Pearson
BTEC Level 3 National Extended Diploma in Construction and the Built Environment

Specification

First teaching from September 2017

First certification from 2019

Issue 8

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About Pearson

We are the world's leading learning company operating in countries all around the world. We provide content, assessment and digital services to schools, colleges and universities, as well as professional and vocational education to learners to help increase their skills and lifelong employability prospects. We believe that wherever learning flourishes so do people.

This specification is Issue 8. We will inform centres of any changes to this issue. The latest issue can be found on our website.

References to third-party material made in this specification are made in good faith. We do not endorse, approve or accept responsibility for the content of materials, which may be subject to change, or any opinions expressed therein. (Material may include textbooks, journals, magazines and other publications and websites.)

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Welcome

With a track record built over 30 years of learner success, BTEC Nationals are widely recognised by industry and higher education as the signature vocational qualification at Level 3. They provide progression to the workplace either directly or via study at a higher level. Proof comes from YouGov research, which shows that 62% of large companies have recruited employees with BTEC qualifications. What's more, well over 100,000 BTEC students apply to UK universities every year and their BTEC Nationals are accepted by over 150 UK universities and higher education institutes for relevant degree programmes either on their own or in combination with A Levels.

Why are BTECs so successful?

BTECs embody a fundamentally learner-centred approach to the curriculum, with a flexible, unit-based structure and knowledge applied in project-based assessments. They focus on the holistic development of the practical, interpersonal and thinking skills required to be able to succeed in employment and higher education.

When creating the BTEC Nationals in this suite, we worked with many employers, higher education providers, colleges and schools to ensure that their needs are met. Employers are looking for recruits with a thorough grounding in the latest industry requirements and work-ready skills such as teamwork. Higher education needs students who have experience of research, extended writing and meeting deadlines.

We have addressed these requirements with:

- a range of BTEC sizes, each with a clear purpose, so there is something to suit each learner's choice of study programme and progression plans
- refreshed content that is closely aligned with employers' and higher education needs for a skilled future workforce
- assessments and projects chosen to help learners progress to the next stage. This means some are set by you to meet local needs, while others are set and marked by Pearson so that there is a core of skills and understanding that is common to all learners. For example, a written test can be used to check that learners are confident in using technical knowledge to carry out a certain job.

We are providing a wealth of support, both resources and people, to ensure that learners and their teachers have the best possible experience during their course. See *Section 10* for details of the support we offer.

A word to learners

Today's BTEC Nationals are demanding, as you would expect of the most respected applied learning qualification in the UK. You will have to choose and complete a range of units, be organised, take some assessments that we will set and mark, and keep a portfolio of your assignments. But you can feel proud to achieve a BTEC because, whatever your plans in life – whether you decide to study further, go on to work or an apprenticeship, or set up your own business – your BTEC National will be your passport to success in the next stage of your life.

Good luck, and we hope you enjoy your course.

Collaborative development

Students completing their BTEC Nationals in Construction and the Built Environment will be aiming to go on to employment, often via the stepping stone of higher education. It was, therefore, essential that we developed these qualifications in close collaboration with experts from professional bodies, businesses and universities, and with the providers who will be delivering the qualifications. To ensure that the content meets providers' needs and provides high-quality preparation for progression, we engaged experts. We are very grateful to all the university and further education lecturers, teachers, employers, professional body representatives and other individuals who have generously shared their time and expertise to help us develop these new qualifications.

Professional bodies and businesses have provided letters of support confirming that these qualifications meet their entry requirements. These letters can be viewed on our website.

Pearson would also like to extend particular thanks to the Ministry of Building Innovation and Education mobie.org.uk who in 2019 collaborated with Pearson on developing additional units for house building and design, available in the National Diploma and Extended Diploma in Construction and the Built Environment.

Summary of Pearson BTEC Level 3 National in Extended Diploma in Construction and the Built Environment specification Issue 8 changes

Summary of changes made between the previous issue and this current issue	Page number
Change made to *Structures of the qualifications at a glance* section to remove incorrect indication that *Unit 3: Tendering and Estimating* is a mandatory unit in the Diploma (720 GLH) in Civil Engineering.	Page 6

Summary of Pearson BTEC Level 3 National Extended Diploma in Civil Engineering specification Issue 7 changes

Summary of changes made between Issue 6 and Issue 7	Page number
The number of mandatory units for the Extended Diploma in Construction and the Built Environment and the Extended Diploma in Building Services Engineering in the *Qualification, sizes and purpose at a glance* section has been corrected to 15.	Page 5
The number of mandatory units has been corrected to nine under *What does this qualification cover?* section.	Page 12
Changes made to *Unit 1: Construction Principles Essential content* under A2 and A3 for clarity.	Pages 25 and 26
Changes made to *Unit 2: Construction Design Essential content* under A1, A2, B1, B4 and C1 for clarity.	Pages 37-41
Changes made for clarity to *Unit 18: Building Information Modelling* wording in sections *Unit in brief* and *Unit introduction*. The rider statements in the *Content* section for A1, A2, A3, Learning aim B, B2, B3, B4, C1, C2, D1, D2, D3 and D5 have been amended for clarity. D4 has been removed to eliminate duplication with D3. A new paragraph on access to industry resource was added under Employer involvement section.	Pages 199-204, 208
Changes made for clarity to *Unit 26: Conversion, Adaptation and Maintenance of Buildings* in *Unit introduction* section. In the *Learning aims, Summary of unit* and *Content* sections Learning aims A and C and content areas A1, C1 and C4 titles have been amended to include 'retrofit'. New bullet point on 'retrofit' was added to A2. New bullet point on 'legislation' was added to C2. New bullet point on 'energy efficiency' was added to C3.	Pages 281-286
In *Unit 40: Offsite and Onsite Alternative Construction Methods Content* section A3 title has been amended to include 'retrofit'. A new paragraph on access to industry resource was added under *Employer involvement* section.	Pages 302, 303 and 309
Removal of references to MyBTEC, as that service is retiring.	Pages 332, 337, 342, 358, 359

If you need further information on these changes or what they mean, contact us via our website at: qualifications.pearson.com/en/support/contact-us.html.

Contents

Introduction to BTEC National qualifications for the construction and the built environment sector

This specification contains the information you need to deliver the Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment. The specification signposts you to additional handbooks and policies. It includes all the units for this qualification.

This qualification is part of the suite of Construction and the Built Environment qualifications offered by Pearson. In the suite there are qualifications that focus on different progression routes, allowing learners to choose the one best suited to their aspirations.

All qualifications in the suite share some common units and assessments, allowing learners some flexibility in moving between qualifications where they wish to select a more specific progression route. The qualification titles are given below.

Within this suite are BTEC National qualifications for post-16 learners wishing to specialise in a specific industry, occupation or occupational group. The qualifications give learners specialist knowledge and technical skills, enabling entry to an Apprenticeship or other employment, or progression to related higher education courses. Learners taking these qualifications must have a significant level of employer involvement in their programmes.

In the construction and the built environment sector these are:

Pearson BTEC Level 3 National Extended Certificate in Construction and the Built Environment (603/0862/X)

Pearson BTEC Level 3 National Foundation Diploma in Construction and the Built Environment (603/0863/1)

Pearson BTEC Level 3 National Diploma in Construction and the Built Environment (603/0864/3)

Pearson BTEC Level 3 National Diploma in Building Services Engineering (603/1218/X)

Pearson BTEC Level 3 National Diploma in Civil Engineering (603/1217/8)

Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment (603/0861/8)

Pearson BTEC Level 3 National Extended Diploma in Building Services Engineering (603/1219/1)

Pearson BTEC Level 3 National Extended Diploma in Civil Engineering (603/1216/6).

Other BTEC National qualifications in this sector provide a broad introduction that gives learners transferable knowledge and skills. These qualifications are for post-16 learners who want to continue their education through applied learning. The qualifications prepare learners for a range of higher education courses either by meeting entry requirements in their own right or by being accepted alongside other qualifications at the same level and adding value to them. Learners may progress to one of the qualifications in this specification having completed a smaller qualification that provides suitable fundamental knowledge and skills.

