Pearson BTEC Level 5 Higher National Diploma in Civil Engineering

1. Construction Design Project (Pearson-set)

The success of any project relies on the development of a good design and the technical information to allow the project to be built. The aim of this unit is to help students to appreciate and be aware of the design process and the information required to communicate the design itself, specify and quantify materials, provide instructions for the assembly and erection, and facilitate precise costing and project management. Topics included in this unit are: project phases; construction drawing; detailing; Computer Aided Design (CAD); Building Information Modelling (BIM); schedules; specifications; bills of quantities; information collaboration. On successful completion of the unit, students will be able to analyse scenarios, make decisions and produce drawings and specifications to achieve appropriate, creative and innovative home design proposals

2. The Construction Environment

The construction industry is one of the major contributors to CO2 emissions. Also, the way that buildings are designed, constructed and maintained means they have an ongoing impact on the environment. Similarly, as a major employer, the industry has an ongoing impact on the working conditions of those in the sector and the way that people are educated, trained and supported through their careers. In this unit, students will explore the make-up and the impact of the construction industry on the environment and society. By exploring the roles and relationships of individuals and organisations in the construction sector, students will gain an overview of the organisational and the personal ways in which the sector works to continue to improve the built environment and limit its impact on the environment, while maintaining economic sustainability and growth.

3. Science & Materials

This unit aims to support students to make material choices to achieve the desired outcomes of a brief. This is approached from the perspective of materials being fit for purpose; as defined by testing standards and properties, but also by consideration of the environmental impact and sustainability. Awareness of health & safety is considered alongside the need to meet legislative requirements. The topics covered in this unit include: health and safety; storage and use of materials; handling and problems associated with misuse and unprotected use; environmental and sustainable consideration in material choices; human comfort performance parameters. Material

choice is developed through the understanding of testing procedures to establish conformity to standards and define performance properties. The performance of materials to satisfy regulations and provide appropriate comfort levels is addressed through design and calculations.

4. Mathematics for Construction

The aim of this unit is to develop students' knowledge and understanding of the mathematical principles and theories that underpin many aspects of construction technology, structures and materials. Students will be introduced to mathematical methods and statistical techniques so that they can analyse and solve problems in a construction engineering context. Topics included in this unit are: trigonometry and algebraic mathematical techniques; matrices; statistical techniques; differential and integral calculus; binomial and normal distribution; dimensional analysis; arithmetic progressions; vector analysis. On successful completion of this unit, students will be able to employ mathematical methods in a variety of contextualised examples; use analytical and computational methods to evaluate and solve engineering construction problems; interpret data using statistical techniques and apply calculus techniques. Students will gain crucial employability skills such as critical thinking, problem solving, analysis, reasoning and data interpretation.

5. Civil Engineering Technology

This unit explores the role of professional civil engineers, their essential involvement in the construction and maintenance of infrastructure, and the key technologies they apply. The technologies and processes of civil engineering in the development of highways, bridges and substructures are crucial in supporting contemporary societies. Topics included in this unit are: earthwork activities; temporary and permanent dewatering procedures; methods and techniques used to create substructures, highways and superstructures and the common hazards; technical problems and solutions associated with modern civil engineering activities.

6. Principles of Structural Design

Buildings, bridges, roads and many other types of man-made structures are critical to the economic and social wellbeing of our society. We rely on these structures to provide us with suitable spaces and infrastructure to support our daily lives. In this unit, students will explore the fundamental principles of structural design, codes of practice and standards required to construct safe, effective static structures commonly used in today's building and infrastructure projects. Topics included in this unit are: methods

and techniques used to determine bending moments and shear forces in simply supported steel and reinforced concrete beams; deflection in simply supported steel beams; axial load carrying capacity of steel and reinforced concrete columns.

7. Surveying, Measuring & Setting Out

In practice, surveying functions are divided between the 'Land Surveyor' to establish the positional reference and provide topographic data, and the 'Civil Engineer' to provide control of construction (setting out) and monitoring. Since there is dependence and commonality between them, this unit covers both contexts equally. In this unit, students will explore the techniques used to set up controls and conductinitial surveys, including communication of results and methods of setting out the built environment. Students will be able to identify and analyse the sources of error and mitigation techniques used in common aspects of surveying.

8. Digital Application for Construction Information

Achieving successful projects in the built environment requires a range of different types of information to describe the project, quantify the materials, provide clear instructions for assembly and erection, and allow for accurate costing and management. Throughout the process of design, construction and post-occupancy management, information is critical. Central to construction information is the production of construction drawings. Theseprovide the geometric definition of a project through the use of graphic conventions. Most other forms of construction information will rely, to a greater or lesser degree,on reference to construction drawings. Therefore, the production of accurate and clearly defined construction drawings is a critical part of the overall construction information package. Digital applications play a key role in the production of construction drawings. They provide a way to manage drawing information and make changes with greater efficiency and can be shared readily through a variety of digital communication systems. In this unit students will develop the skills to needed produce accurate and consistent construction information using industry-standard software. On completion of the unit,students will be able to produce a construction information package. Successful achievement of the unit, may also lead to vendor certification.

