

Unit 6: Building Technology in Construction

Unit code:	D/600/0309
QCF Level 3:	BTEC Nationals
Credit value:	10
Guided learning hours:	60

● Aim and purpose

This unit aims to give learners the opportunity to gain an understanding of common forms of low-rise construction, including the design and construction of their foundations, the techniques used in the construction of superstructures and the implications of issues and constraints on building construction.

● Unit introduction

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. This has become more apparent with the Government's awareness of sustainable construction. Learners need to be aware of these factors in order to underpin their understanding of building technology.

This unit will introduce learners to the common forms of low-rise construction used for domestic and commercial buildings, including their substructures and superstructures. They will be shown how the recent development and use of prefabricated building components and systems has had a major impact on construction, particularly in terms of reducing site costs and contract completion time.

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

They will come to understand that the impact of these technologies on lifecycle costs and 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 by using codes for sustainable homes. Consideration is given to specific provisions within the Health and Safety at Work Act and the Construction Design and Management Regulations, where they relate 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 Understand foundation design and construction
- 3 Understand the techniques used in the construction of superstructures for low-rise domestic and commercial buildings
- 4 Understand the implications of issues and constraints on building construction.

Unit content

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

Forms of low-rise construction: prefabricated including timber frame, steel frame, concrete frame, load bearing, non-load bearing; single storey and low-rise of two to three storeys; detached; terraced; pitched roofs; flat roofs; short span; medium span; differences in construction methods; advantages and limitations of each method

Buildings: houses; flats; warehouses; light industrial units; retail; offices

2 Understand foundation design and construction

Subsoil investigation: site survey and subsoil investigation (regional geology, lithology, ground water); recording and interpretation of results; classification of soils; foundation design

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

Methods: excavation; construction

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

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

3 Understand the techniques used in the construction of superstructures for low-rise domestic and commercial buildings

Principles of 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 to include the code for sustainable homes

Superstructure 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 issues and constraints on building construction

Environmental issues: environmental impact resulting from materials and methods used in the construction of buildings; extraction; manufacture; construction methods; environmental protection; recycling; waste; energy usage; CO₂ emissions; noise; pollution

Legislative constraints: Building Regulations; Health and Safety at Work Act 1974; Construction Health, Safety and Welfare Regulations 1996; Construction Design and Management Regulations 2008; PUWER; COSHH; PPE; RIDOR; Town and Country Planning legislation

Infrastructure: construction plant (characteristics, uses); supply of building materials for traditional and modern projects; prefabricated components; system building

Assessment and grading criteria

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

Assessment and 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 different forms of low-rise construction currently used for domestic and commercial buildings [IE2, IE4, CT2, RL2, RL4, SM3]	M1 justify the 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 environmental performance of modern materials and techniques used in the construction of substructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios
P2 explain how the procedures used in subsoil investigation provide information for the design of substructures [IE2, IE4, CT2, RL2, RL4, SM3]		
P3 describe the principles of foundation design [IE2, IE4, CT2, RL2, RL4, SM3]		
P4 explain the methods used to construct different types of foundation [IE2, IE4, CT2, RL2, RL4, SM3]		
P5 explain the principles of superstructure design [IE2, IE4, CT2, RL2, RL4, SM3]	M2 justify the selection of suitable materials and techniques for use in the construction of superstructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios	D2 evaluate the environmental performance of modern materials and techniques used in the construction of superstructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios.
P6 describe the techniques used to construct and finish the component elements of a superstructure [IE2, IE4, CT2, RL2, RL3, RL4, SM3]		

Assessment and 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:
<p>P7 explain the implications of environmental issues and legislative constraints on building construction [IE2, IE4, CT2, RL2, RL3, RL4, SM3]</p>	<p>M3 evaluate three pieces of legislation applicable to the construction process in terms of the relevance of the legislation and the stage at which each applies.</p>	
<p>P8 explain the purpose of the various parts of the infrastructure required to support the construction process. [IE2, IE4, CT2, RL2, RL3, RL4, SM3]</p>		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills which are embedded in the assessment of this unit. By achieving the criteria, learners will have demonstrated effective application of the referenced elements of the skills.

