Unit 6: Building Technology in Construction

NQF Level 3: BTEC National

Guided learning hours: 60

Unit abstract

Today's buildings use combinations of traditional and modern techniques and materials in their construction, and these are influenced by the functional requirements of building elements and by legislation. An awareness of these factors is necessary to underpin the learner's understanding of building technology.

The unit will introduce learners to the common forms of low-rise construction used for domestic and commercial buildings, including their substructures, and they will be shown how the development and use of prefabricated building components and systems in recent years has had a major impact on construction, including reducing site costs and the need for skilled labour.

Learners will develop an understanding of building technology by investigating and evaluating the ways in which techniques, materials, plant equipment and resources are used to construct buildings that satisfy the functional and aesthetic needs of their users.

They will come to understand that the impact of these technologies on life-cycle costs and on the environment are of major importance, and that the choice of construction methods and materials must comply with all relevant legislation and constraints. These include the Building Regulations, elements of which are intended to reduce environmental impacts, and specific provisions within the Health and Safety at Work Act relating to site safety.

Learning outcomes

On completion of this unit a learner should:

1 Understand common forms of low-rise construction currently used for domestic and commercial buildings

2 Be able to describe, illustrate and evaluate the requirements and techniques used in the construction of substructures for low-rise domestic and commercial buildings

3 Be able to describe, illustrate and evaluate the techniques used in the construction of superstructures for low-rise domestic and commercial buildings

4 Understand the implications of environmental issues and legislative constraints on building construction, together with the infrastructure required to support typical construction processes.

Unit content

1 **Understand common forms of low-rise construction currently used for domestic and commercial buildings**

Building uses: houses; flats; warehouses; light industrial units; retail; offices

Forms of construction: traditional; prefabricated including timber frame; loadbearing; non-loadbearing; single storey; low-rise of two to three storeys; detached; terraced; pitched roofs; flat roofs; short span; medium span

Implications of different forms of construction: differences in construction methods required for different forms; advantages and limitations

2 **Be able to describe, illustrate and evaluate the requirements and techniques used in the construction of substructures for low-rise domestic and commercial buildings**

Subsoil investigation: site survey and subsoil investigation; recording and interpretation of results; classification of soils; impact on foundation design

Foundation design: principles of design and factors affecting choice of foundations (strip, pad and raft and pile foundations); structural requirements; effects of and precautions against subsoil shrinkage; ground heave; differential settlement

Excavations: excavation up to five metres depth; water elimination; temporary supports in trenches and associated health and safety issues; various types of excavation and earth moving plant required

Foundation construction: construction techniques used for strip, pad and raft and pile foundations; selection of materials; economic implications of methods used; plant requirements; health and safety issues; environmental issues; legislative constraints

3 **Be able to describe, illustrate and evaluate the techniques used in the construction of superstructures for low-rise domestic and commercial buildings**

Superstructure design: principles of design and factors affecting choice of primary and secondary elements (floors, walls, roofs, stairs, windows, doors)

Superstructure construction: techniques used for construction of primary and secondary elements (floors, walls, roofs, stairs, windows, and doors); selection of materials; economic implications of methods used; plant and equipment requirements; health and safety issues; environmental issues; legislative constraints

Finishes: factors affecting the choice of internal and external finishes, types of finish available and methods used in their application, economic implications of methods used, plant requirements, health and safety issues, environmental issues, legislative constraints

4 **Understand the implications of environmental issues and legislative constraints on building construction, together with the infrastructure required to support typical construction processes**

Environmental issues: environmental impact resulting from materials and methods used in the construction of buildings; extraction; manufacture; construction methods; recycling; waste; energy usage; CO^2 emissions; noise; pollution

Legislative constraints: Building Regulations; Health and Safety at Work Act 1974 etc; Construction Health, Safety and Welfare Regulations 1996; Town and Country Planning legislation

Plant: range of construction plant (characteristics and uses)

Materials: supply of building materials to the industry both for traditional and modern projects; prefabricated components; system building

Grading grid

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all of the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain the procedures involved in subsoil investigation and how the information obtained is used in the design of substructures	M1 explain and justify their selection of suitable materials and techniques for use in the construction of substructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios	D1 evaluate the performance in use, and environmental implications of, alternative materials and techniques used in the construction of substructures to low-rise domestic and commercial buildings
P2 explain the principles of foundation design and describe the methods used to construct different types of foundation		
P3 produce detailed drawings showing foundation construction for a low-rise domestic building and for a low-rise commercial building	M2 explain and justify the selection of materials and techniques used in the construction of superstructures for low-rise domestic and commercial buildings	D2 evaluate the performance in use, and environmental implications of, alternative materials and techniques used in the construction of a tutor-specified element of superstructure, eg the external wall.
P4 explain the principles of superstructure design and describe the methods used to construct all elements of a superstructure		

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P5 produce detailed drawings showing the techniques used to construct all elements of superstructure for low-rise domestic and commercial buildings.	M3 identify and justify the plant and equipment requirements, including safety equipment, for the construction of a complex tutor-specified element of superstructure, eg a roof.	

Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures, discussions, seminar presentations, site visits, supervised practicals, research using the internet and/or library resources and the use of personal and/or industrial experience are all suitable. Delivery should stimulate, motivate, educate and enthuse learners. Visiting expert speakers could add to the relevance of the subject.

Learner knowledge of the main forms of construction for low-rise domestic and commercial buildings should be developed at an early stage of the delivery, including the range of structural forms, their applications to different uses, traditional methods and prefabrication. Learners should the be made aware of the various elements that make up the substructure and superstructure of a building, in preparation for their gaining a detailed insight into the principles involved in its design and construction. Learners should also become conversant with subsoil investigation procedures and the application of these to the design of foundations.

An awareness and understanding of legislative requirements, including Building Regulations and health and safety, and environmental issues and their effects on design and construction should be embedded into the delivery throughout the unit.

A key element of the delivery must include the development of an ability to produce general and detailed drawings that clearly explain the techniques used to construct a building.

Where possible, links should be formed with industry and visits to housing sites should be arranged as this will provide an opportunity for learners to contextualise their learning and to use this to inform their study of the various aspects of building technology. A further enhancement to the learning process could be made by seeking specialised input from current practitioners.

Overall delivery of the unit should be supported by the use of case-studies and visual media where appropriate including photographs, video, DVD and drawings to demonstrate the methods used to construct buildings.

Group activities are permissible, but tutors will need to ensure that individual learners are provided with equal experiential and assessment opportunities.

Health, safety and welfare issues are paramount and should be strictly reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken prior to practical activities. Centres are advised to read the *Delivery* approach section on page 24, and *Annexe G: Provision and Use of Work Equipment Regulations 1998 (PUWER)*.

Assessment

Evidence for this unit may be gathered from a variety of sources, including well-planned investigative assignments, case studies or reports of practical assignments.

There are many suitable forms of assessment that could be employed, and centres are encouraged to consider and adopt these where appropriate. Some examples of possible assessment approaches are suggested below. However, these are not intended to be either prescriptive or restrictive, and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable. General guidance on the design of suitable assignments is available on page 19 of this specification.

Some criteria could be assessed directly by the tutor during practical activities. If this approach is used, suitable evidence from guided activities would be observation records or witness statements. Guidance on the use of these is provided on the Edexcel website.

The structure of the unit suggests that the grading criteria may be fully addressed by using two assignments, for example two case-studies using typical general plans and sections of the building types being studied. As the time required for completion of each assessment is likely to be extensive, staged submissions should be considered and regular, interim feedback from the tutor would be essential. If the two-assessment model were to be followed, then the first assessment would enable grading criteria P1, P2, P3, M1 and D1 to be covered and the second assessment would cover criteria P3, P4, P5, M2, M3 and D2.

To achieve a pass grade learners must meet the five pass criteria listed in the grading grid.

For P1, learners should explain the procedures involved in subsoil investigation, and how the information obtained is used in the design of substructures. Each procedure should be identified and explained followed by a discussion of the ways in which the data obtained is used to design the most appropriate substructure.

For P2, learners are required to explain the principles of foundation design and describe the methods used to construct different types of foundation. This should convey an understanding of how subsoil conditions influence foundation design, a knowledge of different foundation types and an insight into the techniques used in their construction.

For P3, learners must be able to produce detailed drawings showing foundation construction for a low-rise domestic building and for a low-rise commercial building. This should include strip, pad, raft and pile foundations and the drawings should be clear and comply with standard presentation conventions.

For P4, learners are required to explain the principles of superstructure design and describe the methods used to construct all elements of a superstructure. This should convey an understanding of: the underlying principles that influence the design, such as the external envelope's need for weather resistance; a knowledge of the elements that make up a building; and an insight into the techniques used in their construction.

For P5, learners must be able to produce detailed drawings showing the techniques used for all elements of superstructure construction for a low-rise domestic or commercial building. This should include floors, walls, roofs, stairs, windows, and doors, and the drawings should be clear and comply with standard presentation conventions.

To achieve a merit grade learners must meet all of the pass criteria **and** the three merit grade criteria.

For M1, learners are required to explain and justify the selection of materials and techniques used in the construction of substructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios. After identifying the materials and techniques available, learners must be able to select and justify appropriate solutions for different foundation types for a range of tutor-specified conditions.

