GLOBAL INNOVATION

MONASH University

RESEARCH PROFILE

DEPARTMENT OF CIVIL ENGINEERING

FACULTY OF ENGINEERING

eng.monash.edu
The Department of Civil Engineering at Monash University is renowned for the societal relevance and impact of its innovative research.

With a vision for global leadership in education and research, our mission has a dual purpose:

- to equip tomorrow’s leaders with the skills to meet the demands of the future, and
- to help build a better future through innovative and resilient solutions to the world’s challenges.

In 2012 the Excellence in Research Australia (ERA) initiative awarded the Department five stars for its research activities. Only one other civil engineering department in Australia was awarded this status.

**MESSAGE FROM THE HEAD OF MONASH CIVIL ENGINEERING**

The Department of Civil Engineering invites and welcomes collaborations with industry and researchers across a range of disciplines. We provide quality research and research training in the areas of geomechanics, structures, transport, water, and environmental and mining engineering.

We hope that you are excited by our research activities and look forward to engaging with you in the near future.

Prof Jeffrey Walker

**KEY RESEARCH THEMES**

The Department’s research expertise encompasses three main themes:

**ENERGY, WATER, AND RESOURCES**

Supports innovations in the sustainable use of energy, water and resources to create a better future for all.

**RESILIENCE, INFRASTRUCTURE AND SOCIETY**

Supports infrastructure adaption to ensure it can withstand significant and unexpected changes.

**MONITORING, PREDICTION AND PROTECTION**

Supports the development and integration of monitoring and prediction technologies to better protect society.

The diagram above illustrates the interrelationship of each key theme. It also highlights seven areas of focus – each of which is outlined in this brochure.

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ADDRESSING A MAJOR WORLDWIDE CHALLENGE

Our world's major cities and regional communities could benefit enormously from more sustainable infrastructure. Improved transport, communications, buildings and essential services (such as water, gas and sewer) would make societies more liveable and productive.

Our ‘Sustainable Infrastructure’ initiative focuses on new solutions for infrastructure planning, design, adaptation, analysis and performance monitoring for the benefit of society.

With so many growing populations, the need to adapt and expand our infrastructure in more advanced ways - and better protect existing infrastructure - is greater than ever before.

SOLUTION AREAS

- Optimising transport and the structural reliability of roads and bridges
- Understanding and combating the accelerated deterioration of structures in corrosive environments
- Improving the resilience of water, gas and wastewater infrastructure (such as pipelines, sewers and dams) under new demands

ENGINEERING FOR EXTREMES

PROTECTING SOCIETY WITH RESILIENT INFRASTRUCTURE

Floods, fires, earthquakes and tsunamis are all wretched realities of our natural world. Such extreme events can devastate society - including its infrastructure. Meanwhile explosions and terrorist attacks create more shocking problems.

The ‘Engineering for Extremes’ initiative aims to improve the resilience of society’s infrastructure in the face of extreme events. Our research also factors in mega events – such as cultural festivals and sporting events – imposing infrastructure pressures at scales greater than anticipated.

Our multidisciplinary team is developing models and solutions aimed at:

- predicting the outcomes of extreme events
- warning society in advance of extreme events
- protecting society from extreme events through re-engineered infrastructure.

SOLUTION AREAS

- Designs that protect against natural and man-made events
- Travel demand management during mega events
- Evacuation planning during panic situations
- Improved flood forecast prediction and mitigation
- Fire spread prediction

WATER SENSITIVE URBAN DESIGN

SECURING OUR PLANET’S URBAN WATER SUPPLY

Climate change and population growth both threaten the earth’s future water supply. That’s why adoption of Water Sensitive Urban Design (WSUD) principles across society is so critical.

Also known as Low-Impact Development and Integrated Urban Water Management, WSUD aims to integrate urban water cycle management and urban planning and design through strategies such as:

- water conservation
- reliance on natural processes
- waste management
- environmental protection.

This initiative at Monash University focuses on adoption of WSUD principles across society – and ensuring a successful transition from traditional infrastructure.

SOLUTION AREAS

- Visualising urban water management scenarios
- Quantifying flood risk
- Providing diverse water supply sources (such as treated stormwater, wastewater and groundwater)

SMART STRUCTURES

REDACTING OUR ENVIRONMENTAL IMPACT

Many of today’s structures and construction technologies operate inefficiently. They consume too much material, labour and energy - sacrificing our environment and its natural resources.

The ‘Smart Structures’ initiative aims to address this challenge through the development of smarter structural materials, construction technologies and monitoring systems.

Lighter, stronger and more durable civil structures are now possible with the development of fibre reinforced polymer composites and engineering nano-composites. With an integrated design approach, these structural components can serve multiple functions.

