The Department of Civil & Environmental Engineering has launched its innovative MSc in Civil Engineering programme, which attracts graduates with a background in any discipline of Civil Engineering. Applicants with a degree in environmental engineering, earth-science, maths, physics and mechanical engineering may also be considered.

- **MSc in Civil Engineering**
- **Or an optional specialist stream**
  - MSc in Civil Engineering with **Structural** Engineering and Project Management
  - MSc in Civil Engineering with **Geotechnical** Engineering and Project Management
  - MSc in Civil Engineering with **Geoenvironmental** Engineering and Project Management
  - MSc in Civil Engineering with **Water** Engineering and Project Management – NEW!

Engineering graduates are in great demand from recruiting companies worldwide. The overall aim of the MSc course in Civil Engineering is to meet the needs of a broad range of engineering industries by providing high calibre masters level students with the specialist and generic skills necessary to lead future developments.

Students can choose to graduate with an MSc in Civil Engineering (giving them the highest possible choice of modules) or, uniquely, students can choose to follow one of the specialist named streams in: Structural Engineering and Project Management; Geotechnical Engineering and Project Management; Geoenvironmental Engineering and Project Management or Water Engineering and Project Management.

**LEARNING OBJECTIVES**
- Provide students with the knowledge and skills to equip them for a career in civil engineering;
- Prepare students for a successful career through the development of critical, analytical, problem-based learning;
- Instil confidence in students to take on new challenges and to adapt and respond positively to change and to opportunities within their profession, in society and the environment;
- Enhance the development of students’ interpersonal and team working skills;
- Prepare students for graduate employment and nurture an attitude of self-motivation towards life-long learning and Continuing Professional Development;
- Instil an aspiration to the highest professional levels through analytical rigour, creativity and innovation, business awareness and environmental and societal responsibilities;
- Establish the educational requirements for eventual registration as a Chartered Engineer.

**ACCREDITATION**
- The MSc Civil Engineering programme (including the specialist streams except for the water engineering stream) has been fully accredited by Joint Board of Moderators - JBM (www.jbm.org.uk). The accreditation of MSc in Civil Engineering with Water Engineering and Project Management will be applied three years after initial launch in 2016.

**DESIGN PROJECTS & INDUSTRY COLLABORATION**
All students take the 20 credits compulsory module “Civil Engineering Design Projects” (CL518). This class gives students the opportunity to work on real projects. The projects take in the full breadth of the civil engineering profession from concept to detailed design, from political drivers to financial viability, from environmental issues to technical risk. Students develop comprehensive and innovative designs that involve structural engineering, geotechnical engineering and water engineering, management, environmental and financial planning.

The students then have access to a wide range of options that are listed below as List A and List B. One of the option classes (CL973 Independent Study in Collaboration with Industry), allows students the possibility (provided students are selected competitively via CV) to carry out another project in collaboration with industry, increasing the practical component of this MSc.
COURSE STRUCTURE & CURRICULUM

This **one-year full-time MSc course** comprises two semesters of taught classes. Following successful completion of the 120 credit taught modules, MSc candidates will proceed to the research dissertation (60 credits).

Compulsory for all students: CL518/519 Civil Engineering Design Projects (20 credits); CL 986 Research Protocols for Science & Engineering (10 credits)

