Anglia Ruskin University

Course Information Sheet

# BSc (Hons) Civil Engineering

**Mode and course length** – Full-Time (4 years)

**Location** – ARU Cambridge Campus

**Awarding Body** – Anglia Ruskin University. As a registered Higher Education provider Anglia Ruskin University is regulated by the Office for Students.

## Overview

Location of study:

Level 3 – ARU Cambridge Campus

Level 4-6 – ARU Chelmsford Campus

Mix hands-on learning with vital theory as you prepare for a successful career in Civil Engineering.

Civil engineering means getting out there and making a difference to the world around us. Major projects like roads, buildings, tunnels and flood protection are all designed, constructed and improved by civil engineers.

Here at Anglia Ruskin University, you'll explore the concepts, theories and principles of civil engineering, and its underpinning science and mathematics. But you'll also develop your practical skills and your competence to work as a professional. In reparation for professional practice, you'll learn to work as part of a design team, write technical reports considering issues relating to sustainability, contracts and health and safety.

You'll make full use of our specialist testing and research labs. Learn about structural forms, loading, structural analysis and the behaviour of materials. Apply quantitative methods and relevant computer software.

Our BSc (Hons) course focuses on the practical skills of engineering principles, standards and codes of practice.

## Course Delivery

Our courses are delivered through teaching and learning methods which provide students with the widest possible exposure to a modern and innovative higher education experience.

These methods vary and could include attendance at lectures and seminars, undertaking laboratory exercises or work-based activities, practical work, performances, presentations, field trips, other relevant visits and e-learning through Canvas, our online learning management system.

Each course is divided into a number of 'modules' which focus on particular areas, each of which has a specific approach to its delivery. This information is published to students for each module they take via the Module Definition Form (MDF) and Canvas.

## Assessment

Throughout the course, we'll use a range of assessment methods to help you and your tutors measure your progress. Besides exams, you'll demonstrate your learning though a mix of assignments, group work, presentations, drawings, lab work and projects.

## Fees

Information about your course fee including any annual fee increases or deposits (if required) can be found in your offer letter.

## Additional Costs

Safety footwear (steel toe and midsole) - £40

Additional costs for Residential Field Trip - You will be asked to make a contribution of £250 towards the cost of food and accommodation. You will also be asked to provide your own safety shoes or boots and warm outdoor clothing. Other personal protective equipment will be provided.

# Modules

## Core Modules

**Year 1: Foundation in Engineering, Computing and Technology**

This module will provide students with the necessary skills to begin studying at level 4 in Engineering, Computer Science and related courses.

Students will be introduced to the core skills necessary to succeed in higher education, including thinking critically, researching and referencing appropriately, demonstrating appropriate numeracy and ICT skills, and communicating effectively verbally and in writing.

In addition to these fundamental skills, Students will cover the subjects underpinning the technological disciplines. Fundamental mathematical skills will be covered, alongside pre-calculus, followed by an introduction to calculus and vector and matrix arithmetic. Students will also be introduced to Classical mechanics, and its application to real-world scenarios. Students will be introduced to the fundamentals of computer science, learning about the principles behind programming and applying them through a series of practical coding exercises. Students will undertake a multi-disciplinary group project as they learn about the collaborative nature of engineering, and design from a broader perspective of business.

The module is made up of the following 8 constituent elements:

- Interactive Learning Skills and Communication (ILSC)
- Information Communication Technology (ICT)
- Critical Thinking
- Maths for Scientists
- Maths for Engineers
- Physics for Engineers
- Fundamentals of Computing
- Engineering Design

**Year 2: Geotechnics 1**

The module introduces Geotechnics to civil engineering students. After introducing basic geological concepts, it seeks to provide the student with an appreciation of the ground investigation element of site investigation. It introduces the student to soils laboratory practice and gives the opportunity to relate the results of soil laboratory tests to theoretical concepts and the practical needs of civil engineering construction. The module provides a medium for the development of skills in algebraic manipulation which are applied to the relationships between basic soil properties.

**Year 2: IT and Communications**

Students entering Higher Education will need specific study skills to enable them to maximise their learning potential and take advantage of opportunities available both in the academic setting and workplace. The module is intended to be both preparatory and supportive, building a strong foundation for learning and later development. Students will gain Information and Communication Technology (ICT) skills for information management and presentation purposes and will be encouraged to use contemporary ICT methods for research and for the production and presentation of reports, in a style suitable both for university coursework requirements and the commercial environment.