9. Group Project (Pearson-set)

While working in a team is an important skill in construction projects, collaboration goes beyond just teamwork. The success of a project relies not only on the ability of

each person in a team to do their work but also on each individual's awareness of how their work relates to the work of others, how to ensure that information is shared effectively and that roles and responsibilities are clear. Through this collaborative project-based unit, students will explore how to define roles in a collaborative team, recognising the skills (and 'skills gaps') of each member of the group. Together, students will work to develop a construction project based on their research and analysis, in response to the Pearson-set 'theme'. Content in this unit will typically include role identification and allocation, collaborative structures, human resources management, project management, procurement, tender documentation, information/data sharing, meetings, health and safety, project costing and Building Information Modelling (BIM).

10. Further Mathematics for Construction

The understanding of more advanced mathematics is important in the civil engineering and building services engineering industries. Students will be introduced to additional topics that will be relevant to them as they progress to the next level of their studies; advancing their knowledge of mathematical theory gained in the Level 4 Unit 8: Mathematics for Construction. The aim of this unit is to teach students to analyse and model civil engineering or building services engineering situations using mathematical techniques. Among the topics included in the unit are: number theory, complex numbers, matrix theory, linear equations, numerical integration, numerical differentiation, and graphical representations of curves for estimation in an engineering context. Students will expand their knowledge of calculus to discover how to model and solve problems using first and second order differential equations.

11. Advanced Structural Design

With the development of new materials and processes, along with technologies that allow us to design and model more complex structures, the influence on structural design has become increasingly challenging. The ability to conceive and accurately model complex buildings, bridges, roads and other types of structure, pushes both the aesthetic and technical envelope in which structural and civil engineers now operate. In managing the design and construction of modern structures, the civil or structural engineer must be able to carry out increasingly complex calculations, dealing with dynamic conditions, while maintaining an awareness of the overall design intention. Extending areas of study from Unit 19: Principles of Structural Design, this unit will support students to extend their ability to design, test and quantify more complex structural conditions.

12. Hydraulics

The action, management and distribution of fluids, in relation to built structures, is critical. In civil engineering, it is necessary to ensure that we are able to manage the pressures that water may put on structures, either through its flow or the forces exerted and how to resist these. In building services, the balance between necessary pressures to ensure flow and distribution of fluids (through heating/cooling systems or domestic water supplies), and the sizing of pipes to support this flow, will determine efficiency and effectiveness of a system.

13. Personal Professional Development

As a professional, learning is a continuous and lifelong process. In the construction industry there are constant changes in technology, materials, processes, legislation and practice. In order to stay up to date, it is necessary to recognise the potential of both structured, classroom-based learning and the learning gained through professional activities 'on the job'. This unit provides a framework in which students have the opportunity to reflect on and contextualise the learning they gain from working in the industry. In coordination with tutors and their employers, students will define the scope, duration and content of their expected work-based learning experience. Throughout the period of their work-based learning experience, students will be expected to record and reflect on their own learning.

14. Contract & Management

The successful management of a project relies on ensuring that work is undertaken in accordance with the terms of the contract that exists between client and contractor. In construction, a contract is the legally binding agreement between the client (who wants a project built) and the main contractor (who is responsible for constructing theproject). Time, quality and costs are covered by such contracts to ensure that a client receives a project that has been specified by their designer to a budget and at an agreed handover date for completion. The overall aim of this unit is to give students a working knowledge of contracts sothat they can manage a project team in accordance with the agreed terms and conditions of the contract. The principal person responsible for this is often the quantity surveyor and it is their responsibility to ensure compliance with the conditions of the contract. On successful completion of this unit, students will be able to run and administer a project using the contract terms and conditions that have been agreed between a

client and the main contractor. Students will also have the fundamental knowledge and skills to progress to a higher level of study.

15. Highway Engineering

This unit explores the planning, design, construction and maintenance of our road infrastructure, including the supporting structures such as tunnels, bridges and full pavement construction. On successful completion of this unit, students will be able describe a new route process for a highway and explain civil engineering aspects, including pavement types.They will also be able to appraise improvements to the existing road infrastructure.

16. Advanced Materials

The aim of this unit is to enable students to make decisions based on the application of knowledge and concepts related to advanced materials. As ever more innovative structural solutions are sought, so the need for greater understanding of material performance and behaviour is required. This encapsulates an understanding of the relationship between material microstructure, composition and mechanical properties in use, and also a knowledge of 'smart' materials that are at the heart of innovative material technology development.