**Full List of Taught Classes** (See diagram below for options based on the MSc title undertaken)

<table>
<thead>
<tr>
<th>LIST A</th>
<th>LIST B</th>
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<tbody>
<tr>
<td>CL507  Ground Improvement and Reinforcement (10 credits)</td>
<td>CL946  Global Water Policy (10 credits)</td>
</tr>
<tr>
<td>CL906  Site Investigation and Risk Assessment (10 credits)</td>
<td>CL504  Financial Engineering (10 credits)</td>
</tr>
<tr>
<td>CL510  Advanced Structural Analysis and Design (10 credits)</td>
<td>CL948  Principles of Environmental Microbiology (10 credits)</td>
</tr>
<tr>
<td>CL514  Rock Mechanics, Tunnelling and Groundwater (10 credits)</td>
<td>CL978  Water &amp; Wastewater Treatment Design (10 credits)</td>
</tr>
<tr>
<td>CL976  Prestressed Concrete, Composite Materials and Structural Stability (10 credits)</td>
<td>CL960  Fundamentals of Environmental Forensics (10 credits)</td>
</tr>
<tr>
<td>CL904  Waste Management and Landfill Design (10 credits)</td>
<td>CL965  Science, Technology and Innovation Policy (10 credits)</td>
</tr>
<tr>
<td>CL923  Rock Mechanics, Tunnelling and Groundwater (10 credits)</td>
<td>CL970  Environmental Pollution Management (10 credits)</td>
</tr>
<tr>
<td>CL935  Hydrogeology (10 credits)</td>
<td>CL971  Air Pollution, Climate Change &amp; Human Health (10 credits)</td>
</tr>
<tr>
<td>CL951  Groundwater Flow Modelling (10 credits)</td>
<td>CL973  Independent Study in Collaboration with Industry (10 credits)</td>
</tr>
<tr>
<td>CL952  Aquifer Mechanics (10 credits)</td>
<td>17540  Transport Development and Sustainability (10 credits)</td>
</tr>
<tr>
<td>CL954  Contaminated Land (10 credits)</td>
<td>CL961  Geographical Information Systems (10 credits)</td>
</tr>
<tr>
<td>EF931  Project Management (10 credits)</td>
<td>EF927  Design Management (10 credits)</td>
</tr>
<tr>
<td>NM969  Renewable Marine Energy Systems (10 credits)</td>
<td>EF932  Risk Management (10 credits)</td>
</tr>
<tr>
<td>CL978  Water &amp; Waste Treatment Design (10 credits)</td>
<td>EV908  Pollution and Rehabilitation of Degraded Ecosystems (10 credits)</td>
</tr>
<tr>
<td>CL9XX Urban Water Supply and Drainage Systems (10 credits)</td>
<td>EV939  Environmental Impact Assessment (10 credits)</td>
</tr>
<tr>
<td>EV921  Water and Environment Management (10 credits)</td>
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<tr>
<td>CL917  Slopes &amp; Walls (10 credits)</td>
<td></td>
</tr>
<tr>
<td>CL976  Prestressed Concrete, Composite Material and Structural Stability (10 credits)</td>
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</tbody>
</table>
MSc Civil Engineering
CL518 CL986 (30 core credits)

Select 60 credits option modules (from List A)
And 30 credits option modules (from List A or B)

Career Options:
Design, development and construction of a huge range of projects in the built and natural environment

MSc Civil Engineering with Structural Engineering & Project Management
CL518 CL986 (30 core credits)

Take the following 40 credits of core modules:
CL510 Advanced Structural Analysis and Design
CL976 Prestressed Concrete, Composite Materials and Structural Stability
CL507 Ground Improvement and Reinforcement
EF931 Project Management

Plus 50 other optional credits from Lists A or B

Career Options:
Building Construction; Structural Design; Consultancy; Project Management; Disaster Relief; Academia

MSc Civil Engineering with Geotechnical Engineering & Project Management
CL518 CL986 (30 core credits)

Take the following 40 credits of core modules:
CL507 Ground Improvement and Reinforcement
CL514 Rock Mechanics, Tunnelling and Groundwater
CL917 Slopes and Walls
EF931 Project Management

Plus 50 other optional credits from Lists A or B

Career Options:
Geotechnical Engineer; Specialist Design; Numerical modelling; Consultancy; Project Management; Academia

MSc Civil Engineering with Geoenvironmental Engineering & Project Management
CL518 CL986 (30 core credits)

Take the following 40 credits of core modules:
CL906 Site Investigation and Risk Assessment
CL954 Contaminated Land
CL904 Waste Management and Landfill Design
EF931 Project Management

Plus 50 other optional credits from List A or B

Career Options:
Site Investigation; Environmental remediation; Project Management; Consultancy; Waste Management; Academia

MSc Civil Engineering with Water Engineering & Project Management
CL518 CL986 (30 core credits)

Take the following 40 credits of core modules:
CL978 Water & Waste Treatment Design
CL9XX Urban Water Supply and Drainage System
EV921 Water and Environment Management
EF931 Project Management

Plus 50 other optional credits from List A or B

Career Options:
Water Engineering; Urban Water System Design and Analysis; Drainage System Design; Water Policy and Management; Academia
SUMMARY CLASS (MODULE) DESCRIPTORS
Compulsory Core Class for all MSc Civil Engineering students (including specialist streams)

CL518 Civil Engineering Design Projects (20 credits) (Dr Richard Lord)

Renewable Energy Project
The project takes in the full breadth of the civil engineering profession from concept to detailed design, from political drivers to financial viability, from environmental issues to technical risk. Students will develop comprehensive and innovative designs that involve structural engineering, geotechnical engineering and water engineering, management, environmental and financial planning.

