



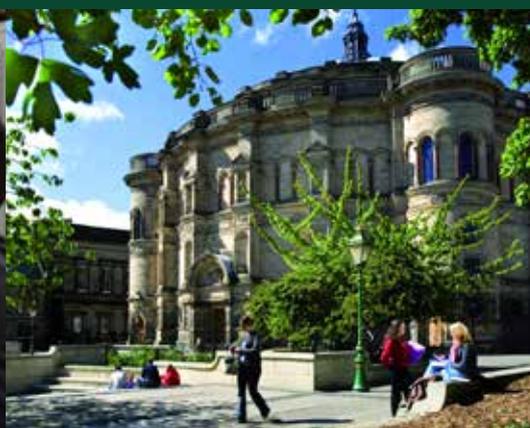
THE UNIVERSITY *of* EDINBURGH  
School of Engineering

2019-2020



# MSc Structural and Fire Safety Engineering

*A world leading masters degree designed to meet a growing demand for advanced knowledge of structural behaviour in fire.*



# Influencing the world since

The University of Edinburgh is one of the world's top universities, consistently ranked in the world top 50 and placed 18th in the 2019 QS World University Rankings.

Our entrepreneurial and cross-disciplinary culture attracts students as well as staff from over 140 countries, which creates a unique Edinburgh experience. We provide a stimulating working, learning and teaching environment with access to excellent facilities and attract the world's best, from Nobel Prize laureates to future explorers, pioneers and inventors. As host to more than 35,000 students, the University of Edinburgh continues to attract the world's greatest minds.

If you have any questions about the MSc programme, please do not hesitate to contact us at [pgtenquiries@eng.ed.ac.uk](mailto:pgtenquiries@eng.ed.ac.uk) or +44 (0)131 651 3565. We also hold regular virtual visiting sessions and would be happy to provide you with information about joining these sessions to speak with us about the MSc Structural and Fire Safety Engineering.



# 1583

## Welcome from the MSc Programme Director & Head of Research Group



Dr Stephen Welch

Thank you for your interest in the MSc programme in Structural and Fire Safety Engineering at the University of Edinburgh, a UK powerhouse in Engineering.

This brochure provides a brief overview of the structure of the programme, its unique features, a description of the courses and links to other resources. This one-year programme will immerse you into the most recent developments in structural fire engineering and will give you a unique opportunity to learn about its relevance in facilitating innovation in the modern built environment. At Edinburgh, we are committed to working individually with each student to understand your learning needs and career aspirations and to help you reach your full potential.

We host regular virtual visits through the year to provide you with more information about the programme. These virtual visits will help you prepare for your degree by giving you an opportunity to speak with academics who lecture on the programme, hear more details about course content and the industrial partners who support the MSc.

If you have any queries, please do not hesitate to contact us directly.

We hope to see you in September!

Dr Stephen Welch &  
Prof Grunde Jomaas



Prof Grunde Jomaas

## Introduction to the MSc Structural and Fire Safety Engineering

The rapid expansion and intense current interest in structural fire engineering stems from its importance in facilitating innovative design in the built environment. While fire considerations are a fundamental constraint on all modern infrastructure, shaping the environments we live in, they are normally given superficial treatment via an over-reliance on historic code-based regulations. Moreover, our fire safety systems and infrastructure are rarely tested by extreme events, but when they do occur unexpected failures have been seen, e.g. World Trade Center collapses. This one year programme at the University of Edinburgh will immerse you in the most current developments, associated with these themes, through a combination of taught modules, delivered by the key experts in the field, a research dissertation and a number of supporting activities.

## Why Pursue a Structural and Fire Safety MSc at Edinburgh?

The University of Edinburgh is consistently ranked as one of the top universities in the world in the QS World Universities Rankings™ and our graduates are highly employable.

The BRE Centre for Fire Safety Engineering is the largest structures and fire research group in the world and is unique in its offering of a holistic teaching programme. It is an ideal place to learn and equip yourself with leading research, skills and knowledge to address the world's growing demand for skilled professionals in structural fire safety engineering.

