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.

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; or Geoenvironmental 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**

As this is a newly launched programme, accreditation for the MSc Civil Engineering programme will be sought from the Joint Board of Moderators - JBM (www.jbm.org.uk), once student outputs have been gathered within 2 years of operation.

**DESIGN PROJECTS & INDUSTRY COLLABORATION**

All students take the 40 credits compulsory module “Civil Engineering Design Projects” (CL509). 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: CL509 Civil Engineering Design Projects (40 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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</thead>
<tbody>
<tr>
<td>CL507 Ground Improvement and Reinforcement (10 credits)</td>
<td>CL946 Global Water Policy (10 credits)</td>
</tr>
<tr>
<td>CL508 Site Investigation and Risk Assessment (10 credits)</td>
<td>CL931 Research Protocols for Science &amp; Engineering (10 credits)</td>
</tr>
<tr>
<td>CL510 Advanced Structural Analysis and Design (10 credits)</td>
<td>CL504 Financial Engineering (10 credits)</td>
</tr>
<tr>
<td>CL976 Prestressed Concrete, Composite Materials and Structural Stability (10 credits)</td>
<td>CL948 Principles of Environmental Microbiology (10 credits)</td>
</tr>
<tr>
<td>CL974 Waste Management and Landfill Design (10 credits)</td>
<td>CL978 Water &amp; Wastewater Treatment Design</td>
</tr>
<tr>
<td>CL970 Groundwater Flow Modelling (10 credits)</td>
<td>CL971 Air Pollution, Climate Change &amp; Human Health (10 credits)</td>
</tr>
<tr>
<td>CL952 Aquifer Mechanics (10 credits)</td>
<td>CL973 Independent Study in Collaboration with Industry (10 credits)</td>
</tr>
<tr>
<td>CL954 Contaminated Land (10 credits)</td>
<td>CL945 Transport &amp; Infrastructure (10 credits)</td>
</tr>
<tr>
<td>EF931 Project Management (10 credits)</td>
<td>EF927 Geographical Information Systems (10 credits)</td>
</tr>
<tr>
<td>NM969 Renewable Marine Energy Systems</td>
<td>EF925 Environmental Impact Assessment (10 credits)</td>
</tr>
<tr>
<td>CL977 Structural Design (20 credits) – this is a prerequisite for those undertaking the Port Design Project option within CL509 and a Civil Engineering background is necessary.</td>
<td>EF932 Risk Management (10 credits)</td>
</tr>
<tr>
<td>CL917 Slopes &amp; Walls (10 credits)</td>
<td>EV908 Pollution and Rehabilitation of Degraded Ecosystems (10 credits)</td>
</tr>
<tr>
<td>EV921 Water and Environment Management (10 credits)</td>
<td>EV939 Environmental Impact Assessment (10 credits)</td>
</tr>
</tbody>
</table>

Please note that choices of optional credits are subject to timetabling constraints, and some require relevant subject background.

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

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

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

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

Select 40 credits option modules (from List A) And 40 credits option modules (from List A or B)

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 40 other optional credits from Lists A or B

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

Plus 40 other optional credits from Lists A or B

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 40 other optional credits from List A or B

Take the following 40 credits of core modules:
CL904 Waste Management and Landfill Design (10 credits)
CL960 Fundamentals of Environmental Forensics (10 credits)
CL951 Groundwater Flow Modelling (10 credits)
CL971 Air Pollution, Climate Change & Human Health (10 credits)
CL952 Aquifer Mechanics (10 credits)
CL904 Waste Management and Landfill Design (10 credits)
CL954 Contaminated Land (10 credits)
CL952 Aquifer Mechanics (10 credits)
CL954 Contaminated Land (10 credits)
EF931 Project Management (10 credits)
EF932 Risk Management (10 credits)
EV908 Pollution and Rehabilitation of Degraded Ecosystems (10 credits)
EV939 Environmental Impact Assessment (10 credits)

Please note that choices of optional credits are subject to timetabling constraints, and some require relevant subject background.
SUMMARY CLASS (MODULE) DESCRIPTORS

Compulsory Core Class for all MSc Civil Engineering students (including specialist streams)

CL509 Civil Engineering Design Projects (40 credits) (Dr Richard Lord, Mr Andrew Briggs)
This module includes a choice between two projects: a renewable energy project or an industrial port project. For students intending to take the industrial Port Project, it is advised that they also take the ‘Structural Design’ option module CL977 in Semester 1.

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.

Port Project
The port project covers the conceptual design for the civil engineering works required to convert a redundant shipyard into a construction port facility for offshore renewable energy projects in semester 1. Semester 2 covers the detailed structural design for the workshop building and dry dock. Project work will focus on the following themes: Integrated design; Optimisation of structural designs; Engineering professional practice; Conceptual and detailed structural design; Interpretation of factual ground investigation reports and preparation of recommendations for foundations, retaining walls and remediation measures; Sustainability; Architectural technology; Coastal engineering

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.

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.

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.

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 geostructures 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 geostructures. 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 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.

Mr Andrew Briggs (UK)
(Civil Engineering Design Projects)
Andrew joined the Department in 2006 as a part time Teaching Fellow running student design projects, while also working in industry as a structural design engineer. He became a full time Teaching Fellow in 2009 and is part of the structures research group. Before joining the Department, Andrew gained 20 years of industrial experience working as a design engineer on a wide variety of different types and scale of project, plus 2½ years working as a site engineer on two major civil engineering projects. He is a chartered engineer and a member of both The Institution of Civil Engineers and The Institution of Structural Engineers. His main interests are the design process and conceptual structural design. His teaching methods have an underlying theme of ‘Project Design – Turning Theory into Practice’ with the aim of helping students make the transition from University to working in industry. **Strathclyde Teaching Excellence Award:** 2013: Best Teacher in the Faculty of Engineering

Mr Brian Dickson (UK)
(Project Management)
Brian is a Senior Teaching Fellow in the Department of Chemical & Process Engineering as well as Academic Selector for all Postgraduate taught full and part time courses. Teaching Duties currently include:
- 3rd year “Safety & Loss Prevention ”
- 5th year “Safety Management Systems”
- PG Masters class “Project Management”
The Project Management course involves looking at the industry practices in Project Management using case studies and a simulation that lets student direct a multi-million team based project.

**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](http://www.strath.ac.uk/civeng/pg/civengineering) or contact the Department via email: [civeng-pgt@strath.ac.uk](mailto:civeng-pgt@strath.ac.uk)