This specification signposts all the other essential documents and support that you need as a centre in order to deliver, assess and administer the qualification, including the staff development required. A summary of all essential documents is given in *Section 7*. Information on how we can support you with this qualification is given in *Section 10*.

The information in this specification is correct at the time of publication.

Total Qualification Time

For all regulated qualifications, Pearson specifies a total number of hours that it is estimated learners will require to complete and show achievement for the qualification: this is the Total Qualification Time (TQT). Within TQT, Pearson identifies the number of Guided Learning Hours (GLH) that we estimate a centre delivering the qualification might provide. Guided learning means activities, such as lessons, tutorials, online instruction, supervised study and giving feedback on performance, that directly involve teachers and assessors in teaching, supervising and invigilating learners. Guided learning includes the time required for learners to complete external assessment under examination or supervised conditions.

In addition to guided learning, other required learning directed by teachers or assessors will include private study, preparation for assessment and undertaking assessment when not under supervision, such as preparatory reading, revision and independent research.

BTEC Nationals have been designed around the number of hours of guided learning expected. Each unit in the qualification has a GLH value of 60, 90 or 120. There is then a total GLH value for the qualification.

Each qualification has a TQT value. This may vary within sectors and across the suite depending on the nature of the units in each qualification and the expected time for other required learning.

The following table show all the qualifications in this sector and their GLH and TQT values.

Qualifications, sizes and purposes at a glance

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Extended Certificate in Construction and the Built Environment	360 GLH (490 TQT) Equivalent in size to one A Level. 4 units of which 4 are mandatory and 2 are external. Mandatory content (100%). External assessment (66%).	The Extended Certificate is for learners who are interested in learning about the construction sector alongside other fields of study, with a view to progressing to a wide range of higher education courses, not necessarily in construction-related subjects. It is designed to be taken as part of a programme of study that includes other appropriate BTEC Nationals or A Levels.
Pearson BTEC Level 3 National Foundation Diploma in Construction and the Built Environment	540 GLH (725 TQT) Equivalent in size to 1.5 A Levels. 7 units of which 4 are mandatory and 2 are external. Mandatory content (66%). External assessment (44%).	The Foundation Diploma is for learners looking to study construction as a one-year, full-time course, or for those wishing to take it alongside another area of contrasting or complementary study, as part of a two-year, full-time study programme. It supports progression to higher education, if taken as part of a programme of study that includes other BTEC Nationals or A Levels. It also supports progression to an Apprenticeship in the construction sector or to a further year of study at Level 3.
Pearson BTEC Level 3 National Diploma in Construction and the Built Environment	720 GLH (985 TQT) Equivalent in size to two A Levels. 10 units of which 7 are mandatory and 2 are external. Mandatory content (75%) External assessment (33%).	The Diploma is designed to be the substantive part of a 16–19 study programme for learners who want a strong core of sector study. This programme may include other BTEC Nationals or A Levels to support progression to higher education courses in construction areas before entering employment. The additional qualification(s) studied allow learners either to give breadth to their study programme by choosing a contrasting subject, or to give it more focus by choosing a complementary subject. This qualification can also be used to progress to Higher Apprenticeships.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Diploma in Building Services Engineering	720 GLH (990 TQT) Equivalent in size to two A Levels. 10 units of which 6 are mandatory and 2 are external. Mandatory content (66%) External assessment (33%).	The Diploma is designed to be the substantive part of a 16–19 study programme for learners who want a strong core of sector study. This programme may include other BTEC Nationals or A Levels to support progression to higher education courses in construction areas before entering employment. The qualification is intended to meet the educational base for registration as a technician. The additional qualification(s) studied allow learners either to give breadth to their study programme by choosing a contrasting subject, or to give it more focus by choosing a complementary subject. This qualification can also be used, when studied part time, as part of an advanced technician Apprenticeship in building services engineering, or for progression to a Higher Apprenticeship in building services engineering.
Pearson BTEC Level 3 National Diploma in Civil Engineering	720 GLH (975 TQT) Equivalent in size to two A Levels. 10 units of which 7 are mandatory and 2 are external. Mandatory content (75%) External assessment (33%).	The Diploma is designed to be the substantive part of a 16–19 study programme for learners who want a strong core of sector study. This programme may include other BTEC Nationals or A Levels to support progression to higher education courses in construction areas before entering employment. The qualification is intended to meet the educational base for registration as a technician. The additional qualification(s) studied allow learners either to give breadth to their study programme by choosing a contrasting subject, or to give it more focus by choosing a complementary subject. This qualification can also be used, when studied part time, as part of an advanced technician Apprenticeship in civil engineering, or for progression to a Higher Apprenticeship in civil engineering.

Title	Size and structure	Summary purpose
Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment	1080 GLH (1465 TQT) Equivalent in size to three A Levels. 15 units of which 9 are mandatory and 3 are external. Mandatory content (66%) External assessment (33%).	The Extended Diploma is a two-year, full-time course that meets entry requirements in its own right for learners who want to progress to higher education courses in construction areas before entering employment. It can also support learners who want to progress directly to employment in job roles in construction or a professional construction role and Higher Apprenticeships in the construction sector.
Pearson BTEC Level 3 National Extended Diploma in Building Services Engineering	1080 GLH (1480 TQT) Equivalent in size to three A Levels. 15 units of which 7 are mandatory and 3 are external. Mandatory content (55%) External assessment (33%).	The Extended Diploma is a two-year, full-time course that meets entry requirements in its own right for learners who want to progress to higher education courses in building services areas before entering employment. The qualification is intended to meet the educational base for registration as a technician. It supports learners who want to progress directly to employment in roles in building services engineering as technicians, or to a professional construction role and advanced/ Higher Apprenticeships in building services engineering.
Pearson BTEC Level 3 National Extended Diploma in Civil Engineering	1080 GLH (1450 TQT) Equivalent in size to three A Levels. 15 units of which 8 are mandatory and 3 are external. Mandatory content (66%) External assessment (33%).	The Extended Diploma is a two-year, full-time course that meets entry requirements in its own right for learners who want to progress to higher education courses in civil engineering areas before entering employment. The qualification is intended to meet the educational base for registration as a technician. It supports learners who want to progress directly to employment in roles in civil engineering as technicians, or to a professional construction role and advanced/Higher Apprenticeships in civil engineering.

Structures of the qualifications at a glance

This table shows all the units and the qualifications to which they contribute. The full structure for this Pearson BTEC Level 3 National in Construction and the Built Environment is shown in *Section 2*. **You must refer to the full structure to select units and plan your programme.**

Key

	Unit assessed externally	**M**	**Mandatory units**	**O**	**Optional units**
CBE	**Construction and the Built Environment**	**CE**	**Civil Engineering**	**BSE**	**Building Services Engineering**

Unit (number and title)	Unit size (GLH)	Extended Certificate (360 GLH)	Foundation Diploma (540 GLH)	Diploma (720 GLH)			Extended Diploma (1080 GLH)		
				CBE	CE	BSE	CBE	CE	BSE
1 Construction Principles	120	M	M	M	M	M	M	M	M
2 Construction Design	120	M	M	M	M	M	M	M	M
3 Tendering and Estimating	120						M	M	M
4 Construction Technology	60	M	M	M	M	M	M	M	M
5 Health and Safety in Construction	60	M	M	M	M	M	M	M	M
6 Surveying in Construction	60		O	M	O		M	O	
7 Graphical Detailing in Construction	60		O	M	O	O	M	O	O
8 Building Regulations and Control in Construction	60		O	M			M	O	
9 Management of a Construction Project	60		O	O	O	O	M	O	O
10 Building Surveying in Construction	60		O	O			O	O	
11 Site Engineering for Construction	60		O	O	M		O	M	
12 Low Temperature Hot Water Systems in Building Services	60			O		O	O		O
13 Measurement Techniques in Construction	60		O	O	O		O	O	
14 Provision of Primary Services in Construction	60		O	O		M	O		M
15 Further Mathematics for Construction	60				M	O	O	M	O
16 Work Experience in the Construction Sector	60						O	O	O
17 Projects in Construction	60			O	O	O	O	O	O
18 Building Information Modelling	60			O	O	O	O	O	O