Key	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators
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Essential guidance for tutors

Delivery

This unit should be delivered using lectures, tutor-led demonstrations/discussions, seminar presentations, site visits, supervised practicals, research using the internet and/or library resources and use of personal and/or industrial experience are all suitable. Tutors delivering this unit have opportunities to use a wide range of techniques including manual and computer-generated drawing techniques. Delivery should stimulate, motivate, educate and enthuse learners. Visiting expert speakers could add to the relevance of the subject.

Since most learners are unlikely to have had experience in this area of work it is essential that there is some formal introduction to the unit content. The unit can then be regarded as investigative in nature. Learners should be given the opportunity to examine a range of complex substructures and superstructures, and tutors should encourage an investigatory approach throughout.

This will allow learner knowledge of the main forms of construction for low-rise domestic and commercial buildings to develop at an early stage in the delivery, including the range of structural forms, their application to different uses, traditional methods and prefabrication.

Learners should be made aware of the various elements that make up the substructure of a building to help them develop a detailed insight into the principles involved in its design and construction. Learners should also become familiar with subsoil investigation procedures and the application of these to the design of foundations. Examples include:

- water elimination
- ground improvement
- temporary support
- associated health and safety
- associated building regulations.

Learners should be made aware of the various types of foundation that make up the substructure of a building together with any associated health and safety and/or building regulations. Examples include:

- strip/trench fill/wide strip
- pad
- pile and beam
- raft
- reinforcement.

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

The delivery approach used will be best determined through an analysis of learner needs and, in particular, through consideration of the range of industrial needs that centres are working with or for which they are preparing their learners.

The learning outcomes are ordered logically, following the construction process, and a reasonable approach would be to develop them sequentially.

A key element of delivery should include the production of sketches and drawings that clearly explain the techniques used to construct a building.

Where possible, links should be formed with industry and visits to construction sites arranged to help learners contextualise their learning and use this to inform their study of the various aspects of building technology. The learning process could be enhanced further by seeking specialised input from current practitioners including building control officers.

Overall delivery of the unit should be supported by the use of case studies and visual media, where appropriate, including photographs, videos, DVDs and drawings to demonstrate the methods used to construct buildings. Group activities and research are advised, but tutors will need to ensure that individual learners have equal experiential and assessment opportunities.

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

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment

Introduction to unit content

Tutor introduction to common forms of low-rise construction currently used for domestic and commercial buildings

Class exercise on identifying building uses: houses, flats, warehouses, light industrial units, retail, offices etc – whole-class teaching followed by small group work

Examples of the different forms of construction, implications of different forms of construction

Differences in construction methods required for different forms: advantages and limitations

Explain site survey and subsoil investigation and how the information obtained is used in the design of substructures – whole-class teaching

Explain water elimination, ground improvement, temporary supports in trenches and associated health and safety issues

Explain the performance-in-use, alternative materials and techniques used in the construction of substructures for low-rise domestic and commercial buildings

Group work to investigate the performance in use, alternative materials and techniques used in construction of substructures to low-rise domestic and commercial buildings

Explain the principles of foundation design and describe the methods used to construct different types of foundation in different situations – whole-class teaching

Explain materials and techniques used in the construction of substructures for low-rise domestic and commercial buildings

Class exercise in scale drawing, using typical dimensions of foundation types available. Class split to cover all types and then compare

Construction site visit relevant to the above

Topic and suggested assignments/activities and/assessment

Assignment 1: Site Investigations, Foundation Design and Substructure

Explain the principles of superstructure design and describe the methods used to construct all elements of a superstructure – whole-class teaching

Explain the selection of suitable materials and techniques for use in the construction of the superstructure for low-rise domestic and commercial buildings

Explain types of internal and external finishes available and methods of application for the superstructure

Class exercise in producing fully annotated section drawings to a recognised scale using typical dimensions, showing elements of the superstructure for a low-rise domestic building and for a low-rise commercial building – individual work