CL986 Qualitative and Quantitative Research Methods (10 credits) (Dr. Elsa João)
Students will acquire familiarity with, and practice of, research techniques, and examine different ways of, and gain experience in, presenting research results. The class discusses the key principles, and practical exercises, on both quantitative and qualitative research methods, including survey methods, interviewing techniques, use of census data and statistical methods. The class also includes discussion of ethical issues. Finally, there is dissertation-related teaching on choosing a research question and a research method, and writing a research proposal. This is a semester 1 and 2 class but meetings do not happen every week.

Compulsory core classes for students undertaking specific specialisms:

MSc Civil Engineering with Structural Engineering & Project Management

CL510 Advanced Structural Analysis and Design (10 credits) (Dr Yixiang Xu)
This class examines the links between form, geometric shape, and structural performance and design. It deals with different ways of breaking up a continuum, and how this affects global structural properties; structural concepts and preliminary design methods that are used in tension structures and deployable structures. Geometric foundations, surfaces; space frames, cable and membrane structures, form-finding, wrinkle-free pneumatic domes, balloons, tension-stabilized struts, tensegrity domes; deployable and adaptive structures, coiled rods and their applications, flexible shells, membranes, structural mechanisms, actuators, concepts for smart structures will all be addressed.

Students will be able to use Matlab computing package to implement computational analysis which is applicable to form-findings of advanced shell or membrane structures. They will also be able to design basic novel structures, e.g. balloon and retractable roof.

The aim of this class is also to understand the fundamental principles of composite structures.

CL976 Prestressed Concrete, Composite Materials and Structural Stability (10 credits) (Dr Yixiang Xu)
The overall aim of the module is to provide strong skills in the structural behaviour, analysis and design of civil engineering structures. The first part of the module (5 credits) will give students understanding of the fundamental principles of structural stability and become familiar with common types of bifurcation and buckling phenomena and to formulate methods capable of dealing with geometrically non-linear structural behaviour. The second part of the module (5 credits) will give students understanding of structural behaviour structural systems (with appropriate design and analysis methods) commonly adapted by the construction industry including prestressed concrete and concrete-steel composite members.

CL507 Ground Improvement and Reinforcement (10 credits) (Dr Mike Kenny)
This class covers the principles & techniques of ground improvement (grouting, vertical drains, vibro methods etc.) and soil reinforcement (reinforced earth and soil nailing), and apply the appropriate design methods in various ground conditions, including the use of computer-aided design.

MSc Civil Engineering with Geotechnical Engineering & Project Management

CL514 Rock Mechanics, Tunnelling and Groundwater (10 credits) (Professor Rebecca Lunn, Professor Zoe Shipton)
The class aims to provide an understanding of sub-surface geology and rock mechanics and its influence on the engineering design of slopes and tunnels. Some aspects associated to testing of rocks both in the laboratory and in-situ are also discussed. The class provides an overview of groundwater flow through soil and rocks as well as introducing techniques for the in-situ measurement of permeability and methodologies for site investigation in dewatering projects. Some of the lectures are devoted to the analysis of pumping from aquifers including the study of pumping-induced subsidence. The well-known commercial software SEEP/W is applied to the analysis of typical groundwater flow problems through natural soil deposits and earth structures.