continued overleaf

Unit (number and title)	Unit size (GLH)	Extended Certificate (360 GLH)	Foundation Diploma (540 GLH)	Diploma (720 GLH)			Extended Diploma (1080 GLH)		
				CBE	CE	BSE	CBE	CE	BSE
19 Quantity Surveying	**60**		**O**	**O**		**O**	**O**		**O**
20 Quality Control Management in Construction	**60**			**O**			**O**	**O**	**O**
21 Building Services Science	**60**					**M**	**O**		**M**
22 Economics and Finance in Construction	**60**						**O**		
23 Construction in Civil Engineering	**60**				**M**		**O**	**M**	
24 Planning Application Procedures in Construction	**60**						**O**		
25 Property Law	**60**						**O**		
26 Conversion, Adaptation and Maintenance of Buildings	**60**						**O**		
27 Building Services Control Systems	**60**					**O**			**O**
28 Heating, Ventilation and Air Conditioning Design	**60**					**O**			**O**
29 Use of Static and Dynamic Fluids in Building Services Engineering	**60**					**O**			**O**
30 Plumbing Technology in Building Services Engineering	**60**					**O**			**O**
31 Electrical Principles in Building Services Engineering	**60**					**O**			**O**
32 Electrical Installation Standards, Components and Design	**60**					**O**			**O**
33 Quantity Surveying Measurement Techniques in Building Services Engineering	**60**					**O**			**O**
34 Building Regulations and Control in Building Services Engineering	**60**					**O**			**O**
35 Principles and Applications of Structural Mechanics	**60**				**O**			**O**	
36 Public Health Engineering	**60**				**O**			**O**	
37 Specialist Civil Engineering Techniques	**60**				**O**			**O**	
38 Highway Construction and Maintenance in Civil Engineering	**60**				**O**			**O**	

Unit (number and title)	Unit size (GLH)	Extended Certificate (360 GLH)	Foundation Diploma (540 GLH)	Diploma (720 GLH)			Extended Diploma (1080 GLH)		
				CBE	CE	BSE	CBE	CE	BSE
39 Housing Design Project	**60**			**O**			**O**		
40 Offsite and Onsite Alternative Construction Methods	**60**			**O**			**O**		
41 Renewable Energy for Housing	**60**			**O**			**O**		
42 The Housing Industry	**60**			**O**			**O**		

Qualification and unit content

Pearson has developed the content of the new BTEC Nationals in collaboration with employers and representatives from higher education and relevant professional bodies. In this way, we have ensured that content is up to date and that it includes the knowledge, understanding, skills and attributes required in the sector.

Each qualification in the suite has its own purpose. The mandatory content provides a balance of breadth and depth ensuring that all learners have a strong basis for developing technical skills required in the sector. Learners are then offered the opportunity to develop a range of technical skills and attributes expected by employers, with some opportunity to select between optional units where a degree of choice for individual learners to study content relevant to their own progression choices is appropriate. It is expected that learners will apply their learning in relevant employment and sector contexts during delivery and have opportunities to engage meaningfully with employers.

The proportion of mandatory content ensures that all learners are following a coherent programme of study and acquiring the knowledge, understanding and skills that will be recognised and valued. Learners are expected to show achievement across mandatory units as detailed in *Section 2*.

BTEC Nationals have always required applied learning that brings together knowledge and understanding (the cognitive domain) with practical and technical skills (the psychomotor domain). This is achieved through learners performing vocational tasks that encourage the development of appropriate vocational behaviours (the affective domain) and transferable skills. Transferable skills are those such as communication, teamwork, planning and completing tasks to high standards, which are valued in both the workplace and in higher education.

Our approach provides rigour and balance, and promotes the ability to apply learning immediately in new contexts. Further details can be found in *Section 2*.

Centres should ensure that delivery of content is kept up to date. Some of the units within the specification may contain references to legislation, policies, regulations and organisations, which may not be applicable in the country you deliver this qualification in (if teaching outside of England), or which may have gone out-of-date during the lifespan of the specification. In these instances, it is possible to substitute such references with ones that are current and applicable in the country you deliver subject to confirmation by your Standards Verifier.

Assessment

Assessment is specifically designed to fit the purpose and objective of the qualification. It includes a range of assessment types and styles suited to vocational qualifications in the sector. There are three main forms of assessment that you need to be aware of: external, internal and synoptic.

Externally-assessed units

Each external assessment for a BTEC National is linked to a specific unit. All of the units developed for external assessment are of 120 GLH to allow learners to demonstrate breadth and depth of achievement. Each assessment is taken under specified conditions, then marked by Pearson and a grade awarded. Learners are permitted to resit external assessments during their programme. You should refer to our website for current policy information on permitted retakes.

The styles of external assessment used for qualifications in the Construction and the Built Environment suite are:

- examinations – all learners take the same assessment at the same time, normally with a written outcome
- set tasks – learners take the assessment during a defined window and demonstrate understanding through completion of a vocational task.

Some external assessments include a period of preparation using set information. External assessments are available twice a year. For detailed information on the external assessments please see the table in *Section 2*. For further information on preparing for external assessment see *Section 5*.

Internally-assessed units

Most units in the sector are internally assessed and subject to external standards verification. This means that you set and assess the assignments that provide the final summative assessment of each unit, using the examples and support that Pearson provides. Before you assess you will need to become an approved centre, if you are not one already. You will need to prepare to assess using the guidance in *Section 6*.

In line with the requirements and guidance for internal assessment, you select the most appropriate assessment styles according to the learning set out in the unit. This ensures that learners are assessed using a variety of styles to help them develop a broad range of transferable skills. Learners could be given opportunities to:

- demonstrate practical and technical skills using appropriate (tools/processes etc.)
- complete realistic tasks to meet specific briefs or particular purposes
- write up the findings of their own research
- use case studies to explore complex or unfamiliar situations
- carry out projects for which they have choice over the direction and outcomes.

You will make grading decisions based on the requirements and supporting guidance given in the units. Learners may not make repeated submissions of assignment evidence. For further information see *Section 6*.

Synoptic assessment

Synoptic assessment requires learners to demonstrate that they can identify and use effectively, in an integrated way, an appropriate selection of skills, techniques, concepts, theories and knowledge from across the whole sector as relevant to a key task. BTEC learning has always encouraged learners to apply their learning in realistic contexts using scenarios and realistic activities that will permit learners to draw on and apply their learning. For these qualifications we have formally identified units which contain a synoptic assessment task. Synoptic assessment must take place after the teaching and learning of other mandatory units in order for learners to be able to draw from the full range of content. The synoptic assessment gives learners an opportunity to independently select and apply learning from across their programmes in the completion of a vocational task. Synoptic tasks may be in internally or externally assessed units. The particular units that contains the synoptic tasks for this qualification is shown in the structure in *Section 2*.

Language of assessment

Assessment of the internal and external units for these qualifications will be available in English. All learner work must be in English. A learner taking the qualifications may be assessed in British or Irish Sign Language where it is permitted for the purpose of reasonable adjustment.
For information on reasonable adjustments see *Section 7*.

Grading for units and qualifications

Achievement in the qualification requires a demonstration of depth of study in each unit, assured acquisition of a range of practical skills required for employment or progression to higher education, and successful development of transferable skills. Learners achieving a qualification will have achieved across mandatory units, including external and synoptic assessment.

Units are assessed using a grading scale of Distinction (D), Merit (M), Pass (P), Near Pass (N) and Unclassified (U). The grade of Near Pass is used for externally-assessed units only. All mandatory and optional units contribute proportionately to the overall qualification grade, for example a unit of 120 GLH will contribute double that of a 60 GLH unit.

Qualifications in the suite are graded using a scale of P to D*, **or** PP to D*D*, **or** PPP to D*D*D*. Please see *Section 9* for more details. The relationship between qualification grading scales and unit grades will be subject to regular review as part of Pearson’s standards monitoring processes on the basis of learner performance and in consultation with key users of the qualification.

UCAS Tariff points

The BTEC Nationals attract UCAS points. Please go to the UCAS website for full details of the points allocated.

1 Qualification purpose

Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment

In this section you will find information on the purpose of this qualification and how its design meets that purpose through the qualification objective and structure. We publish a full 'Statement of Purpose' for each qualification on our website. These statements are designed to guide you and potential learners to make the most appropriate choice about the size of qualification suitable at recruitment.