Construction site visit relevant to the above

Assignment 2: Superstructure

Explain the implications of environmental issues, such as waste and sustainable construction, and legislative constraints both before and during the construction of the substructure and superstructure – whole-class teaching

Responsibilities and issues affecting health and safety

Examples of types of legislation, eg Building Regulations, Health and Safety at Work Act and Construction Design and Management Regulations

Risk assessments – whole-class demonstration followed by individual work

Learner activity to carry out risk assessment for a given element of the substructure and superstructure

Management of Health and Safety Regulations, PUWER, COSHH, PPE, RIDDOR

Group work to investigate infrastructure requirements to support the construction process

Explain the plant and equipment required, including safety equipment, for the construction of the substructure and superstructure

Assignment 3: Legislation, Environmental Issues and Infrastructure

Review of unit and assignment feedback

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. Alternatively learners may build a portfolio from the above to include investigations of a programme of well-planned site visits.

There are many suitable forms of assessment that could be used, and centres are encouraged to consider and adopt these where appropriate. Some example 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.

Some criteria could be assessed directly by the tutor during practical activities. If this approach is used, suitable evidence 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 could be addressed fully by using three assignments, for example three 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 tutor feedback would be essential. If the three – assignment model is to be followed, then the first would cover P1, P2, P3, P4, M1 and D1, the second would cover P5, P6, M2 and D2 and the third would cover P7, P8 and M3.

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

For P1, learners must explain the different forms of low-rise construction currently used for domestic and commercial buildings.

For P2, learners should explain how the procedures involved in subsoil investigation are used to provide information for the design of substructures. Each procedure should be identified and explained followed by a discussion of how the data obtained is used to design the most appropriate substructure. This should convey an understanding of how subsoil conditions influence the choice of substructure and an insight into the techniques used in substructure construction.

For P3, learners need to describe the principles of foundation design. This should convey an understanding of how subsoil conditions influence foundation design and knowledge of different foundation types.

For P4, learners must explain the methods used to construct three different types of foundation. Annotated sketches and drawings, supported by simple method statements, will suffice.

For P5, learners must be able to explain the principles of superstructure design. This should convey an understanding of the underlying principles that influence the design, such as the external envelope's need for weather resistance, and knowledge of the elements that make up a building. The form of evidence could be as for P4.

For P6, learners must describe the techniques used to construct and finish the elements of various forms of superstructure for low-rise domestic and commercial buildings. This should include traditional, timber-framed, steel-framed and concrete-framed buildings. The form of evidence could be as in P4.

For P7, learners must explain the implications of environmental issues and legislative constraints, including health and safety issues and the Construction Design and Management Regulations for building construction.

For P8, learners must explain the purpose of the various parts of the infrastructure required to support the construction process. A detailed treatment of how the infrastructure is constructed is not required but there must be evidence of an understanding of the different components of the infrastructure and the purpose of each.

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 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 foundations.

For M2, learners are required to justify the selection of materials and techniques for use in the construction of superstructures for low-rise domestic and commercial buildings for two tutor-specified scenarios. This should include all the elements described in the unit content and the methods used to assemble these elements to produce the specified buildings.

For M3, learners must evaluate three pieces of legislation that are considered before and during construction of both substructures and superstructures. Evidence must address the relevance of each piece of legislation at each stage of the construction process.

For D1, learners should evaluate the environmental performance of modern materials and techniques used in the construction of substructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios. This will involve examining the range of materials and methods available for foundation 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. Annotated sketches and drawings, supported by simple method statements, will suffice.

For D2, learners must evaluate the environmental performance of modern materials and techniques used in the construction of superstructures for low-rise domestic and commercial buildings, for two different tutor-specified scenarios.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, M1, D1	Site Investigations, Foundation Design and Substructure	Working as a building consultant you are asked to carry out a site investigation on two ongoing local construction.	Report to include text, sketches, drawings, schedules and specifications as appropriate.
P5, P6, M2, D2	Superstructure	You are asked to report on their superstructure as a building consultant.	Report to include text, sketches, drawings, schedules and specifications as appropriate.
P7, P8, M3	Legislation, Environmental Issues and Infrastructure	You are asked to report on the legislation, environmental issues and infrastructure for the two constructions as a building consultant.	Report to include text, sketches, drawings, schedules and specifications as appropriate.