CL507 Ground Improvement and Reinforcement (10 credits) (Dr Mike Kenny)
This class covers the principles & techniques of ground improvement (grouting, vertical drains, vibro methods etc.) and soil reinforcement (reinforced earth and soil nailing), and apply the appropriate design methods in various ground conditions, including the use of computer-aided design.
CL917 Slopes and Walls (10 credits) (Professor Alessandro Tarantino)
This class aims to cover the design of geotechnical structures under ultimate conditions including slopes and retaining walls, based on Eurocode 7.
The syllabus will cover the following main areas: 1). Introduction to geotechnical structures: slopes and embankments, shallow foundations, pile foundations, retaining walls. 2). Stability Analysis of Geostructures. 3). Earth Retaining Structures. 4) Slope Stability

MSc Civil Engineering with Geoenvironmental Engineering & Project Management
CL906 Site Investigation and Risk Assessment (10 credits) (Dr Philippe Sentenac)
This class explores the complete sequence of a site investigation (Desk study, Site sampling organisation and techniques, Data collection and Chemical analysis) followed by data modelling and interpretation using risk assessment models.

CL954 Contaminated Land (10 credits) (Dr Christine Switzer)
This class introduces the problem of urban land reuse, the regulatory framework and risk assessment and the various remedial techniques to enable an understanding of the role of land recycling in urban development. It will allow the student to possess knowledge of the relevant planning advice and legislation and determine appropriate remediation technologies and strategies. It will also allow decisions on land recycling based on technical solutions, risk management, planning and financial constraints to be made.

CL904 Waste Management and Landfill Design (10 credits) (Dr Tara Beattie)
This class covers organizational and regulatory aspects of waste management practice in the UK: legislation, composition of domestic and industrial wastes, storage, collection, reception, and disposal of solid wastes, clinical wastes, sewage sludge disposal, recycling and recovery.

MSc Civil Engineering with Water Engineering & Project Management
Water & Wastewater Treatment Design (10 Credits) (Dr Charles Knapp)
This module aims to develop a detailed understanding of treatment processes, as well as the ability to undertake design calculations sufficient to produce a concept and detailed design of a water and wastewater treatment plant.

Water Environment Management (10 Credits) (Dr Tara Beattie)
The module develops an understanding of the physical, chemical and biological parameters within surface water and how these relate to water quality, water quality objectives and pollution control strategy. To class also provides an introduction to water and wastewater treatment.

Urban Water Supply and Drainage Systems (10 Credits) (Dr Tiku Tanyimboh)
This module aims to provide essential knowledge for the planning, management and efficient operation of urban water supply and sewerage systems.

Core module for all specialist streams
EF931 Project Management (10 credits) (Mr Brian Dickson, Dept of Chemical Engineering)
This module aims to provide students with skills relating to the use of engineering practices in Project Management with particular respect to the effective and efficient use of resources. The range of learning includes: introduction to project management techniques and project control; basic aspects of project teams; project networks; procedural and graphical presentation techniques; introduction to contract law; project budgetary control.

Option Module for those interested in Industry Collaboration
CL973 Independent Study in Collaboration with Industry (10 credits) (Dr Richard Lord, Knowledge-Exchange Director, Dept of Civil and Env Eng)
Graduates increasingly need highly developed transferable professional skills to prepare for and to gain future employment. This module will allow students carrying out placements and projects with industry to develop and refine professional skills while gaining credits in the process. One of such projects will be the small or medium sized enterprise (SME) Carbon Audit that students carry out with training from Carbon Trust. A placement type project activity is another possibility, by individual agreement. Approval of students being able to take this module would be done on case-by-case basis by MSc course leaders as an individualised learning contract. Students will be selected by competitive application and CV. [Students doing the SMS Carbon Audit will be asked to pay between £100-£250 (exact figure, which depends on subsidy and number of students taking part) to be determined later.]

Further descriptions of the modules shown in Lists A and B on page 2 can be found here:
http://www.strath.ac.uk/civeng/pg/modules/
READING

Each class (or module) will provide reading material and you are not required to undertake reading before the course starts. However, if you are interested in a relevant textbook for a specialist steam, please email civeng-pgt@strath.ac.uk for more information.

CAREER PROSPECTS FOR THE MSc CIVIL ENGINEERING

MSc Civil Engineering
High-calibre Civil Engineers are in demand throughout the world. Graduates may gravitate towards engineering consultancies, where the work normally involves planning and designing projects; or contractors, where they will be managing and overseeing works on-site; or in other aspects of the field such as working for utilities or local authorities; or for large companies such as those within oil production, mining and power generation.