The key focus of this course is on learning the knowledge and skills of fire safety engineering for structures, enabling innovative designs to be realised with the same level of safety as those using traditional design techniques. Rather than dealing with fire safety once the design is completed, it becomes an integral part of the process. Our graduates are leaders in applying new methods in pioneering performance based design.

We will also allocate you a personal tutor when you arrive to begin your degree with us. Your personal tutor will work with you throughout the year to give you academic guidance and help you reflect on your academic progress so you get the most out of your studies and empower you to fulfil your academic and career goals.

## What Does the Degree Involve?

The MSc programme is delivered over a total duration of 12 months, full-time only, with predominantly taught material in the first two semesters followed by a research project leading to a Masters thesis. The taught and research courses account for 90 credits in total.

The taught courses in semester 1 (September to December) start with fundamental material on fire science and structural behaviour, which are followed by more applied and advanced courses in semester 2 (January to May), including experimental work in our fire laboratory and experience of fire safety engineering design, using real-life case studies, with students working in groups to present their own proposals to reviewers

We are consistently ranked in the top 50 universities in the world

representing clients, architects, regulatory authorities and the fire service.

The use of modelling methods is interwoven, including finite element methods and other fire models, with an emphasis on an appreciation of the appropriate use and the limitations and validity of different models, rather than training in the operation of the software.

## Teaching and Assessment Methods

The programme uses a broad range of learning methods, lectures, tutorials, workshops and final exams. Assessment varies from course to course and may involve a combination of continuously assessed coursework and an examination at the end of the semester, or be based on only one of these components. Each course has several opportunities for formative feedback.

There is a strong emphasis on using virtual learning environments, including the Learn® online system for sharing lectures, videos and course materials.

Dissertation related work runs in parallel with the teaching throughout the year. You will select your research topic at the start of the year and will complete a review project worth 10 credits in semester 1.

In semester 2 a pre-dissertation project will explore your chosen research topic in more detail in order to define the research questions for the main dissertation phase of the work running in the summer months after the semester 2 exams in May. These components account for the remaining 20 and 60 credits of the dissertation related components, respectively. You may suggest your own research topics.



## Fire Safety Engineering Community

At Edinburgh we treat our students as our extended family and we hope that they see us, the staff, in the same way. In the end, we are all part of the larger Fire Safety Engineering community! Throughout the year, there are many events that bring together everyone associated with Fire Safety Engineering at Edinburgh: students, staff and industrial partners. These events are an excellent opportunity for you to socialise with the students from other years, learn more about recent developments in structural fire engineering and share your recent experiences from industry or other adventures. Many of these events are organised by the students themselves through the fire group, who have initiated a buddy system between PhD and MSc students. We hope to see you there and we would welcome you into our community!

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Every one of  
our  
departments  
conducts  
world-leading  
research

## Links to Industry

The MSc programme in Structural and Fire Safety Engineering is supported by range of fire consultants. As well as direct sponsorship from Trenton Fire, industrialists provide direct input to taught courses, including for example serving as reviewers for fire designs developed in the course Models for Fire Safety. We also convene an annual recruitment evening and aim to arrange visits to local fire consultant offices.

Throughout the year, there are a number of networking opportunities and events oriented at introducing our MSc students to the industrial representatives, but also encouraging their engagement with the wider vibrant Edinburgh fire safety engineering community.

## Scholarships and Bursaries

We are proud to have Trenton Fire ([www.trentonfire.co.uk/](http://www.trentonfire.co.uk/)) as a partner sponsoring £1,000 annually to the best dissertation and poster.

The School of Engineering and the University of Edinburgh offer many scholarships and bursaries. These range from course specific funding options, to general MSc scholarships. You should visit the University's scholarships website (<http://www.ed.ac.uk/schools-departments/student-funding/postgraduate/overview>) to find out more.

