure such as bridges and buildings.

#### - Advanced Applied Mechanics Laboratory (AAML)

Physical behavior of structures and materials is being investigated by applying various numerical analysis techniques. A Lamb wave phased array system is developed using finite element method, and the simulation of the Lamb wave propagation is being studied. The mechanical reliability of electric circuits under shock and thermal cycling conditions is evaluated. Also, program parallelization is implemented for more efficient calculation. Additionally, numerical studies on thin-film blisterings in nano-scale, failure

characteristics of building structures under impact and blast loadings, Peridynamics and others are being conducted.

#### **□ Geotechnical Engineering and Geosystems**

##### **- Geotechnical Engineering Laboratory**

Our laboratory conducts researches on analysis, design, construction, and maintenance of geo-structures constructed on soft-clay and unsaturated weathered soils. The main target structures are embankments on soft-clay, earth dams, and slopes. Especially, we aim to develop an optimum system for the complex geo-structures. We not only perform fundamental researches related to the stress-strain behavior characteristics of soil materials, but also develop numerical analysis techniques and softwares for the analysis and design of related geo-structures. Recently, we have developed a CFD-based finite element modeling for analyzing thermal behaviors of Ground Coupled Heat Pump (GCHP) system as well as thermal energy storage (TES) system.

##### **- Soil Dynamics Laboratory**

Researches soil dynamic property evaluation by field/laboratory test, offshore foundation and anchor design, and seismic design for geotechnical structures. Research focused on reproducing natural and manmade disaster like earthquake and flood, and developing centrifugal model experiment technique for safety evaluation and performance improvement of geotechnical structure by using world-class geotechnical centrifuge and shaking table.

##### **- Geosystems laboratory,**

Geosystems laboratory founded in June 2002, is dedicated to overcoming the limits of nature and civilization through focused research on creation of new space and development of alternative energy. Using world-class elastic wave and electrical resistivity techniques, we understand the behavioral properties ranging from minuscule soil particles to large-scale underground spaces and also conduct numerous research in various fields, such as the design and construction of underground space, development of alternative construction methods for large-scale construction in urban areas, properties of gas hydrate-bearing sediments and geological CO<sub>2</sub> storage within sub-seabed sediments.

#### **□ Environmental Engineering and Sustainability**

##### **-Environment Management & Research Laboratory**

EMRL is carrying researches of technologies and policies development in subject to Integrated water management for sustainable water and civil environment, green infrastructure regeneration, and resilience to disaster within civil water infrastructure.

##### **-Environmental Geobiochemical Research Laboratory**

We study and research treatment and remediation technologies to treat soil and water contaminated with all sorts of contaminants. And find out hidden theories and reaction mechanisms related to the reactions in environmental processes and systems using cutting edge experimental and simulation techniques.

-Environmental Biotechnology and BioEnergy Laboratory

Based on microbial research with specific purpose and high efficiency, research is mainly focused on the environmental-friendly bioenergy production through bioethanol, biodiesel, and microbial fuel cell.

-Environmental Microbiology Laboratory

Environmental Microbiology Laboratory focuses on understanding and harnessing microbial reactions to find solutions to various environmental problems including global warming and chemical contamination. Our research group seeks solutions to reduce the greenhouse gas (CH<sub>4</sub> and N<sub>2</sub>O) emission from natural and engineered environments by understanding and manipulating the microbial C- and N-cycles. Our research group will also carry out research on bioremediation of various organic and inorganic contaminants.

**□ IT, Planning and Transportation**

IT-based civil engineering research fields focus on the fusion technologies between IT and civil engineering including civil robotics, intelligent construction automation, and U-City management that are aimed at constructing smart and sustainable environment. We also focus on a variety of domains ranging from urban and architectural theories, design methodology, representation and visualization techniques, structural and ecological sustainability. Our department also considers transportation engineering as a study of providing accessibility rather than the flow of people and goods as traditionally defined.

- Smart & Sustainable Environment Laboratory

Smart & Sustainable Environment Lab (SSEL) pursues ubiquitous information technologies such as mobile communication, sensor networks, RFID, BcN, interactive multimedia, LBS, multimodal interfaces, context-aware computing, intelligent robots as well as green technologies to apply virtuous circulation of energy, heat, light, sound, air, and materials to sustainable ecosystems in the domains of architecture, civil engineering, urban planning and environmental design.

- Smart Transportation System

Smart Transportation System Lab aims to deliver effective and sustainable transport systems and community by modeling of transport phenomena, prediction and safety using information and communication technology combined with intelligent transportation systems

- Transportation Research and Urban Engineering Laboratory

Transportation Research and Urban Engineering (TRUE) Lab's research objective is to offer solutions to problems in complexly connected transportation and social infrastructure systems by data-driven analysis including statistical methods and simulation techniques. The solutions encompassing economical and operational engineering aspects aim to build a foundation for a sustainable and intelligent urban environment in future.

- Urban Robotics Laboratory

Urban Robotics lab (URL) focuses on the development of fusion technologies between IT and civil engineering. The research fields include structural health monitoring and inspection robots, localization and autonomous robot navigation in ubiquitous city, 3D modeling and perception of civil structures, and management robot for ubiquitous city, etc.

- Intelligent Robotic Autonomy and perception Laboratory

Intelligent Robotic Autonomy and Perception (IRAP) Lab focuses on robotics problems in civil and environmental engineering applications. Targeting many hardly accessible or dangerous sites in the environment, IRAP Lab solves for robot autonomy dealing with perceptual sensor data. Main research interest and detailed robotics topics include perception based environment mapping, intelligent sensor fusion, decision making and control of the robotic agents, robotic operation and navigation in GPS-denied environments (e.g., underwater, indoor).