MSc Civil Engineering with Structural Engineering & Project Management
Structural engineers are a key part of the design and construction team, working alongside civil engineers, architects and other construction professionals. Together they create all kinds of structures from houses, theatres, sports stadia and hospitals to bridges, oil rigs and space satellites. Additionally, structural engineers are charged with developing existing structures to ensure that they remain safe, fit for purpose and take into account environmental and sustainability issues that may not have been understood when the structures were first designed.

As well as working in building construction, you could use your skills to work in construction design, project management, research and lecturing. With experience, you could move into consultancy work, for example providing services to building insurers. You could also work overseas on construction and engineering projects, for example with disaster relief agencies.

MSc Civil Engineering with Geotechnical Engineering & Project Management
There is a huge skills shortage in the geotechnical industry worldwide and, despite the recent economic downturn, this need continues. This is partly to do with the fact that 50% of the Chartered Engineers in the field are expected to retire within ten years. There is an increasing need to respond to the demands created by ageing infrastructure, sustainable transport infrastructure and the challenges created by climate change. Geotechnical Engineering Consultants specialise in projects involving site investigation, foundation design, foundation repair and expert advice on soil, rock and groundwater aspects in relation to a project’s feasibility, buildability or dispute resolution.

The geotechnical engineering specialist stream also offers the integration of modern techniques for analysis within the syllabus, such as numerical modelling using a range of technical software. The course enables students to be at the leading edge of their profession. Additionally, the course has a significant design element, including a major design project that integrates acquired knowledge and acts as a platform for structured self-learning. The design teaching is based on the most up-to-date specialist design guidelines.

MSc Civil Engineering with Geoenvironmental Engineering & Project Management
Geoenvironmental engineering is an emerging field at the interface between infrastructure and the natural environment. The complex environmental challenges that we face in the 21st century require a transdisciplinary approach. Geoenvironmental engineers draw skills from civil and environmental engineering; earth and environmental sciences; and environmental chemistry and microbiology.

Geoenvironmental engineering graduates have exciting career opportunities in environmental risk assessment; management and remediation of contaminated soils and water; environmental impact assessment; water and sanitation engineering; water resource management; contaminant fate and transport; waste management; and international development.

MSc Civil Engineering with Water Engineering & Project Management
The World Economic Forum’s Global Risks 2015 Report ranked water as the global risk with the greatest potential to impact economies and societies over the next decade. Efficient water management is necessary to safeguard future water supplies. Water management involves planning, development and sustainable use of water resources while satisfying the relevant regulatory requirements. As well as traditional Civil Engineering, water management offers careers in areas such as water services, infrastructure management and water dependent sectors such as agriculture. In addition to new systems (for example, less than 10% of the cultivated land in Africa employs irrigation), there is an urgent need for investment to renew aging water infrastructure worldwide. Water scarcity affects more than 40% of the global population while 2.4 billion people lack access to basic sanitation services.
**LABORATORY FACILITIES**

The Department has benefitted from a £6M University investment in 2013 - with brand new, state-of-the-art research and teaching laboratory facilities which cover core areas of activity including geomechanics, microbiology, analytical chemistry and structural design.

Modern environmental and civil engineering laboratories. We are well equipped for chemical, geological and microbiological analyses of natural and engineered systems.

Students who undertake laboratory-based and design projects will have access to these state of the art facilities.

Field Investigation. We are equipped with nanoseismic systems for monitoring the mechanical evolution of soil and rock masses (landslides, ground surrounding underground waste repositories), Electrical Resistivity Tomography systems to detect clay fissuring and ground water flow in earth-structures (flood embankments, foundations), and dielectric permittivity-based sensors to monitor water flow in the sub-surface environment.

Geomechanics Laboratory. We are equipped with state-of-the art technologies for testing multiphase (unsaturated) porous geomaterials. These include suction-controlled double-wall triaxial cells, pressure plates, triaxial cells equipped with bender elements for dynamic testing, image analysis unit to monitor soil specimen deformation, instruments for measurement of pore-water tensile stress, and Mercury Intrusion Porosimeter and SEM for microstructure investigation.