The construction sector

Construction is a very important global industry and is worth £90 billion annually to the UK economy. At technician level and beyond, there is a diverse range of career pathways, with established professional entry and development routes in civil engineering, building services, engineering, design/architecture, and construction supervision/management. Currently, qualified construction technicians, managers and professionals are highly sought after in the UK industry, with demand for a greater number of professionals to implement and lead low-carbon and sustainable building projects in an efficient, cost-effective way.

Who is this qualification for?

The Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment is intended as a Tech Level qualification, equivalent in size to three A Levels. It is designed to meet the Tech Bacc measure when studied alongside Level 3 mathematics and the Extended Project Qualification (EPQ). It allows learners to develop a substantial core of knowledge, to study in depth a full range of optional units, and to develop the broader skills highly valued by higher education institutions, such as critical thinking, and the range of written and verbal communications required in the construction sector.

The qualification is primarily for learners studying full time over a period of two years and who want to pursue a career in construction, proceed directly to employment as a technician, or progress to higher education. The qualification is intended to meet the requirements for registration as a technician.

No prior study of the sector is needed but learners should normally have a range of achievement at Level 2, in GCSEs or equivalent qualifications, including English, mathematics and science.

What does this qualification cover?

The content of this qualification has been developed in consultation with employers and professional bodies to ensure that it is appropriate for those interested in working in the sector. In addition, higher education representatives have been involved to ensure that it fully supports entry to the relevant range of specialist degrees.

The qualification provides the knowledge, understanding and skills that will allow learners to progress to further education, or directly to employment or an Apprenticeship in the construction sector.

There are nine mandatory units, which cover the following aspects of construction:

- construction principles
- construction design
- tendering and estimating
- health and safety in construction
- construction technology
- projects in construction
- graphical detailing in construction
- building regulations and control in construction
- surveying in construction.

The mandatory units will introduce learners to personal responsibilities for health, safety and welfare, the industry and legislative requirements for health and safety, and the application of organisational processes and risk management to ensure compliance. They will also introduce learners to the skills needed for tendering and estimating within a project environment.

Learners will be able to choose six optional units focusing on their areas of preferred specialism. These units will offer learners the opportunity to gain specialist skills and knowledge, which they will need to work as a technician in the construction sector or to progress to higher education.

Learners will be required to engage with sector employers as part of their course. This could include work experience with an employer in the sector, where they will be given opportunities to develop practical skills in preparation for employment.

What could this qualification lead to?

This qualification will prepare learners for direct employment in the construction and built environment sector, and is ideal if they wish to enter a particular specialist area of work, such as:

- construction contracting technician
- design technician
- architectural technician
- quality controller
- site quality controller
- building control/planning technician
- quantity surveying technician.

The optional units give learners the chance to learn about a particular aspect of construction in more detail, but because the mandatory content makes up two-thirds of the qualification, they will be prepared for all these roles whichever optional units they choose.

There are many roles in this sector where recruitment is at graduate level. The qualification carries UCAS points and is recognised by higher education providers as meeting admission requirements to many relevant courses, for example:

- BSc (Hons) in Construction Management
- BSc (Hons) in Property Management (Building Surveying)
- BSc (Hons) in Architecture
- BSc (Hons) in Civil Engineering
- HNC/D in Civil Engineering
- HNC/D in Building Services Engineering
- HND in Construction and the Built Environment.

Learners should always check the entry requirements for degree programmes with specific higher education providers. After this qualification, learners can also progress directly into employment, however it is likely that many will do so via higher study. Areas of employment include specialist roles, such as construction contracting technician, design technician, architectural technician, quality controller, site quality controller, building control/planning technician, quantity surveying technician.

As part of their higher study choices, learners may also choose to progress to a BTEC Higher National (HN) qualification. HNs are widely supported by higher education and industry as the principal vocational qualifications at Levels 4 and 5 and are designed to reflect the increasing need for high quality professional and technical education at Levels 4 and 5. They provide learners with a clear line of sight to employment and to a degree at Level 6 if they choose. The Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment meets the admission requirements for:

- Pearson BTEC Level 4 Higher National Certificate in Construction and the Built Environment
- Pearson BTEC Level 5 Higher National Diploma in Construction and the Built Environment.

How does the qualification provide employability and technical skills?

In the BTEC National units there are opportunities during the teaching and learning phase to give learners practice in developing employability skills. Where employability skills are referred to in this specification, we are generally referring to skills in the following three main categories:

- **cognitive and problem-solving skills**: use critical thinking, approach non-routine problems applying expert and creative solutions, use systems and technology
- **intrapersonal skills**: communicating, working collaboratively, negotiating and influencing, self-presentation
- **interpersonal skills**: self-management, adaptability and resilience, self-monitoring and development.

There are also specific requirements in some units for assessment of these skills where relevant. For example, where learners are required to undertake real or simulated activities.

Many of the mandatory and specified optional units encourage learners to develop the specific practical skills that employers are looking for.

How does the qualification provide transferable knowledge and skills for higher education?

All BTEC Nationals provide transferable knowledge and skills that prepare learners for progression to university or other higher study either immediately or for career progression. The transferable skills that universities value include:

- the ability to learn independently
- the ability to research actively and methodically
- being able to give presentations and being active group members.

BTEC learners can also benefit from opportunities for deep learning where they are able to make connections among units and select areas of interest for detailed study. BTEC Nationals provide a vocational context in which learners can become prepared for life-long learning through:

- reading technical texts
- analytical skills.

2 Structure

Qualification structure

Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment

Mandatory units

There are nine mandatory units, six internal and three external. Learners must complete and achieve at Near Pass grade or above in all mandatory external units and achieve a Pass or above in all mandatory internal units in group A. Learners must complete all units in group B.

Optional units

Learners must complete at least six optional units.

Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment				
Unit number	**Unit title**	**GLH**	**Type**	**How assessed**
	Mandatory units group A – learners complete and achieve all units			
1	Construction Principles	**120**	**Mandatory**	External
2	Construction Design	**120**	**Mandatory**	External
3	Tendering and Estimating	**120**	**Mandatory and Synoptic**	External
4	Construction Technology	**60**	**Mandatory**	Internal
5	Health and Safety in Construction	**60**	**Mandatory**	Internal
	Mandatory units group B – learners complete all units			
6	Surveying in Construction	**60**	**Mandatory**	Internal
7	Graphical Detailing in Construction	**60**	**Mandatory**	Internal
8	Building Regulations and Control in Construction	**60**	**Mandatory**	Internal
9	Management of a Construction Project	**60**	**Mandatory**	Internal
	Optional units group C – learners complete 3 - 6 units			
10	Building Surveying in Construction	**60**	**Optional**	Internal
11	Site Engineering for Construction	**60**	**Optional**	Internal
12	Low Temperature Hot Water Systems in Building Services	**60**	**Optional**	Internal
13	Measurement Techniques in Construction	**60**	**Optional**	Internal
14	Provision of Primary Services in Buildings	**60**	**Optional**	Internal
15	Further Mathematics for Construction	**60**	**Optional**	Internal
16	Work Experience in the Construction Sector	**60**	**Optional**	Internal
17	Projects in Construction	**60**	**Optional**	Internal
18	Building Information Modelling	**60**	**Optional**	Internal
19	Quantity Surveying	**60**	**Optional**	Internal

Unit number	Unit title	GLH	Type	How assessed
20	Quality Control Management in Construction	**60**	**Optional**	Internal
21	Building Services Science	**60**	**Optional**	Internal
22	Economics and Finance in Construction	**60**	**Optional**	Internal
23	Construction in Civil Engineering	**60**	**Optional**	Internal
24	Planning Application Procedures in Construction	**60**	**Optional**	Internal
25	Property Law	**60**	**Optional**	Internal
26	Conversion, Adaptation and Maintenance of Buildings	**60**	**Optional**	Internal
	Optional units group D – learners complete 0 - 3 units			
39	Housing Design Project	**60**	**Optional**	Internal
40	Offsite and Onsite Alternative Construction Methods	**60**	**Optional**	Internal
41	Renewable Energy for Housing	**60**	**Optional**	Internal
42	The Housing Industry	**60**	**Optional**	Internal

External assessment

This is a summary of the type and availability of external assessment, which is of units making up 33% of the total qualification GLH. See *Section 5* and the units and sample assessment materials for more information.