**Year 2: Elementary Survey Skills**

This module is intended to develop the necessary site related survey skills for students entering the construction industry.

Students will gain both a theoretical understanding as well as hands-on practice in the use of both traditional and contemporary instruments in order to set-up and control the most common elements of construction.

Survey work is one of the most complete and satisfying disciplines involved in construction because it involves the application of theoretical knowledge to solve practical problems using tactile skills and common-sense in the field.

Following brief theoretical introductions and backed up by student managed pre-reading and preparation, much of the module content will be experienced out of doors. As time is limited and weather conditions unpredictable, students should be prepared to dress appropriately and attend all timetabled classes. There will be little if any time for repeat sessions or to catch up on missed experiences.

Students will be expected to display a hands-on competence in order to pass a number of practical tasks in the field as well as be able to perform the basic off-site calculations necessary to be able to prepare site/quality/survey documentation to satisfy specified tolerances and employer requirements. To quote a former student, "there's nowhere to hide and no-one gets a free ride".

The skills gained in this module are those which the most junior of site engineers and site managers will be expected to perform and are therefore of immeasurable value in employability terms.

**Year 2: Elements of Engineering Design**

This module is designed for students of civil engineering to introduce them to some of the basic analytical concepts and processes involved in the design of structures. Some of the fundamental concepts relating to analytical and design processes will be derived from first principles and students will develop analytical skills which will allow them to carry out basic structural calculations

Students will also be introduced to basic 2D drafting techniques using industry standard software. This will allow them to effectively interpret technical drawing and give them the skills which can be applied to their specialist discipline area in later modules. Skills in this medium are highly sought after in the construction industry. Students will be introduced to BIM and will gain an appreciation of the role of the designer in civil engineering and have an understanding of the design process.

**Year 2: Safe Civil Engineering Works**

This module addresses key elements of civil engineering construction, placing them firmly alongside the management responsibility to ensure the prioritisation of health and safety within the work environment at all times. As the technical aspects of engineering are addressed, specific considerations of harm, hazard and risk are explored, ensuring the relevance of health and safety management within the civil engineering construction context. This module covers earthworks and groundwork techniques. This includes the principles and practice of earth-moving plant selection, cycles and economics. Groundwater control and soil stabilisation techniques of dynamic consolidation, vibratory systems and grouting are also included as well as methods for testing ground strength. Temporary and permanent earthwork support techniques, such as cofferdams; secant piling, contiguous piling and diaphragm walls are considered. Various foundation options are examined for their suitability for application within these different situations, including conventional piled foundations and associated foundation types for low and medium rise structures. Health and safety management practices including undertaking risk assessment and preparing and communicating associated method statements to ensure safe systems of work for the specific civil engineering techniques are examined alongside the technology, including the legal responsibilities of the civil engineer in the selection and management of the work. This knowledge will ultimately enable students to consider long-span low-rise and medium rise structures in terms of the evaluation and application of different groundwork techniques, construction methods, foundation types and the health and safety management of both the selection and construction processes.

**Year 2: Science and Materials**

An understanding of material properties is essential in all areas of engineering. For an engineer to make reasoned decisions about the materials to be used in a project an understanding of processing, structure and properties is necessary. By the end of this module the student should be familiar with the material properties relevant to engineering performance and how these properties are defined. The relevant properties of materials will be discussed in the context of engineering solutions.

Students will also be expected to carry out calculations to determine the position of a centroid in a solid body and moments of inertia with respect to a specific axis. The relationship between displacement, velocity and acceleration will be studied and then

applied in the context of Newton's 2nd Law and the application of forces. Forces in equilibrium and associated calculations are considered in statics with emphasis on their application to structural analysis.

**Year 2: Mathematical Skills for Civil Engineers**

This module is designed to develop the underpinning mathematical skills for use in modules covering topics related to structural analysis, geotechnics and hydraulics. The module will contain a section on algebra to reinforce and develop basic skills needed for all mathematical analysis and specifically the algebraic skills needed for calculus. The module will contain a significant section on calculus mainly focussed on developing an understanding of the origin and uses of calculus in engineering and the mathematical skills needed to in carry out differentiation and integration of a variety of functions. The module will introduce the mathematics of trigonometry and geometry and use them to solve practical engineering problems. The module will feature the use of spreadsheets for charting and solving numerical problems to support student's analysis of experimental data from other modules.

