

Unit 5: Construction Technology and Design in Construction and Civil Engineering

NQF Level 3: BTEC National

Guided learning hours: 60

Unit abstract

Modern developments in construction technology and materials have enabled us to create more efficient and complex structures. The ability to design, plan and communicate these ideas effectively is essential if a project is to be translated from an idea into reality.

This unit will encourage learners to develop their understanding of the design process, and to recognise the contribution of other members of the design team.

Planning and organisation of design activities is related to the decision making process and the likely outcomes of decisions taken by the team within a legal framework should be considered in the wider social context, rather than simple subjective preferences.

This unit will enable learners to cope with the requirements of construction related projects as they pass through various stages from design to construction including the implications of changes and variations in the design. Learners will develop their ability to produce clear drawings of construction components, coupled with succinct and accurate explanations that specify to builders the exact characteristics of relevant construction details. Use of scale, proportion and appropriate description is expected of all successful learners.

Learners will be able to use appropriate design and planning procedures to specify and communicate requirements for the technical components of buildings to other team members involved in a construction project.

Learning outcomes

On completion of this unit a learner should:

- 1 Know the factors that influence the design process and the need to work with others to create a suitable design solution
- 2 Be able to communicate ideas between various members of the design and production teams using graphical and written documents to determine design strategy
- 3 Be able to use relevant technical and architectural terminology to describe and specify aspects of construction technology and design
- 4 Understand construction details and be able to translate them into written and graphical instructions to enable progress from design to production.

Unit content

1 Know the factors that influence the design process and the need to work with others to create a suitable design solution

Financial and regulatory factors: implications of financial; legal and environmental constraints for design team (Building Regulations, health, safety and welfare); CDM (Construction Design and Management) Regulations

Stages of design process: need for and benefits of a structured framework for design; eg RIBA (Royal Institute of British Architects) *Architect's Plan of Work*; characteristics of individual stages; factors that affect each stage; ways in which various stages interconnect

Design team: team members (client, architect, architectural technologist, landscape architect, structural engineer, services engineer, facilities manager); qualifications, roles and responsibilities; interactions between team members

2 Be able to communicate ideas between various members of the design and production teams using graphical and written documents to determine design strategy

Brief: initial brief, after consideration of client's requirements, to aid design

Decision-making process: factors that contribute to making design decisions; influence of such decisions on final project outcomes

Outcomes: roles and responsibilities in design office and on site; communication between designer, client and production team

Legal aspects: legal position of each member of a design team; rights of client; damages; negligence; health, safety and welfare; environment; CDM

3 Be able to use relevant technical and architectural terminology to describe and specify aspects of construction technology and design

Construction methods: characteristics, applications and limitations of traditional and modern methods of construction; influence of these on design; identification of multiple construction options to satisfy requirements of a given design; variety of construction options available to satisfy the primary and secondary requirements of a design

Terminology: construction and architectural terminology to describe traditional and modern building elements and methods; terminology associated with legislation; health and safety and environmental factors

4 Understand construction details and be able to translate them into written and graphical instructions to enable progress from design to production

Sketch designs: multiple options in sketch form to satisfy given brief and comply with technical, financial, legal and environmental constraints

Drawings: drawings and documentation needed to make a formal planning and Building Regulations application, processes and procedures required to obtain planning consent; working drawings and details to facilitate construction

Specifications: sample model specifications to meet requirements of client, building control and production team

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:
<p>P1 identify and describe factors that influence the design process in terms of procedures, communication and the need to work with others and the roles of four different team members</p> <p>P2 construct and write suitable instructions or requests for information to members of the design team</p> <p>P3 describe construction methods and components and the arrangements necessary to incorporate them into the completed building</p> <p>P4 produce sketch designs, plans, drawings and/or sketches of construction details using standard conventions and symbols</p> <p>P5 create sample specifications for construction details to provide suitable instructions to the construction team.</p>	<p>M1 explain for a complex project the operation and effectiveness of the RIBA <i>Architect's Plan of Work</i>, including examples of where it is modified/not followed</p> <p>M2 compare and explain the methods recommended for communicating design changes to members of the design team</p> <p>M3 interpret and evaluate tutor-provided construction details, using recognised technical terminology.</p>	<p>D1 analyse and evaluate the effectiveness of the RIBA <i>Architect's Plan of Work</i> in terms of teamwork and the introduction of changes to design once construction has started</p> <p>D2 appraise the implications of a tutor-provided set of instructions produced by a design team, that represent modifications to the original contract.</p>

Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures, discussions, seminar presentations, site visits, 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.