Unit	Type	Availability
Unit 1: Construction Principles	• Written exam. • 1 hour 30 minutes. • Written submission. • 75 marks.	**Jan and May/June** **First assessment May/June 2018**
Unit 2: Construction Design	• A task set and marked by Pearson and completed under supervised conditions. • Before the supervised assessment, learners will be given information to research in approximately three hours in a two-week period timetabled by Pearson. • The supervised assessment is 12 hours in a two-week period timetabled by Pearson. • Written submission of evidence. • 63 marks.	**May/June** **First assessment May/June 2018**
Unit 3: Tendering and Estimating	• A task set and marked by Pearson and completed under supervised conditions. • The supervised assessment is 12 hours in a two-week period timetabled by Pearson. • Written submission of evidence. • 63 marks.	**May/June** **First assessment May/June 2019**

Synoptic assessment

The mandatory synoptic assessment requires learners to apply learning from across the qualification to the completion of a defined vocational task. Within the asseessment for *Unit 3: Tendering and Estimating* learners complete a task where they produce an estimated project cost and then consider external factors and risks to develop a firm tender offer. Learners complete the tasks using knowledge and understanding from their studies of the sector and apply both transferable and specialist knowledge and skills. This draws together underpinning knowledge of surveying, along with practical knowledge of site engineering and measurement techniques. Learners complete the task using using knowledge and understanding from their studies of the sector and apply both transferable and specialist knowledge and skills.

In delivering these units you need to encourage learners to draw on their broader learning so they will be prepared for the assessment.

Employer involvement in assessment and delivery

You need to ensure that learners on this qualification have a significant level of employer involvement in programme delivery or assessment. See *Section 4* for more information.

3 Units

Understanding your units

The units in this specification set out our expectations of assessment in a way that helps you to prepare your learners for assessment. The units help you to undertake assessment and quality assurance effectively.

Each unit in the specification is set out in a similar way. There are two types of unit format:

- internal units
- external units.

This section explains how the units work. It is important that all teachers, assessors, internal verifiers and other staff responsible for the programme review this section.

Internal units

Section	Explanation
Unit number	The number is in a sequence in the sector. Numbers may not be sequential for an individual qualification.
Unit title	This is the formal title that we always use and it appears on certificates.
Level	All units are at Level 3 on the national framework.
Unit type	This shows if the unit is internal or external only. See structure information in *Section 2* for full details.
GLH	Units may have a GLH value of 120, 90 or 60 GLH. This indicates the numbers of hours of teaching, directed activity and assessment expected. It also shows the weighting of the unit in the final qualification grade.
Unit in brief	A brief formal statement on the content of the unit that is helpful in understanding its role in the qualification. You can use this in summary documents, brochures etc.
Unit introduction	This is designed with learners in mind. It indicates why the unit is important, how learning is structured, and how learning might be applied when progressing to employment or higher education.
Learning aims	These help to define the scope, style and depth of learning of the unit. You can see where learners should be learning standard requirements (‘understand’) or where they should be actively researching (‘investigate’). You can find out more about the verbs we use in learning aims in *Appendix 2*.
Summary of unit	This new section helps teachers to see at a glance the main content areas against the learning aims and the structure of the assessment. The content areas and structure of assessment are required. The forms of evidence given are suitable to fulfil the requirements.
Content	This section sets out the required teaching content of the unit. Content is compulsory except when shown as ‘e.g.’. Learners should be asked to complete summative assessment only after the teaching content for the unit or learning aim(s) has been covered.

Section	Explanation
Assessment criteria	Each learning aim has Pass and Merit criteria. Each assignment has at least one Distinction criterion. A full glossary of terms used is given in *Appendix 2*. All assessors need to understand our expectations of the terms used. Distinction criteria represent outstanding performance in the unit. Some criteria require learners to draw together learning from across the learning aims.
Essential information for assignments	This shows the maximum number of assignments that may be used for the unit to allow for effective summative assessment, and how the assessment criteria should be used to assess performance.
Further information for teachers and assessors	The section gives you information to support the implementation of assessment. It is important that this is used carefully alongside the assessment criteria.
Resource requirements	Any specific resources that you need to be able to teach and assess are listed in this section. For information on support resources see *Section 10*.
Essential information for assessment decisions	This information gives guidance for each learning aim or assignment of the expectations for Pass, Merit and Distinction standard. This section contains examples and essential clarification.
Links to other units	This section shows you the main relationship among units. This section can help you to structure your programme and make best use of materials and resources.
Employer involvement	This section gives you information on the units that can be used to give learners involvement with employers. It will help you to identify the kind of involvement that is likely to be successful.

External units

Section	Explanation
Unit number	The number is in a sequence in the sector. Numbers may not be sequential for an individual qualification.
Unit title	This is the formal title that we always use and it appears on certificates.
Level	All units are at Level 3 on the national framework.
Unit type	This shows if the unit is internal or external only. See structure information in *Section 2* for full details.
GLH	Units may have a GLH value of 120, 90 or 60 GLH. This indicates the numbers of hours of teaching, directed activity and assessment expected. It also shows the weighting of the unit in the final qualification grade.
Unit in brief	A brief formal statement on the content of the unit.
Unit introduction	This is designed with learners in mind. It indicates why the unit is important, how learning is structured, and how learning might be applied when progressing to employment or higher education.
Summary of assessment	This sets out the type of external assessment used and the way in which it is used to assess achievement.
Assessment outcomes	These show the hierarchy of knowledge, understanding, skills and behaviours that are assessed. Includes information on how this hierarchy relates to command terms in sample assessment materials (SAMs).
Essential content	For external units all the content is obligatory, the depth of content is indicated in the assessment outcomes and sample assessment materials (SAMs). The content will be sampled through the external assessment over time, using the variety of questions or tasks shown.
Grade descriptors	We use grading descriptors when making judgements on grade boundaries. You can use them to understand what we expect to see from learners at particular grades.
Key terms typically used in assessment	These definitions will help you analyse requirements and prepare learners for assessment.
Resources	Any specific resources that you need to be able to teach and assess are listed in this section. For information on support resources see *Section 10*.
Links to other units	This section shows the main relationship among units. This section can help you to structure your programme and make best use of materials and resources.
Employer involvement	This section gives you information on the units that can be used to give learners involvement with employers. It will help you to identify the kind of involvement that is likely to be successful.

Index of units

This section contains all the units developed for this qualification. Please refer to *pages 4–5* to check which units are available in all qualifications in the construction and the built environment sector.

Unit 1: Construction Principles

Level: **3**

Unit type: **External**

Guided learning hours: **120**

Unit in brief

Learners demonstrate an understanding of the underlying principles used in the design, construction and refurbishments of buildings and infrastructure.

Unit introduction

Roles in the construction and built environment industry require the application of knowledge and understanding related to the design of structures and infrastructure, selection and use of construction materials, and the provision of human comfort in buildings. Whether you want to become a site manager, designer, engineer or surveyor, you will apply the knowledge and skills to ensure that materials are fit for purpose and that specified quantities are ordered and used on a construction project.

In this unit, you will develop the skills needed to solve a variety of practical construction problems by applying scientific knowledge and carrying out mathematical and statistical techniques. You will learn about the science underpinning the manufacture, properties and degradation of construction materials. You will apply mathematical principles and techniques to carry out calculations that determine how materials behave under the action of forces or loads when used as structural members, and draw conclusions regarding whether a material is fit for purpose. You will understand scientific principles and apply them to heat loss, sound reduction and lighting levels to provide human comfort during structure design, build and refurbishment.

This unit gives a foundation to help you progress to a wide range of construction-related higher education qualifications, and will support you in a variety of construction roles such as technician, and Higher Level Apprenticeships.

Summary of assessment

This unit is assessed through a written examination set and marked by Pearson.

The examination is 1 hour and 30 minutes. During the supervised assessment period, learners will be assessed on their knowledge of construction materials and their properties, application of mathematics in construction contexts, and the provision of human comfort in buildings. The number of marks for the paper is 75.