**Year 3: Site and Engineering Surveying**

This module is designed to expose students to both traditional and contemporary advanced survey techniques. They will capture, manipulate and utilise field data for both horizontal control and detail acquisition. The theory and practice of traditional traversing and curve ranging techniques will be given emphasis alongside contemporary practices. Students will gain hands on experience in the use of advanced contemporary surveying equipment (theodolites and total stations) for data capture and for setting out. Acquired data will be sorted and processed both manually and electronically, the latter to be converted into a format suitable for CAD output. Final survey drawings will be produced and annotated using AutoCAD 2006 and will be presented in a style appropriate to industry. These field and office skills are invaluable in the workplace and are transferable to across a wide range of survey products and to many branches of the construction industry. Students will also gain an understanding of how remote surveying by extra-terrestrial systems has evolved and of how a variety of control systems relate to the Ordnance Survey National Grid.

**Year 3: Design Technology in Civil Engineering**

With an increasing emphasis from the industry and the professional bodies on design and creativity this module is a holistic introduction to the design process with particular emphasis on the design of infrastructure projects. Technological tools used in current design practice will be studied and students encouraged to investigate the most recent innovations in design practice.

The module provides the student with an understanding of the relationship between design and technology. It introduces the student to the concept that the realisation of design into built form requires building technology and also how that technology has a very real influence on the generation of the design.

Students will have the opportunity to explore technology strategically as well as to develop it in detailed solutions. The importance of economics in technical design will also be explored.

Students will also be introduced to the technology currently in use in design in the industry. This will include how BIM is used in the design process and students will be advance their CAD tools and skills they will need to work within the BIM philosophy. Students will also be made aware of other innovations in the industry that affect the design process, such as modular construction.

**Year 3: Hydraulics**

This module covers the principles of hydrostatics and fluids in motion in pipes and open channels. Equations for calculation of pressures and forces on submerged and partially submerged objects are derived and applied. Continuity, energy and momentum equations are used to analyse uniform flow in pipes and open channels. The principle of flow in networks for water supply and surface water drainage is examined using simple models, whilst awareness is given of the availability of commercial computer models for more complex analysis. Laboratory sessions give the students the opportunity to explore the limitations of the mathematical models of fluid behaviour. Whilst the module concentrates on numerical techniques, the student is encouraged to consider that pipes and regularly shaped channels are not necessarily the ideal environmental solution.

**Year 3: Applied Mathematics for Civil Engineers**

The module is designed to build on the skills acquired in the pre-requisite module by introducing techniques that lie behind the

solution of engineering problems. The emphasis is on the application of algebra and calculus to allow students to build their own mathematical models to solve engineering problems. Methods will be introduced to solve first and second order differential equations including numerical solutions such as Newton Raphson. Methods to solve simultaneous linear equations with 3 unknowns using matrices and determinants are considered in depth as are series and their applications in calculus. A statistics section is also included applied to the numerous areas of civil engineering which use these techniques. It is intended that the module will enable students to undertake appropriate analysis in areas such as hydraulics, geotechnics, structural analysis and design and understand the mathematical basis on which the widely used specialist software functions.

**Year 3: Material Technology**

This module is designed to give civil engineering students a thorough grounding in the principles and manufacture of materials used in the construction industry. The aim is to provide the student with a practical understanding of the factors, which influence the properties and durability from the design requirements to the finished product.

Students will be introduced to the more common construction materials such as steel, concrete and timber as well as polymers and bituminous materials.

Materials will be analysed in terms of their molecular structure and constituent materials, engineering properties and behaviour, performance in service, quality control and sustainability.

A well-structured laboratory work programme is used to give the students practical experience of the theoretical concepts explained in the lectures.

Employability skills. On successful completion of the module students will be able to:

* Take decisions relating to appropriate and sustainable material use in construction projects

* Demonstrate analytical, experimental and interpretative skills with respect to materials laboratory work.

**Year 3: Structural Method and Design**

This module aims to develop students' understanding on the principles and methods of structural design to the Codes of Practices, typically to the Structural Eurocodes. It develops students' ability to design structural members in accordance with current Codes of Practices (Eurocodes) and by looking at past failures. This, in turn, would reinforce students' understanding of the effect of design assumptions on the safety of a structure and economy of its construction with the following particular references:

- The basic philosophies and general procedures used in the design of structural elements in buildings constructed with the three most commonly used building materials, i.e., steel, concrete and timber.
- The link knowledge of structural forms, loading, structural analysis and materials behaviour
- An appreciation of the role of the designer in the construction process and to appreciate the importance of producing structural drawings of elements in sufficient details for construction and/manufacture.