The School of Engineering also has several courses which are eligible for the Postgraduate Tuition Fee Loan (PTFL) which is a loan system for Home/EU students. For more information visit ([www.ed.ac.uk/schools-departments/student-funding/postgraduate/uk-eu/other-funding/psas](http://www.ed.ac.uk/schools-departments/student-funding/postgraduate/uk-eu/other-funding/psas)). To find a full list of the scholarships you are eligible for, please use the Search Tool located here: [www.ed.ac.uk/student-funding/search-scholarships](http://www.ed.ac.uk/student-funding/search-scholarships).

# We are in the top 5 for research funding in the UK



## What Can I do After my Degree?

This unique programme will offer you the knowledge and skills you need to work in fire safety engineering, encompassing the built environment but also a range of other industries. Many of our graduates are leaders in these fields, initially pioneering the application of advanced methods for structural fire safety engineering, as regulatory frameworks began to allow performance based design, and now routinely employing these methods in leading engineering consultancies.

Fire research is long established at Edinburgh, our first graduates from previous MSc programmes graduated back in 1975, and we are very well known internationally. You will benefit from networking opportunities offered by the research links of our academics and research staff to many of the principal organisations that are currently active in this field, both in the research field and within industry.

The vast majority of our previous graduates have proceeded to employment and responsible positions in fire consultancies and research institutions around the world, organisations include: Trenton Fire, Arup Fire, AECOM, Mott MacDonald, Buro Happold, WSP, Jeremy Gardner Associates, Exova Warringtonfire, Tenos, BB7, Maurice Johnson & Partners, St James Group, EFLA Consulting Engineers, China Academy of Safety Science & Technology, CETU (Centre d'Etudes des Tunnels), BAM (Federal Institute for Materials Research and Testing), Underwriters Laboratory and Singapore Civil Defence Force.

The MSc in Structural and Fire Safety Engineering may also lead to further studies in a PhD programme, over 10% of previous students pursuing this path and some having now graduated. With 94% of our research activity rated as world-leading or internationally excellent (according to the most recent Research Excellence Framework, REF 2014), Edinburgh is a UK powerhouse in Engineering. As an MSc student at Edinburgh, you will have a unique opportunity to experience this multidisciplinary research environment, and interact with PhD, MEng/BEng, MSc students and academics working in Structural and Fire Safety Engineering (as well as other Institutes and

Schools).

## What are Admissions Staff Looking for?

You should have a UK 2.1 honours degree or its international equivalent, in civil engineering or a related subject such as applied mathematics or mechanical engineering. You will find our most up to date entry requirements at [www.ed.ac.uk/pg/423](http://www.ed.ac.uk/pg/423).

If your background is in another field, we also may consider your application. Please contact us to check before you apply.

In support of your application, you must also provide a personal statement and one academic reference. To read further information about the application process and advice on submitting an application please either visit the "How to apply" page on the University of Edinburgh Postgraduate Online Degree Finder here: <https://www.ed.ac.uk/studying/postgraduate/applying> or email the Postgraduate Taught Office at the School of Engineering at [pgtenquiries@eng.ed.ac.uk](mailto:pgtenquiries@eng.ed.ac.uk).

## Where are we Located?

The School of Engineering is located on the King's Buildings campus, which is located on the south side of Edinburgh. Getting to and from King's Buildings is easy due to its excellent public transport, walking and cycling links. King's Buildings campus is approximately 2.5 kilometres from the Central Area and is extremely well served by the public bus system. The University provides a shuttle bus between the King's Buildings and the Central Area during term time. For more information on travel please visit:

[www.ed.ac.uk/transport/travelling-here](http://www.ed.ac.uk/transport/travelling-here).

# “At the heart of ideas and inspiration”



# Edinburgh, a city of influence

Edinburgh is regularly voted as one of the best places to live in the world. Cobbled lanes, dramatic skylines and striking architecture combine to produce a stimulating setting for the writers, philosophers, political thinkers and inventors whose stories have been woven into the capital's fabric throughout history. The city's medieval Old Town and Georgian New Town, which offer contrasting history and architecture, have been designated a UNESCO World Heritage site.