The assessment availability is January and May/June each year. The first assessment availability is May/June 2018.

Sample assessment materials will be available to help centres prepare learners for assessment.

Assessment outcomes

AO1 Demonstrate knowledge of construction terms, standards, concepts, methods and processes

Command words: calculate, describe, explain, identify, state/give

Marks: ranges from 1 to 4 marks

AO2 Demonstrate understanding of construction standards, concepts, methods and processes in context, in order to find solutions to real-life construction problems

Command words: calculate, describe, discuss, draw, explain, find

Marks: ranges from 1 to 8 marks

AO3 Analyse and evaluate information in order to recommend and justify the use of technologies and methodologies to solve construction problems in context

Command words: analyse, discuss, evaluate

Marks: ranges from 6 to 12 marks

AO4 Make connections between information, technologies and methodologies to resolve construction problems

Command words: analyse, discuss, evaluate

Marks: ranges from 8 to 12 marks

Essential content

The essential content is set out under content areas. Learners must cover all specified content before the assessment.

A Construction materials

The use of materials in construction, including their manufacture, the properties of materials linked to their use, the degradation of materials, the effects of temperature change on materials and the behaviour of materials under different loading conditions.

A1 Properties of materials

Material properties, terminology and use in construction:

- mass and density
- strength – tensile, compressive, shear, bending
- hardness
- toughness
- malleability
- workability
- stiffness
- fatigue and creep
- fire resistance
- electrical conductivity and conductance
- thermal conductivity and conductance
- resistance to moisture penetration
- resistance to vapour penetration
- resistance to degradation
- embedded energy
- recycling potential.

A2 Properties of construction materials

Key properties of construction materials, how they work together to provide composite performance and properties, how they impact on performance in use and on the specification of materials for different scenarios and levels of exposure to the elements.

- Bricks – facings, Class A engineering, Class B engineering, commons.
- Concrete – prescribed mixes, design mixes, new mixes using additives, smart concrete, hempcrete, mixes by ratio of volume, mixes by ratio of weight, screed mixes.
- Concrete blocks – aerated, high density, insulated.
- Mortar mixes – cement mortar, lime mortar, cement lime mortar, coloured mortar.
- Sand – building, sharp, silver.
- Plasterboard.
- Glass and glass finishes – structural, smart, laminated, tempered, float, clear, obscured.
- Insulation materials – fibreglass, expanded polystyrene, Celotex, mineral wool, cellulose, straw, polyurethane.
- Plastics used for polythene damp-proof membranes (DPM), damp-proof courses (DPC).
- Plastics used for doors and window frames, soffits, bargeboards, fascia, guttering, Polyvinylchloride (PVC), unplasticised Polyvinylchloride (uPVC).
- Timber and manufactured boards – hardwoods, softwoods, plywood, chipboard, particle board, medium-density fibreboard (MDF).
- Roofing materials – slate, concrete, pantile, roofing felt, thatch, ridge, lead flashing, green/living roofs, smart roofing materials, coverings with built-in PV cells.
- Engineered timber – SIPS (Structural Insulated Panels), glulam beams, engineered joists.
- Steel – mild, stainless, high strength.
- Aluminium alloys.

A3 Manufacturing and processing of construction materials

The manufacturing, processing and technology of construction materials and how this impacts on properties and fitness for purpose.

- Materials:
  - cements – ordinary Portland and sulphate-resisting cement
  - steels – mild and stainless
  - concrete – including modern concretes, fedcrete, hempcrete, admixtures, FEB
  - bricks – engineering and facing bricks
  - concrete blocks – aerated, high density, insulated
  - aluminium alloys
  - glass – laminated, tempered, float, smart and structural glass.
- Technologies:
  - 3D printing
  - CNC to manufacture structural elements
  - on-site robotics to perform repetitive tasks in construction.

A4 Degradation of construction materials

The impact of the environment on building materials for various scenarios, degradation methods and types, preventive and reduction measures, and impact of failure of a single material in a composite element.

- Sources of degradation and their cause:
  - natural agents – ageing, ultraviolet (UV) radiation
  - timber infestation – insect attack, fungal
  - timber decay – wet rot, dry rot, lichens and mosses
  - moisture movement – capillary action, shrinkage
  - exposure conditions – weathering, freeze-thaw, thermal ageing, creep, humidity, loadings
  - chemical degradation – acid rain, sulphate, alkalis, leaching
  - corrosion in metals – oxidation.
- Remedial measures to prevent and reduce degradation and their benefits and drawbacks:
  - use of special paints
  - protective coatings.
- Material failure:
  - concrete and reinforced concrete
  - brickwork
  - timber – external and internal applications
  - steel
  - mortars.

A5 Effects of temperature changes on construction materials

- Types of heat: latent, sensible.
- The effect of temperature change on the properties of materials:
  - changes of state
  - evaporation
  - expansion and contraction.

A6 Behaviour of structural members under load

- Types of structural members:
  - beams, lintels
  - columns, walls and frames
  - struts and ties.

- The effect of different loading conditions and potential failure of beams, lintels, columns, walls, frames, struts and ties in the following materials:
  - concrete
  - reinforced concrete
  - timber
  - steel.
- Types, configuration and effect of loads:
  - dead and live load
  - imposed and wind loads
  - point and distributed loads.
- Characteristics, properties and use of types of supports – pinned, roller, hinged and fixed.
- Effects of structural failure on structural members.

B Solving practical construction problems

B1 Application of mathematical and statistical methods and techniques used in practical construction contexts

Recall, perform procedures, demonstrate an understanding of and analyse information in a variety of construction contexts by applying mathematical and statistical techniques, including the following.

- Algebraic techniques:
  - linear equations of the form $y = mx + c$
  - pair of simultaneous linear equations in two unknowns
  - factorisation and quadratics:
    - multiply expressions in brackets by a number, symbol or by another expression in a bracket
    - by extraction of a common factor $a(x + y)$, $a(x + 2) + b(x + 2)$
    - by grouping $ax - ay + bx - by$
    - quadratic expressions $a^2 + 2ab + b^2$
    - roots of an equation, including quadratic equations with real roots by factorisation, use of quadratic formula, completing the square
  - rearranging formulae to change subject of formulae, complex formulae involving exponents, roots and trigonometric identities
  - substituting values into and evaluating formulae.
- Accuracy of calculations:
  - use of significant figures
  - use of approximation to check a calculation
  - effects of rounding-off errors.
- Trigonometric techniques:
  - trigonometric functions: sine, cosine, tangent ratios
  - application of trigonometry to determine dimensions in 2D and 3D:
    - in surveying
    - in setting out
    - other practical contexts.
- Circular measure:
  - radian measure
  - conversion of degree measure to radian measure and vice versa
  - arc length $s = r\theta$
  - area of sector $A = \frac{1}{2} r^2 \theta$
- Geometric techniques:
  - properties of points, lines, angles, circles
  - Pythagoras' theorem.

- Graphical techniques:
  - Cartesian coordinates
  - intersections of graph lines with axes
  - gradients of straight lines
  - equations of graphs: straight line
  - areas under graphs: straight line
  - interpolation and extrapolation.
- Mensuration techniques for quantity surveying and buying:
  - calculation of perimeters, centre lines, areas, surface areas and volumes of:
    - rectangles, squares, triangles, circles, trapeziums
    - prisms, spheres, pyramids, cones, cylinders
    - compound and irregular shapes and objects.
- Statistical techniques:
  - types of data: discrete data, continuous data, ungrouped data, grouped data
  - methods of visual presentation of statistics and data, interpretation and production of: line graphs, bar charts, scatter diagrams, pie charts, histograms, distribution curve, Venn diagrams, tables
  - processing large groups of data to achieve mean, median, mode
  - statistical methods to present data and make decisions based on them
  - interpretation of climate maps.
- Application of mathematical techniques used in structural analysis:
  - concurrent and non-concurrent coplanar forces
  - relationship between force (load), mass and acceleration due to gravity
  - forces: tension, compression, shear
  - application of Hooke's law $F = -kx$ and $F = kx$
  - stress, strain and modulus of elasticity
  - loading as the result of gravitational attraction
  - shear force and bending moment in a beam and its effect on the beam cross section
  - equilibrium conditions to ensure stability of a beam
  - determination of support reactions for simply supported beams with point and distributed loads.
- Application of mathematical techniques involving the human comfort effect of temperature on construction materials while in situ:
  - calculating the effect of temperature change on materials
  - coefficients of thermal expansion application and its significance for selecting fit-for-purpose construction materials and details
  - calculation of U-value
  - calculating required insulation thickness
  - calculation of structural temperature profiles
  - calculation of dew-point temperature profiles.
- Calculation of sound absorption coefficients, reverberation, actual and optimum reverberation times.
- Application of mathematical techniques to determine lighting requirements:
  - inverse square law of illumination:

    $$E = \frac{I}{r^2}$$

  - cosine law of illumination:

    $$E = \frac{I}{d^2}\cos\theta$$

  - lumen method of design
  - daylight factor.
- Application of the desktop method to determine daylight factor.