Software and Numerical Modelling. The Department has access to a wide range of software packages relevant to civil and geotechnical engineering applications, including: GEOSTUDIO suite (Slope, Seep, Sigma, Quake, Temp, CTran, Air and Vadose); ABAQUS finite element packages, Ansys, Autodisk Civil 3D, Limit State, Strand 7 and Talren 4.

**KEY STAFF**
**Dr Yixiang Xu (China) - Course Director MSc in Civil Engineering programme**

*(Leader of the Structural Engineering and Project Management stream)*

Yixiang is part of the Infrastructure Research Group and works to provide innovative solutions for the environment, infrastructure and transportation. He is interested in the area of numerical study of advanced space structures as well as and design and analysis of infrastructural structures, e.g. portal frame and web crippling. He obtained his B.Eng at the department of Mechanical Engineering and Automation, Shanghai Jiao Tong University, China in 2002. Subsequently, he carried out research in shell and inflatable membrane structures in Deployable Structures Lab (DSL) at Cambridge University and finished his PhD in 2007. Before he took up his current appointment, he was a specialist engineering consultant at Scott Wilson Ltd.

**Professor Alessandro Tarantino (Italy) (Leader of the Geotechnical Engineering and Project Management stream)**

Alessandro has expertise in the mechanical and hydraulic behaviour of three-phase porous geomaterials, the behaviour of geostuctures above the water tables, and the development of experimental techniques for laboratory and field applications. His research interests lie in the hydro-mechanical behaviour of unsaturated soil. He is also currently working on climate-adaptive and low carbon footprint geostuctures. He has been cooperating with major academic institutions in Europe (France, Spain, Switzerland, Italy).

**Dr Christine Switzer (USA) (Leader of the Geoenvironmental Engineering and Project Management stream)**

Dr Christine Switzer specialises in contaminant fate, transport and remediation with emphases on non-aqueous phase liquids (NAPLs) and aggressive remediation technologies. She is currently working on an innovative, patent-pending method for in-situ smouldering remediation. Other projects include innovative uses for biochar for water and soil contamination and rehabilitation of soils after remediation efforts. She has strong research links with Canada, the USA and Malawi.

**Dr Tiku Tanyimboh (Leader of the Water Engineering and Project Management stream)**

Water supply and sewerage systems serve communities worldwide and Dr Tanyimboh's research is concerned with large-scale water systems and networks, where the main focus is the development of rigorous and efficient computational methods and solutions for sustainable long-term management. His pioneering research placed pressure-driven modelling and reliability analysis of water distribution systems on a firm footing and brought pressure-driven modelling to the mainstream. He is on the editorial board of several international journals and conference series.

**Dr Richard Lord (UK) (Civil Engineering Design Projects)**

Richard is a Senior Lecturer in Engineering Geoscience at the University of Strathclyde, and his current research interests are in the utilisation of brownfield, derelict, underutilised or neglected urban land and marginal agricultural land for renewable energy, organic waste management, carbon sequestration and the enhanced provision of ecosystem services. Following initial work for the EC raw Materials Programmes, his research expertise includes 18 years for environmental geochemistry and 12 years for contaminated land, with particular interests in mining impacts, sediment contamination, bioremediation or phytoremediation, sustainable and "green" remediation.
FOR MORE INFORMATION ABOUT THE MSc CIVIL ENGINEERING
Detailed class descriptions can be provided upon request. For more information please visit www.strath.ac.uk/civeng/pg/civengineering or contact the Department via email: civeng-pgt@strath.ac.uk

The Department of Civil and Environmental Engineering (est. 1889) continues its longstanding commitment of providing relevant engineering training to address contemporary, global challenges. Its newly renovated facilities at the James Weir Building include a £6M investment in state-of-the-art integrated environmental and civil engineering labs, which provide educational and research opportunities to students.

The Department of Civil and Environmental Engineering is highly interdisciplinary. Academic and research staff, from 13 different countries, originate from a range of different fields including civil engineering, environmental engineering, geology, microbiology, chemistry, mechanical engineering, geography, economics and maths. We have 45 members of academic (31) and research (14) staff, of whom 19 are women (42%). See http://www.strath.ac.uk/engineering/civilenvironmentalengineering/whatmakesusunique/