With an array of museums, galleries, parks, gardens, pubs, clubs, restaurants, shops, theatres, cinemas, sports facilities and much more, you'll find something for every taste in the city. And not forgetting the biggest arts festival in the world, the Edinburgh Festival Fringe, which takes place in the city every August.

Well known for its friendly people, its safe, green environment and its stunning architecture, Edinburgh is a compact city, which makes it easy to get around. Wherever you are in the city, you are seldom far from open countryside and our central location and excellent transport links make it easy to travel to other parts of Scotland.

Edinburgh enjoys a creative and cultural significance that was further confirmed with its appointment as the world's first UNESCO City of Literature – a permanent title reflecting its recognition as a worldwide centre for literary activity. You couldn't ask for a more inspiring setting in which to further your knowledge and broaden your horizons.



DUGALD STEWART  
BORN NOVEMBER 31 1769  
DIED JUNE 11 1828

## Semester 1: September – December

Welcome Week

### Semester 1: Fundamentals

During this first semester you will study fundamental material on fire science and structural behaviour.

Exam Revision

Semester 1 Exam Diet

University closes for Christmas

## Semester 2: January – April

University reopens after Christmas break

January Welcome Week

### Semester 2: Application

During the second semester you will build on the knowledge gained in first semester and apply this knowledge through experimental work in our fire laboratory and in design.

Flexible Learning Week

Semester 2 resumes

Spring Vacation

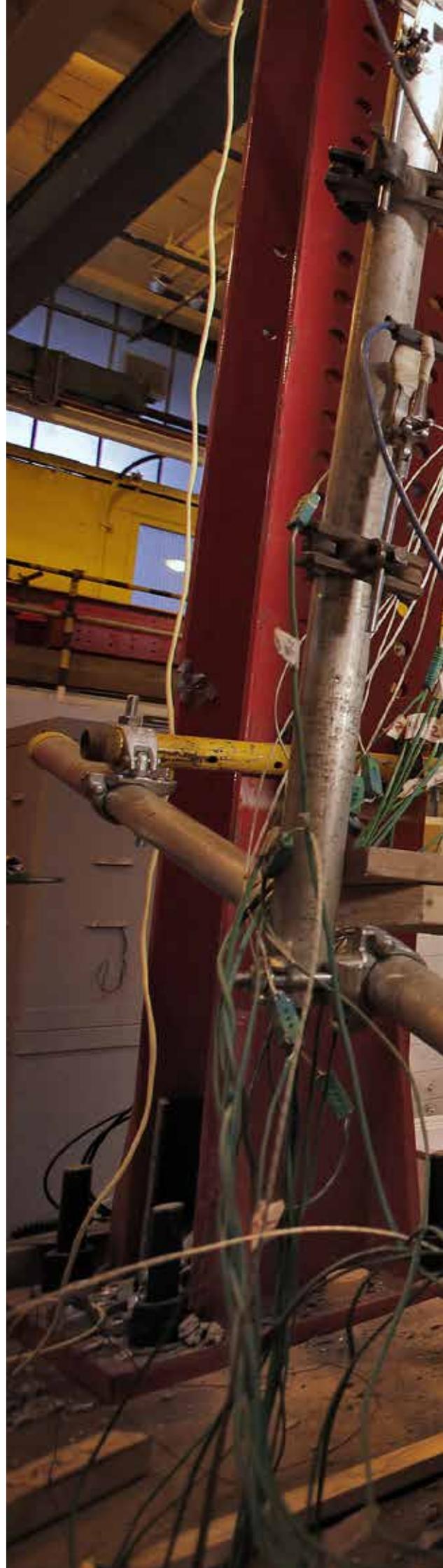
Exam Revision

Semester 2 Exam Diet

## Dissertation: May - August

Dissertation

Dissertation Submission and Poster Day





## Course Information

### Compulsory Taught Courses

#### Fire Science and Fire Dynamics (10 credits)

2 Lecture hours; 1 Tutorial hour per week

This course is intended to provide the knowledge required for quantitative fire hazard analysis. Physical and chemical behaviour of combustion systems as well as the impact of fire on structures and materials will be addressed. You will acquire skills for quantitative estimation of the different variables of fire growth. Basic principles of fire dynamics will be used to provide analytical formulations and empirical correlations that can serve as tools for design calculations and fire reconstruction. Focus will be given to the scientific aspects of fire but some basic features of fire safety engineering will be also developed.