C Human comfort

The impact of heat, light and sound on human comfort in the built environment.

C1 Heat

The impact of the natural and built environment on human comfort and the provision of comfortable living and working environments.

- Scientific principles and their application in the built environment:
  - air temperature
  - mean radiant temperature
  - relative humidity
  - air movement
  - dry and wet bulb temperatures
  - mechanisms of heat transfer:
    - conduction
    - convection
    - radiation.
- Measurement instruments and their application in heat in determining human comfort conditions:
  - thermometer
  - globe thermometer
  - hygrometer
  - anemometer
  - electronic control systems
  - thermostats
  - remote monitoring systems, e.g. smartphone applications to monitor and control temperature.
- Acceptable thermal comfort parameters according to:
  - current building regulations
  - combination of personal factors and thermal comfort requirements:
    - age
    - gender
    - clothing
    - state of health
    - level of activity
    - metabolic rate.
- Principles of heat losses and gains in buildings and methods to control them to provide human comfort in buildings:
  - how heat is lost in a building:
    - fabric heat losses
    - ventilation heat losses
    - thermal bridges and their impact on heat losses
    - contribution of air changes to heat losses
  - factors contributing to heat gains and losses:
    - insulation of building
    - surface area of the external shell
    - exposure and impact of local climatic conditions on a building
    - temperature difference between inside and outside
    - air change rate
    - building use
  - thermal conductivity and thermal resistance
  - significance of the insulating material and its thickness
  - determination of fabric and ventilation heat losses.

- Heat loss control methods (alternative: methods for controlling heat loss from buildings):
  - roof, wall and floor insulation
  - double/triple glazing, low emissivity glass
  - secondary glazing
  - draught reduction
  - insulated building materials
  - location and type of heating installations in a building.
- The source and causes of condensation, the consequences of its occurrence and potential impact on the building fabric and methods of control to provide human comfort in buildings:
  - sources of water vapour in buildings
  - causes and effects of condensation in buildings
  - impact of structural temperature profiles
  - impact of dew-point temperature profiles
  - prediction and prevention of condensation
  - interstitial condensation
  - methods for controlling condensation in buildings:
    - air conditioning
    - heating and ventilation
    - dehumidification
    - extractor fans.

C2 Acoustics

Scientific principles of sound, its relation to human comfort and the acoustic fitness for purpose of the area relative to its intended use.

- Scientific principles:
  - difference between sound and noise
  - frequency of sound
  - standard units
  - addition and averaging of decibel levels
  - sound reduction indices
  - reverberation times.
- Acceptable acoustic comfort parameters of an area relative to its intended use:
  - current building regulations
  - noise criteria indices
  - personal factors:
    - age
    - previous exposure to noise
    - state of health
    - activity.
- Measurement of sound levels.
- Difference between sound insulation and sound absorption.
- Difference between airborne and impact sound.
- Issues associated with flanking transmission.
- Reasons why sound insulation and sound reduction is required.
- Understanding and application of sound insulation approaches:
  - source-path-receiver approach
  - improving structural elements
  - controlling flanking sound
  - use of appropriate materials to reduce sound.

C3 Lighting

Scientific principles and the provision of appropriate lighting levels and type for various activities in the built environment.

- Scientific principles:
  - differences between natural and artificial light
  - illuminance levels
  - daylight factors
  - glare indices
  - direct and reflected light
  - power of a light source
  - flow of light energy
  - illumination of surface.
- Standard units of measurement:
  - candela – power of a light source
  - lumen – flow of light energy
  - lux – illumination on surface.
- Acceptable illuminance levels for different activities and building use.
- Variation of daylight factors in a room.
- Principal components of daylight factor:
  - sky component (SC)
  - externally reflected component (ERC)
  - internally reflected component (IRC).
- Artificial lighting sources:
  - incandescent lamps
  - compact fluorescent lamps (CFLs)
  - fluorescent tubes
  - discharge lamps
  - halogen lamps
  - ballast lamps
  - light-emitting diodes (LEDs).

Grade descriptors

To achieve a grade learners are expected to demonstrate these attributes across the essential content of the unit. The principle of best fit will apply in awarding grades.

Level 3 Pass

Learners will be able to apply their understanding of construction principles to develop a solution to given situations and information in context. Learners are able to use and apply basic construction, human factors and mathematics to solve simple and familiar construction problems directly. They can provide responses showing understanding and analysis of basic and familiar construction problems. They can interpret and analyse drawings, diagrams, graphical information and meteorological information, and use their knowledge and understanding to solve basic and familiar problems. They are able to use their knowledge of construction to deconstruct given scenarios to produce solutions with interpretation. They often use appropriate construction and human comfort terminology in their responses. Learners will apply their knowledge and understanding of basic construction, human comfort and applied mathematical principles to make recommendations and propose evolutionary or analytical solutions to construction problems.

Level 3 Distinction

Learners will be able to use and apply advanced construction, human factors and mathematical principles to solve complex and unfamiliar construction problems directly, indirectly and synoptically. They can provide balanced responses showing developed understanding and evaluation of complex familiar and unfamiliar construction problems. They can interpret and evaluate drawings, diagrams, graphical information and meteorological information, and use their knowledge and understanding to solve complex, familiar and unfamiliar problems. They use appropriate and technically accurate construction and human factors terminology consistently. They are able to synthesise knowledge and understanding of construction to deconstruct given scenarios, drawing on various sources of information to develop effective solutions with justification. Learners can propose justified synoptic solutions to problems, drawing on their knowledge and understanding of construction, human comfort and applied mathematical principles to make recommendations and propose evolutionary or analytical solutions to construction problems. Learners are able to evaluate the effectiveness of solutions to make justified recommendations on their development and future actions that can be taken.

Key words typically used in assessment

The following table shows the key words that will be used consistently by Pearson in our assessments to ensure learners are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Analyse	Learners examine in detail a scenario or problem to discover its meaning or essential features. Learners will break down the problem into its parts and show how they interrelate. This may include the analysis of graphs to solve construction problems. There is no requirement for any conclusion.
Calculate	Learners apply some form of mathematical process to give an answer. Learners judge the number or amount of something by using the information they already have and add, subtract, multiply, or divide numbers, and apply formula to solve mathematical problems.
Describe	Learners give a clear, objective account in their own words, or highlight a number of key features of a given topic to show recall and/or application of relevant features and information about a subject.
Discuss	Learners investigate a problem or scenario, showing reasoning or argument. There is no requirement for any conclusion.
Draw	Learners produce hand-drawn graphical information or a drawing to show their understanding of and/or solve a construction problem.
Evaluate	Learners review and synthesise information to provide a supported judgement about the topic or problem. Typically a conclusion will be required.
Explain	Learners make a series of linked points and/or justify or expand on an identified point.
Find	Learners discover the facts or truth about something, typically from information contained in a diagram, graph or chart.
Identify	Learners assess factual information, typically when making use of given stimuli. Requires a single word or short-sentence answer.
State/Give	Learners assess factual information. Learners declare definitely or specifically in a single word or short-sentence answer.

Links to other units

This unit has links to all other units in the qualification.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 2: Construction Design

Level: **3**

Unit type: **External**

Guided learning hours: **120**

Unit in brief

Learners will apply the principles and practice of design and construction for low- and medium-rise buildings and structures.