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

This unit forms part of the BTEC Construction and the Built Environment sector suite. This unit has particular links with the following unit titles in the Construction and the Built Environment suite:

Level 1	Level 2	Level 3
	Construction Processes and Operations for Low-rise Buildings	Health, Safety and Welfare in Construction and the Built Environment
	Construction Methods and Techniques for Low-rise Buildings	Sustainable Construction
	Construction Drawing Techniques	Science and Materials in Construction and the Built Environment
		Construction Technology and Design in Construction and Civil Engineering
		Graphical Detailing in Construction and the Built Environment
		Measuring, Estimating and Tendering Processes in Construction and the Built Environment
		Building Regulations and Control in Construction
		Project in Construction and the Built Environment

This unit has links with the Edexcel Level 3 NVQ in Technical Design (Construction Environment) and the Edexcel Level 4 NVQ in Site Inspection. It also links with the following National Occupational Standards at Level 3:

- BE Design
- BE Development and Control
- Construction Contracting Operations
- Construction Site Supervision
- Surveying, Property and Maintenance.

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 the preparation of assessment material. This could include manual and CAD facilities. Where possible, supervised visits to building sites will be 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.

Employer engagement and vocational contexts

Support to enable centres to initiate and establish links to industry, and to networks arranging visits to industry and from property practitioners is given below:

- Learning and Skills Network – www.vocationallearning.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- The Royal Institution of Chartered Surveyors – www.rics.org
- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei/

The use of vocational contexts is essential in the delivery and assessment of this unit. Much of the work can be set in the context of learners' work placements, be based on case studies of local employers, or the unit *Project in Construction and the Built Environment*. Construction site visits will enhance this unit.

Indicative reading for learners

Textbooks

Topliss S, Hurst M and Skarratt G – *BTEC Level 3 National Construction and the Built Environment Student Book* (Pearson, 2009) ISBN 9781846906565

Topliss S, Hurst M and Skarratt G – *BTEC Level 3 National Construction and the Built Environment Teaching Resource Pack* (Pearson, 2009) ISBN 9781846906558

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

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

Journals

The Architects' Journal – Emap

Construction News – Emap

Websites

www.greenspec.co.uk

www.thenbs.com

www.planningportal.gov.uk

Green Building

National Building Specification

The Complete Online Planning and Building Resource

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	investigating the performance-in-use of alternative materials and techniques used in the construction of substructures for low-rise domestic and commercial buildings carrying out risk assessments for a given element of the substructure and superstructure investigating infrastructure requirements to support the construction process
Creative thinkers	asking questions to extend their thinking
Self-managers	organising time and resources, prioritising.

Although PLTS opportunities are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	carrying out a class exercise on identifying building uses planning and carrying out research and appreciating the consequences of decisions exploring issues, events or problems from different perspectives when considering foundation types, water retention etc analysing and evaluating information and judging its relevance and value supporting conclusions, using reasoned arguments and evidence
Creative thinkers	asking questions to extend their thinking during whole-class teaching questioning their own and others' assumptions
Reflective learners	setting goals with success criteria for their development and work reviewing progress, acting on the outcomes inviting feedback and dealing positively with praise, setbacks and criticism
Team workers	collaborating with others to work towards common goals
Self-managers	working towards goals, showing initiative, commitment and perseverance organising time and resources, prioritising actions responding positively to change, seeking advice and support when needed
Effective participators	discussing issues of concern and seeking resolution where needed.

● Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	using the internet to research information for projects
Manage information storage to enable efficient retrieval	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	using the internet to research and collate information for projects
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> • text and tables • images • numbers • records 	using ICT to produce reports, including text, images, drawings, schedules and specifications as appropriate
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
Evaluate the selection and use of ICT tools and facilities used to present information	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	exchanging information, communicating by email and attaching and opening attachments to emails
English	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching and collating information for inclusion in reports
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing reports for assessment purposes.