**Year 3: Structural Analysis**

The aim of this module is to introduce students to the fundamental principles and methods of structural mechanics with particular reference to the understanding of the responses and performance of different structures under different actions. It addresses the series of the mechanics principles, including equilibrium, superposition, how structures resist external actions; the distributions/diagrams of internal forces, including axial force, shear force and bending moment, within a structure; the relationship between the external actions and direct stress, shear stress and bending stress as well as the combined stress and principal stresses. The students are also introduced to the deformability of structures under actions, the concepts of static indeterminacy of a structure and influence lines of removable actions, the analysis of pinned and rigid frames and continuous beam, unit load method and moment distribution method.Employability skills Students will acquire knowledge which will enable them to carry out the analysis of different structures under different actions and discover their responses and performances using manual calculation and computer modelling.

**Year 3: CAD for Civil Engineers**

This module is intended to give civil engineers and other interested students an appreciation of the growing importance of three-dimensional CAD software. It will give hands-on training in some of the most up to date software complying with the latest British and European Standards. Intelligent object orientated design methods will be employed to create virtual models which can interact with digital terrain models. Students will gain an appreciation of the substantial benefits such systems can offer in terms of client visualisation and design flexibility and will produce a basic site animation.

**Year 4: Environmental Management for the Construction Industry**

The growth in environmental awareness, at all levels from local to international, over recent decades is introduced and considered in the context of the construction industry. Legislation and other pressures for the protection of the environment are considered, including pollution control and environmental impact assessment. The advantages and disadvantages of formal and informal environmental management systems are examined. Design implications of concepts such as life cycle analysis are considered. It is intended that the student should, by the end of the module, look at environmental management, not as a burden, but as a fundamental part of the efficient management of the construction industry. Such an outlook is likely to enable the student to guide their present or future employers towards a sustainable future.

**Year 4: Civil Engineering Group Project**

This module is designed to develop the student’s ability to evaluate and resolve practical problems and work as part of a team.

The module aims to apply the skills and knowledge developed in other modules of the course (and where possible, experiences from work) within a piece of work that reflects the type of performance expected of a civil engineer. The project will include analysis and design and students will be expected to consider the work within the environmental and economic constraints of a built environment project.

It is designed to bring small groups of students together into teams so that they co-ordinate their individual skills and abilities. The scheme of work should allow the individual student an opportunity to take responsibility for their own contribution to the outcome and to demonstrate their ability to work as part of a team. The brief will include an agreed timescale for the staged development of the overall plan of work within defined constraints, with the team working towards an acceptable and viable solution to the brief.

Employability skills

On successful completion of the module students will be able to:

- Identify solutions to practical design problems requiring planning of solutions, calculations for principal members and detailed report as well as the appraisal and presentation of working drawings.

- Demonstrate group management and interpersonal skills

- Present work in reports and in oral and/or visual formats.

**Year 4: Geotechnics 2**

The module extends the knowledge of basic soil properties gained I the pre-requisite module to include an appreciation of the nature of soil strength in the context of the principles of total and effective stress. This is then applied to the geotechnical design of foundations and earth retaining structures. The use of Codes of Practice is introduced and the philosophy of Factors of Safety within soils design is explored.

**Year 4: Major Project (Civil Engineering)**

This module represents the culmination of each student's development through learning undertaken on their programme. It provides an opportunity for students to demonstrate their ability to undertake a substantial original study to investigate a subject, issue, or problem and to produce a usable outcome. Students carry out an original piece of work that may be either an expert study or a research study. Advice will be offered on choosing a research topic and producing a proposal in a briefing session delivered towards the end of the academic year prior to that in which students undertake the dissertation. The research will be undertaken under the supervision of an academic member of staff but the early part of the module in semester one is also supported by taught classroom sessions. These taught sessions enable students to develop research and study skills in respect