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#### Structural Design for Fire (MSc) (10 credits)

2 Lecture hours per week

The course will provide a brief overview of the fundamentals of fire behaviour in buildings and introduce simple methods of quantifying the threat it poses to structures. This will involve estimating the temperatures in building compartments and the temperatures that individual structural members get exposed to as a function of time. Fundamentals of the behaviour of common construction materials and estimation of the variation of mechanical properties of construction materials affected by fire (i.e. temperature rise). Structural analysis principles are then applied to the fire problem. Simple methods to carry out calculations to determine structural behaviour in the event of a fire will be presented followed by an introduction to advanced analytical and computational tools for analysing structural behaviour in fire. Finally an introduction to current (code based) design procedures and performance based design will be provided. The overall outcome for this course is that students will understand the use, advantages and limitations of analytical and empirical models of structural behaviour in fire..

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#### Steel Structures (MSc) (10 credits)

2 Lecture hours; 1 Tutorial hour per week

This course explains the behaviour of steel structures, and explores how understanding of their behaviour is applied in structural design. The fundamental mechanics of steel structural members is described. The role of design codes in interpreting observed and theoretical behaviour is explained. This course also introduces the behaviour and algebraic analysis of thin-walled structural members; and covers the stability of structural elements and their analysis.

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#### Finite Element Analysis for Solids (MSc) (10 credits)

2 Lecture hours; 1 Tutorial hour per week

The finite element method (FEM) (also called finite element analysis or FEA) originated from the need to solve complex problems in solid mechanics. FEM is used to obtain approximate numerical solutions to a variety of equations of calculus. Today it is used in a wide range of disciplines. This course is an introduction to FEA as applied to elasticity problems in solid and structural mechanics. The mathematical equations are developed using the virtual work basis of FEM and this is used to develop equations for one, two and three dimensional elements. As FEA is a computational tool this course includes practical exercises using the commercial package ABAQUS. A number of tutorials involving hand calculations are provided to aid understanding of the technique.

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#### Fire Science Laboratory (MSc) (10 credits)

4 Laboratory hours per week (average)

This course consists of a series of laboratory sessions that will introduce you to a variety of different experimental techniques of relevance to fire safety engineering. Each session will be introduced with a guide to relevant theory with the aim of providing you with the fundamental knowledge to support understanding and interpretation of the experiments, as well as a safety briefing and guide to risk assessment. The use of standard tests and the application of the results to design will be emphasized. .

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## Models for Fire Safety (MSc) (10 credits)

2 Lecture hours per week

This course explores the practicalities of performance-based design of buildings for fire safety. It focuses on the use of modelling tools in the estimation of performance of fire safety systems. Zone models, Egress models and CFD fire models are introduced to establish modern approaches to fire safety engineering. The models will be applied using a real-life case study.

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## Structural Dynamics and Earthquake Engineering (10 credits)

2 Lecture hours; 1 Tutorial hour per week

Structures are often subjected to dynamic forces of one form or the other during their lifetime. This course introduces the theory of dynamic response of structures with emphasis on physical insight into the analytical procedures and with particular application to earthquake engineering. The structural dynamics component of the course includes free and forced vibration response of single and multi-degree of freedom systems. The earthquake engineering component considers seismic analysis methods, earthquake resistant design philosophy and includes elements of engineering seismology.