The study of this unit is dependent on a prior knowledge and understanding of construction technology. An overview of the role of the design process and the wider context within which it fits needs to be addressed at an early stage in the delivery. Learners must be made aware that the design process encompasses a wide range of professionals each of whom contribute varying amounts to the design and implementation of projects.

Learners should understand the role and importance of the RIBA *Architect's Plan of Work* in facilitating a well-organised process for building design. An awareness and understanding of the procedures adopted, and of the implications of design change, are also essential. In addition, learners need to possess an appreciation of the importance of effective communication between the design and production teams. Job descriptions and training-needs for the design team along with examples of relevant documentation can provide a good basis for case-study material to enhance and contextualise the learning experience.

Learners should develop an awareness and understanding of the ways in which legislative requirements, such as building regulations and health and safety provisions, together with relevant areas of contract law, impact upon the design process. The effects of more recent concerns and provisions relating to environmental issues should also be addressed.

A key element of the delivery should include development of an ability to produce sketch designs, plans, drawings and/or sketches of construction details using standard conventions and symbols. Learners should be encouraged to develop their ability to draw plans and details for buildings that are functional, but also to express themselves within a design context. These should normally be restricted to the building types studied in *Unit 6: Building Technology in Construction*, ie low-rise domestic and/or commercial buildings. Conversion projects would also be suitable for this purpose whereby floor layout and accommodation arrangements may provide suitably demanding projects on which learners could develop their understanding of design layouts and arrangements.

Learners will need to grasp the necessity of accurate scale drawings showing salient and important information for construction teams. The ability to translate the information contained in the drawing into meaningful written technical terminology is essential for learners.

Where possible, links should be formed with design practices and construction firms with visits arranged to enable the learning to be contextualised. Further enhancement to the learning process could be achieved 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 role of the design process in the construction of 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. 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. The first of these would cover criteria P1, P2, P3, M1, M2 and D1, and the second would cover criteria P4, P5, M3 and D2. Two case studies could provide a suitable vehicle for the assessments. 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.

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

For P1, learners must identify and describe factors that influence the design process in terms of procedures, communication and the need to work with others. Learners should describe the nature of teams, how they work and who would be appropriately deployed within design teams to create and effect a suitable design for construction works. Learners must be able to identify at least four members of a design team, along with their relevant backgrounds, their expected qualifications and be able to explain their contribution to the design. Learners should also be able to express the effect of working together in teams and understand that the complexities of construction projects mean that one person is unlikely to possess all of the technological skills necessary to complete all of the design themselves.

For P2, learners should be able to construct and write suitable instructions or requests for information to members of the design team. Learners must demonstrate the ability to request or demand information in an appropriate manner. Learners must also be specific and focused in order to solicit the exact information necessary to complete the work. Learners must understand that when an instruction for a design change or for a modification is issued, the instructions have to be clear, concise and succinct. Writing the instruction for a suitable audience is therefore implied in this criterion and the use of technical terminology must be used appropriately.

For P3, learners are required to describe construction methods and components and the arrangements necessary to incorporate them into the completed building. Descriptions of technical components are required which may be found and adapted for use through appropriate technical literature and standards. Learners should adopt the technical expressions found in legislative documents such as the Building Regulations or British Standards to ensure that the materials and workmanship meet suitable standards and expectations. In addition, learners should describe the process of integrating these components into the fabric of the building, in order to demonstrate their understanding of the relationship between components.

For P4, learners have to produce sketch designs, plans, drawings and/or sketches of construction details using standard conventions and symbols. Learners are required to communicate construction information through carefully constructed drawings. These should be accurate, using scale, proportion and appropriate symbols complying with BS1192, *Drawing Office Practice*. Technical terminology is required at this level, with relevant references provided to British Standards or suitable legislative requirements.

For P5, learners must create sample specifications for construction details, to provide suitable instructions to the construction team. This requires learners to demonstrate the ability to write specifications, using appropriate terminology and formats, relating to details and components that have been drawn.