What’s more, modern modular construction and 3D printing technology make ‘made-to-measure production’ possible – further reducing societal and environmental impact.

SOLUTION AREAS

- Fibre reinforced polymer composites and engineering nano-composites
- Modular construction and 3D printing technologies
- Intelligent structural control and health monitoring

SUSTAINABLE INFRASTRUCTURE

FOCUS AREAS OF RESEARCH

ENGINEERING FOR EXTREMES

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SUSTAINABLE INFRASTRUCTURE

FOCUS AREAS OF RESEARCH
DEEP EARTH
ENERGY

Worldwide demand for energy is steadily increasing – as is the demand for sustainable energy development and environmental protection solutions. Integral to Australia’s transition to a new energy economy is the Deep Earth and its potential for producing sustainable resources and containing waste. Tomorrow’s Australia must fully understand the viability of using Deep Earth resources and the impact of doing so.

In this innovative research, Monash is making important contributions to coal seam gas, shale gas, geothermal energy and carbon sequestration. Research focuses on feasibility assessment and solutions that address the technical problems impeding progress in this exciting area.

SOLUTION AREAS
- Low-emission unconventional hydrocarbon (oil and gas including shale gas) resources and advanced low-emission methods for extraction and production
- Deep geological carbon dioxide sequestration
- Cleaner coal technology, including underground coal gasification and coal-seam gas
- Understanding fluid flow systems in geothermal energy
- Deep Earth exploration, mining and management - and deep geological nuclear waste storage

SENSING TECHNOLOGIES

DEVELOPING NEW MONITORING TECHNOLOGIES

Monitoring data is critical to society. It helps us understand physical processes, validate models and constrain predictions.

The ‘Sensing Technologies’ initiative focuses on the development and testing of new monitoring technologies - including in-situ, proximal and remote sensing platforms. We are also investigating new uses for existing technologies.

Application areas range from monitoring structural health to the temporal evolution of the natural environment using ground, air and satellite platforms.

SOLUTION AREAS
- Calibration and validation contributions to NASA, ESA and JAXA satellites for soil moisture and vegetation monitoring using airborne simulators and ground-based sensors
- New environmental technologies that use GPS and mobile phone tower signals for soil moisture and precipitation monitoring
- Pipeline failure monitoring using strain sensor networks and measuring leakage
- Embedded sensor technologies to monitor structural integrity
- Monitoring networks to inform transport routing and evacuation systems

MODEL-DATA FUSION

ACHIEVING A MORE RESILIENT SOCIETY

Numerical models are critical to the prediction of extreme events and our understanding of physical processes. However, models isolated from data are highly uncertain.

The ‘Model-Data Fusion’ initiative seeks to address societal problems by developing new algorithms - and using existing algorithms in new ways - to combine observations with model predictions.

Our research encompasses all techniques related to model-based prediction through model confrontation with data. Studied algorithms include:
- filtering and smoothing techniques
- real-time control
- uncertainty analysis
- parameter estimation.

SOLUTION AREAS
- Structural analysis for improved safety and resilience
- Traffic behaviour for crowd control and travel time optimisation
- Flood and drought management for damage mitigation and higher security
- Urban development for improving quality of living and more liveable cities

STUDENTS

If you would like to contribute to the future of society and our pioneering research, the Department of Civil Engineering at Monash would like to hear from you.

As a PhD student, you will have access to world-class facilities furnished with highly specialised equipment and software.

To learn more about our research activities:
Visit www.eng.monash.edu.au/civil/research

To learn more about entry requirements, fees, scholarships and how to apply:
Visit www.eng.monash.edu.au/research/apply
Phone (+61) 3 9905 1956

INDUSTRY

The Department of Civil Engineering provides expert services to industry, professional bodies and the wider community.

Our academic and research teams are actively involved in industry-based research. We remain committed to delivering high quality research outputs that are relevant to Australian industry and society at large.

To learn more about partnership opportunities with the Department:
Visit www.eng.monash.edu.au/civil/research
Phone (+61) 3 9905 1956
The Department of Civil Engineering runs a range of undergraduate and postgraduate programs including:

- Bachelor of Engineering (Hons) in Civil Engineering
- Bachelor of Environmental Engineering (Hons)
- Bachelor of Mining Engineering (Hons)
- Bachelor of Engineering (Hons) and Bachelor of Architectural Design
- Bachelor of Engineering (Hons) and Arts
- Bachelor of Engineering (Hons) and Laws
- Bachelor of Engineering (Hons) and Science
- Master of Advanced Engineering
- Master of Transport (off-campus)
- Master of Infrastructure Engineering and Management (off-campus)
- PhD