For M2, learners are required to explain and justify the selection of materials and techniques used in the construction of superstructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios. After identifying the materials and techniques available, learners must be able to select and justify appropriate solutions for all elements of superstructure construction including floors, walls, roofs, stairs, windows and doors for a range of tutor-specified conditions and uses.

For M3, learners have to identify and justify the plant and equipment requirements, including safety equipment, for the construction of a complex tutor-specified element of superstructure, for example a roof. After itemising the construction activities, learners will be required to consider and select appropriate plant and equipment and clearly justify that selection using supportive evidence. A critical evaluation of alternative solutions will be required as a part of the learner's justification of their lection.

To achieve a distinction grade learners must meet all of the pass criteria **and** merit grade criteria and the two distinction grade criteria.

For D1, learners should evaluate the performance in use, and environmental implications of, alternative materials and techniques used in the construction of substructures to low-rise domestic and commercial buildings. This will involve an examination of the range of materials and methods available for foundation construction followed by a detailed evaluation with regard to their suitability in different situations, and their effects on the environment including energy implications, sourcing, wastage and recycling.

For D2, learners are required to evaluate the performance in use, and environmental implications of, alternative materials and techniques used in the construction of a tutor-specified element of superstructure, for example an external wall. This should involve examination of the range of materials and methods available for external wall construction, followed by a detailed evaluation of their suitability in different situations, and their effects on the environment including energy implications, sourcing, wastage and recycling.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit has links to *Unit 1*: *Health Safety and Welfare in Construction and the Built Environment*, *Unit 4*: *Science and Materials in Construction and the Built Environment*, *Unit 5*: *Construction Technology and Design in Construction and Civil Engineering*, and *Unit 17*: *Building Regulations and Control in Construction*, together with similar units at Higher National and degree level.

This unit may have links to the Edexcel Level 3 Technical and Professional NVQs for Construction and the Built Environment. Updated information on this, and a summary mapping of the unit to the CIC Occupational Standards, is available from Edexcel. See *Annexe D: National Occupational Standards/mapping with NVQs*.

The unit provides opportunities to gain Level 3 key skills in: information and communication technology; improving own learning and performance; and problem solving. Opportunities for satisfying requirements for Wider Curriculum Mapping are summarised in *Annexe F: Wider curriculum mapping*.

Essential resources

Learners should have access to authentic general and detailed working drawings to demonstrate their format, use and application, together with drawing equipment to facilitate preparation of assessment material. Where possible, supervised visits to building sites will provide a valuable vehicle for contextualising the unit and demonstrating real examples of building technology. Appreciation of the characteristics of building materials and components would be enhanced by the availability of selected samples.

Indicative reading for learners

Textbooks

Billington M J, Simons M W and Waters J R — *The Building Regulations Explained and Illustrated, 12th Edition* (Blackwell, 2004) ISBN 0632058374

Chudley R and Greeno R — *Building Construction Handbook, 6th Edition* (Butterworth-Heinemann, 2006) ISBN 0750668229

Chudley R and Greeno R — *Construction Technology, 4th Edition* (Pearson, 2005) ISBN 0131286420

Emmitt S and Gorse C — *Barry's Introduction to Construction of Buildings* (Blackwell, 2005) ISBN 1405110554

Greeno R — *Principles of Construction* (Longman, 1995) ISBN 0582230861

Riley M and Howard C — *Construction Technology 1 House Construction* (Palgrave, 2002) ISBN 0333804562

Website

www.thenbs.com	NBS—Building Regulations and Approved Documents (dates to 2006)

Key skills

Achievement of key skills is not a requirement of this qualification but it is encouraged. Suggestions of opportunities for the generation of Level 3 key skill evidence are given here. Staff should check that learners have produced all the evidence required by part B of the key skills specifications when assessing this evidence. Learners may need to develop additional evidence elsewhere to fully meet the requirements of the key skills specifications.

Information and communication technology Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• using the internet and other electronic media to research and gather information on construction methods • using ICT processes to produce the assessment evidence.	ICT3.1 Search for information using different sources, and multiple search criteria in at least one case. ICT3.2 Enter and develop the information and derive new information. ICT3.3 Present combined information such as text with image, text with number, image with number.
Improving own learning and performance Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• evaluating the performance in use, and environmental implications of, alternative materials and techniques used in the construction of a selected element of superstructure.	LP3.1 Set targets using information from appropriate people and plan how these will be met. LP3.2 Take responsibility for your learning, using your plan to help meet targets and improve your performance. LP3.3 Review progress and establish evidence of your achievements.

Problem solving Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• explaining and justifying the selection of materials and techniques used in the construction of superstructures for low-rise domestic and commercial buildings.	PS3.1 Explore a problem and identify different ways of tackling it. PS3.2 Plan and implement at least one way of solving the problem. PS3.3 Check if the problem has been solved and review your approach to problem solving.