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## The Finite Element Method (10 credits)

1.5 Lecture hours; 1 Tutorial hour per week

The finite element method is an indispensable tool for engineers in all disciplines. This course introduces you to the fundamental theory of the finite element method as a general tool for numerically solving differential equations for a wide range of engineering problems. A range of field problems described by the Laplace, Poisson and Fourier equations is presented first and all steps of the FE formulation is described. Specific applications in heat transfer and flow in porous media are demonstrated with associated tutorials. The application of the method to elasticity problems is then developed from fundamental principles. Specific classes of problem are then discussed based on abstractions and idealisations of 3D solids, such as plane stress and strain, Euler-Bernoulli and Timoshenko beams and Kirchoff and Mindlin-Reissner plates and shells.

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## Optional Taught Courses

### Fire Safety, Engineering and Society (MSc) (10 credits)

2 Lecture hours; 1 Tutorial hour per week

Although engineering provides rigorous tools for addressing complex societal goals, there is little formal teaching with regard to the way these goals are understood. This course will fill this gap by providing you with a range of conceptual tools (illustrated with examples from many fields of engineering and technological development) geared towards understanding the ways that social factors influence engineering (especially fire safety engineering) practice. In addition, the understandable tendency in engineering to quantification and calculation can obscure the central roles of choice and judgement in engineering practice. This course will therefore also address the ways that the knowledge claims used in engineering are socially constructed, and why this matters for engineering outcomes.

The course has two main aims. First, to provide a more comprehensive understanding of the social context of fire safety engineering with regard to issues such as the socioeconomic factors that contribute to fire risk and its understanding and the history and rationale of regulatory practices. Second, to stimulate you to interrogate and debate taken-for-granted aspects of engineering practice, and thus to be more reflexive about the basis of the claims generated and used in fire safety engineering.

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### Fire Investigation and Failure Analysis (MSc) (10 credits)

2 Lecture hours; 1 Tutorial hour per week

This course consists of a series of laboratory sessions that will introduce you to a variety of different experimental techniques of relevance to fire safety engineering. Each session will be introduced with a guide to relevant theory with the aim of providing you with the fundamental knowledge to support understanding and interpretation of the experiments, as well as a safety briefing and guide to risk assessment. The use of standard tests and the application of the results to design will be emphasized.

## Research Courses

### State-of-the-Art Review in Fire Safety Engineering (10 credits)

Self study project supervised by a member of staff

You will undertake a detailed review of a structural fire safety engineering (or related) topic in parallel with the taught courses in Semester 1 under the supervision of a member of staff. Ideally this would be based upon the chosen dissertation project (choices made available at the start of Semester 1) but this is not mandatory. However, the supervisor for this course will also supervise the subsequent predissertation and dissertation course. It is expected that the topic chosen will be derived from the dissertation project, thus this could normally serve as an extended literature survey. More specific and self-contained smaller projects could also be undertaken depending on the agreed preference between you and supervisor.

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### Pre-Dissertation Project in Fire Safety Engineering (20 credits)

Self study project supervised by a member of staff

This course is comprised of a short research project, undertaken as a preparation for the main project leading to MSc Dissertation. The course will enable you to do a preliminary investigation of a complex research topic and to make interim conclusions about a complex research question in a short space of time. You will also learn to identify and prioritise the key sub-topics relevant to your chosen topic of research for further detailed investigation.

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### MSc in Structural and Fire Safety Engineering Dissertation Project (60 credits)

Dissertation

This course is the dissertation project element of the MSc programme in Structural and Fire Safety Engineering. The student will contribute an original piece of research on a topic relevant to structural and fire safety engineering. The work undertaken and a critical appraisal of the results will be written up in the dissertation report and presented at the final Poster Day as the culmination of the degree programme.

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\* Every effort has been made to ensure that the information contained in the MSc in Advanced Chemical Engineering brochure is accurate. However, it will not form part of a contract between the University and a student or applicant and must be read in conjunction with the Terms and Conditions set out in the Postgraduate Prospectus. Printed for the School of Engineering [www.eng.ed.ac.uk](http://www.eng.ed.ac.uk) The University of Edinburgh is a charitable body, registered in Scotland with registration number SC005336



*The University of Edinburgh is ranked 18th in the world by the QS World University Rankings 2019.*



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