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

For M1, learners should explain the operation and effectiveness of the RIBA *Architect's Plan of Work*, in terms of teamwork and the introduction of design changes after work has begun. This should include examples of how the Plan is used effectively, with at least one example of a complex project whereby the plan is either not used or is modified to provide a more effective service to the client. Learners may wish to explore examples of small to medium sized enterprises that do not have the capacity or the staff for the clear division of responsibilities that the RIBA *Architect's Plan of Work* assumes.

For M2, learners have to compare and explain the methods recommended for communicating design changes to members of the design team. Changes and modifications to the original design should be addressed, and the requirement of contractors to adopt these changes explained.

For M3, learners must interpret and evaluate analyse tutor-provided construction details using recognised technical terminology. Learners will need to be provided with suitable materials that can be used to draft specifications. Examples of these include construction working drawings, photographs, manufacturer's literature and

detailed sketches. Learners will be expected to demonstrate an ability to use technical expressions and terminology effectively linking British Standards and legislative controls to the suitability of materials to the relevant application.

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 are required to analyse and evaluate the effectiveness of the RIBA Architect's *Plan of Work* in terms of teamwork and the introduction of changes to design once construction has started. The plan should be evaluated in terms of its flexibility and practical application in use. Examples of changes once construction work has begun should be used to provide a consideration of how to accommodate these changes, and learners must demonstrate some understanding of the need for a degree of flexibility and the ability to respond swiftly to changes in different circumstances. The pre-established methods of determining and quantifying such changes in progress should also be explained, and learners should be able to provide good examples of the effectiveness of the plan and its use.

For D2, learners are required to appraise the implications of instructions produced by the design team that represent modifications to the original contract. Learners should critically appraise a tutor-provided example of instructions issued by members of a design team to apply modifications to an original contract.

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

This Unit has links to *Unit 8: Graphical Detailing in Construction and the Built Environment*, *Unit 6: Building Technology in Construction*, *Unit 17: Building Regulations and Control in Construction* and *Unit 22: Design Procedures 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: communication; and problem solving. Opportunities for satisfying requirements for Wider Curriculum Mapping are summarised in *Annexe F: Wider curriculum mapping*.

Essential resources

Access to drawing studios and equipment and sample construction materials is essential to the delivery of this unit.

Indicative reading for learners

Textbooks

BSI – *Construction Drawing Practice, BS1192 Part 5* (British Standards Institute, 1999) ISBN 0580295141

Emmitt S – *Design Management for Architects* (Blackwell, 2006) ISBN 1405131470

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

Emmitt S and Yeomans D – *Specifying Buildings: a Design Management Perspective* (Butterworth-Heinemann, 2001) ISBN 075064849X

Phillips R – *Architect's Plan of Work* (RIBA Publishing, 2000) RIBA Order Code 21009

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

Thompson A – *Architectural Design Procedures, 2nd Edition* (Butterworth-Heinemann, 1998) ISBN 0340719419

Zunde J M – *Design Procedures Level 4* (Sheffield Hallam University Press, 1989)

Website

www.thenbs.com

Building Regulations and Approved Documents
(NBS 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.

Communication Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> identifying and describing factors that influence the design process in terms of teamwork and the need to work with others. 	<p>C3.2 Read and synthesise information from at least two documents about the same subject.</p> <p>Each document must be a minimum of 1000 words long.</p>
Information and communication technology Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> using the internet and/or other electronic sources to research material to produce the assessment evidence using the internet and other electronic media to research and gather information on construction technology and design. 	<p>ICT3.1 Search for information using different sources, and multiple search criteria in at least one case.</p> <p>ICT3.2 Enter and develop the information and derive new information.</p> <p>ICT3.3 Present combined information such as text with image, text with number, image with number.</p>
Problem solving Level 3	
When learners are:	They should be able to develop the following key skills evidence:
<ul style="list-style-type: none"> comparing and explaining the methods recommended to communicate design changes to members of the design team. 	<p>PS3.1 Explore a problem and identify different ways of tackling it.</p> <p>PS3.2 Plan and implement at least one way of solving the problem.</p> <p>PS3.3 Check if the problem has been solved and review your approach to problem solving.</p>