of reviewing and analysing literature, developing a research question, collecting, presenting and analysing data, and managing the research process. In addition to the taught sessions, a minimum of four supervision tutorials will take place during the academic year in which the module is studied. It is each student's responsibility to make contact with their tutor to arrange appointments. 10% of the marks for the dissertation/major project are for attendance and performance at these tutorials which must be recorded in an appendix to the dissertation. The module is in three parts. The proposal will identify the subject area, the aims of the study, the rationale for it, the method statement and an ethics statement and evaluation. Students are also required to identify a minimum of ten literature sources that will be used. The proposal is to be submitted early in trimester one, the exact date being in the Study Guide. Proposals must be approved before a tutor is allocated and work proceeds with the study. Where proposals are not approved, students will be counselled and required to re-submit the proposal to the required standard. Advice will be provided regarding the writing of the proposal. The major project/dissertation requires students to demonstrate analytical, deductive, investigative and written communication skills in relation to their chosen subject. Students will deploy a wide range of skills that they have developed during their programme including initiative, self-motivation, time-management, analysis and integration of data and information together with the organisational skills needed for such a large piece of work. The dissertation should be submitted in accordance with the date published in the Study Guide. Students will also identify their achievements and skills and provide a plan for progression via the production of a c.v. and exit plan, which must be submitted as an Appendix to the Dissertation.

**Year 4: Civil Engineering Contract Administration**

This module is in two parts: the first considering the selection of partners for achieving successful design and construction of a civil engineering contract and the second the way in which traditional and more modern contracts handle situations that may arise on site. In the first part different approaches to contractual arrangements and payment bases are compared so that the student may advise on the most appropriate approach for a particular project. The purpose and inter-relationship of the different documents comprising the contract is explored as are methods of selecting partners. Consideration is give to developments in the construction industry that are intended to foster a team approach. Account is taken of external influences such as European and National legislation and standards. In the second part an examination is made of the rights and obligations of the parties during the performance of a traditional contract such as the ICE 7th edition and JCT 98, and how these apply to various events that may occur. The traditional approach is then compared with the Engineering and Construction Contract that encourages a more co-operative approach.

**Year 4: Structures**

This module is to enhance the students' understanding of the behaviour of steel and concrete in medium and low rise structures. Through analysis it introduces students to the modelling and solutions of indeterminate frames and trusses. Through design studies the module aims to introduce students to the design of low-rise structures and alternative forms of structural elements. Other objectives of the module may be summarised as follows: - To enhance the students' confidence in applying the design theories for tackling structural analysis and design problems for simple steel and reinforced concrete structures. - To link knowledge of structural forms, loading, structural analysis and materials behaviour. - To appreciate how connections can affect fabrication and erection of steel work - To appreciate how the methods of construction are considered in modelling the structural behaviour, analysis and design of steel and reinforced concrete structures. Employability skills - Students will acquire knowledge, which will enable them to appreciate the basic principle behind codified design for steel and concrete structures. - Design a typical low-rise framed building in steel and concrete, sizing primary elements and connections - Prepare drawings of elements, forming part of a structure, in sufficient details for construction in accordance with current Eurocodes.

## Optional Modules

*(Subject to availability)*

**Year 4: Highways Design and Construction**

This module is designed to enable the student to appreciate problems and techniques associated with highway design, construction and maintenance and to formulate technical solutions. Students will become conversant with highway geometrical design including Horizontal Layout design, Vertical Layout Design, Design of Cross Sections, Earth Work calculations and construction cost benefit analysis. Furthermore, the fundamentals of traffic analysis, traffic flow and queuing theory will be discusses during this module. This module focuses on providing the depth of coverage necessary to solve highway related problems likely to be encountered in practice.

**Year 4: Flood Management**

Flooding puts huge pressure on national economics, cities, communities and individuals. Short-term impacts may include human casualties, displaced people and communities, serious health problems and enormous damage to property and infrastructure. Affected areas may take years to recover. Significant river floods in the UK and EU, over the years, have prompted changes in flood legislations but the risks still remain significant.

This module aims to develop a deep understanding of flood management framework and different approaches to that. First, it focuses on hydrological principles of flooding and introduces different flooding drivers, impacts and the required interventions/strategies (mitigation and adaptation) to cope with that. This module will specifically focuses on flood risk formulation and assessment and introduces different flood frequency analysis methods.

Computer modelling of flood is focused and used in this module aiming to improve engineering students' practical skills. Additionally, economic appraisal of flood management strategies will be introduced as well. Furthermore, with recent focuses on flood resilience (in flood management), resilience concept is introduced and discussed.