Unit introduction

Almost all human activity takes place in and around buildings and structures that are, for example, places of shelter, work, worship, culture and sport, and these places have a strong influence on our quality of life. Buildings are deceptively complex and expensive to build and maintain, so their design requires careful consideration to ensure that they are fit for purpose and meet user requirements. Creating buildings and structures is a unique process that requires input from a team of built environment professionals, who take into consideration a wide variety of factors to resolve problems and meet client requirements.

In this unit, you will learn the principles and practice involved in the design and construction of low- and medium-rise buildings and structures, and gain an understanding of how design is influenced by client requirements and external constraints. You will consider the stages involved in the design and construction process and gain an understanding of the use of design techniques, including sketching and computer-aided design (CAD) to provide efficient methods of designing, constructing and maintaining structures over their life cycle. To complete the assessment task within this unit, you will need to draw on your learning from across your programme.

This unit will give you the knowledge and understanding of design and construction that will support your progression to employment as an apprentice or trainee construction professional, or entry to a construction-related higher education programme.

Summary of assessment

This unit is assessed under supervised conditions. Learners will be given a scenario two weeks before a supervised assessment period in order to carry out research.

The supervised assessment period is a maximum of 12 hours and can be arranged over a number of sessions. During the supervised assessment period, learners will be given a set task that will assess their ability to produce designs to meet client requirements. Pearson sets and marks the task.

The number of marks for the unit is 63.

The assessment availability is May/June each year. The first assessment availability is May/June 2018.

Sample assessment materials will be available to help centres prepare learners for assessment.

Assessment outcomes

AO1 Demonstrate knowledge and understanding of construction design and build concepts and processes

AO2 Apply knowledge and understanding of construction design and build concepts and processes to design a building to meet an initial project brief

AO3 Analyse site, client and construction information to make decisions in order to produce a building design to meet an initial project brief

AO4 Be able to develop a reasoned design solution for a building to meet an initial project brief

Essential content

The essential content is set out under content areas. Learners must cover all specified content before the assessment.

A The construction design process

A1 Stages and tasks involved in the design process

The application of Stages 1-7 of the Royal Institute of British Architects (RIBA) Plan of Work 2020 to the tasks associated with the design of low- and medium-rise domestic, commercial and industrial buildings.

- Preparation and brief.
- Concept Design including information modeling and coding.
- Developed design.
- Technical design.

A2 Factors that influence the design process

Requirements and constraints and their impact on the initial project brief and design process for combinations of rural, urban, greenfield and brownfield settings.

- Client requirements for the project outcomes:
  - building use:
    - to include domestic, industrial, commercial, retail, health, cultural and recreation
    - how the building operates within its defined use
  - the project spatial requirements – building size, layout, circulation space, number of floors, number and use of rooms
  - flexibility and remodelling potential
  - future extension potential to meet residential needs and business expansion
  - external and internal aesthetics, types and use of materials
  - sustainability, energy efficiency, alternate types of energy sources
  - age demographic of the building user(s)
  - target market sector
  - needs of different building users
  - security requirements for the building and client operations
  - corporate image and branding requirements.
- Site information and constraints:
  - site features – location, size, configuration, orientation, access, topography
  - borehole report used to provide information on geotechnical and ground conditions
  - ground contamination
  - building services availability
  - existing buildings, structures
  - interaction and compatibility between traditional and modern materials for retrofit
  - neighboring structures and the need for temporary and permanent support
  - existing underground services
  - trees
  - rights of way
  - underground transport.

- Planning constraints:
  - planning consent/approval
  - local plan requirements
  - design sympathetic to local environment
  - planning objections and pressure groups
  - listed building consent
  - protection of greenbelt land
  - conservation areas, Areas of Outstanding Natural Beauty (AONB), Site of Special Scientific Interest (SSSI)
  - tree preservation orders (TPO), contaminated land, flood risk areas.
- Statutory constraints and their requirements, including subsequent updates:
  - Construction (Design and Management) Regulations 2015
  - building regulations approval
  - Party Wall etc. Act 1996
  - Disability Discrimination Acts 1995 and 2005
  - Equality Act 2010
  - Landlord and Tenant Act 1985
  - restrictive covenants on land and property
  - legislation and restrictions relating to outcomes of the Hackitt report, including restrictions on the architect on specifying cladding.
- Environmental constraints:
  - avoidance of air, water and noise pollution
  - National Planning Policy Framework (NPPF) 2012 with reference to:
    - Part 6 Delivering a wide choice of high quality homes
    - Part 7 Requiring good design
    - Part 9 Protecting Green Belt land
    - Part 10 Meeting the challenge of climate change, flooding and coastal change
    - Part 11 Conserving and enhancing the natural environment
    - Part 12 Conserving and enhancing the historic environment
  - Part 1 of the Wildlife and Countryside Act 1981, with reference to protected species and habitat conservation
  - the findings of Environmental Impact Assessments (EIAs) and their use in developing designs for a project.
- Social constraints:
  - neighbour's rights
  - local community objections
  - green space requirements
  - environmental requirements
  - mixed and balanced development.
- Project budget and economic constraints:
  - cost planning
  - available funds
  - source of additional funding for business premises – grants, government incentives, European funding
  - local land prices
  - first-time buyer residential accommodation – borrowing potential, shared-ownership schemes, Help to Buy scheme, government incentives for developers
  - life cycle costs.
- Design for Manufacture and Assembly:
  - logistics for offsite including just in time concepts and transport from factory to site
  - site preparation including the ability to receive prefabricated products
  - the importance of communications and accuracy of data
  - site personnel and roles required.

B Project information and building design production

B1 Project information

Information used in the production of building designs.

- Information requirements of offsite construction.
- Client requirements.
- Site constraints.
- Planning constraints.
- Statutory constraints.
- Environmental constraints.
- Social constraints.
- Economic constraints.

B2 Initial project brief

- The initial project brief's purpose and its application.
- Content of an initial project brief:
  - spatial requirements
  - desired project outcomes
  - site information
  - budget requirements.
- Use of an initial project brief to generate and develop design ideas and specifications.
- Completion of an initial project brief: use of appropriate tone and technical language for target audience.

B3 Design production

Production of creative and innovative outline solutions and designs to meet initial project brief requirements and their presentation requirements for client and design team use.

- Production of designs for low- and medium-rise domestic, commercial and industrial buildings.
- Outline solution – to communicate use of space and appropriate form of construction.
- 2D and 3D sketches of initial ideas, to include internal and external views, plans and elevations:
  - freehand sketched
  - single-point perspective
  - two-point perspective
  - planometric views
  - isometric views
  - use of line thickness to convey a 3D effect
  - use of shade and light direction
  - freehand rendering techniques.
- Clear communication using technical annotations.
- Clear communication of key features, to include external fabric, roof type, service access, circulation space, windows, doors etc.

B4 Digital design competencies

- Use of Digital Design software, including CAD, to produce virtual models and interiors.
- Setting up CAD projects:
  - number of floors
  - floor levels
  - linking elements, to include top and bottom anchors
  - building footprint
  - component libraries
  - saving in an appropriate format.

- Use of basic CAD methodologies:
  - dimensional control, sizing and scale
  - detail levels, to include appropriate level for drawing use and audience:
    - fine
    - medium
    - coarse
  - use of 'hidden element' features
  - setting up and drawing composite elements:
    - walls
    - floors
    - roofs
  - standard opening components, placing and positioning:
    - doors, to include external, internal, garage and industrial
    - windows
  - inclusion and placing of fixtures and fittings:
    - stairs
    - fitted units and fitted furniture
    - plumbing and sanitary ware fixtures
    - light fittings
  - furnishing and lighting for selected internal area.
- External site area:
  - setting up ground area
  - surface effects, to include natural and built environment
  - contours, relief and topography
  - inclusion of features, to include street furniture, cars, etc.
  - inclusion of landscaping and planting features.
- Use and manipulation of Digital Technologies to produce virtual models:
  - New technologies:
    - BIM software
    - coding
    - coordination
    - VR, AR, holoLens
  - 3D digital project information:
    - 3D views
    - 3D perspective effects
    - surface detailing and effects
  - 2D digital project information, to include appropriate scale and level of detail:
    - plans
    - elevations
    - sections.
- 3D manipulation:
  - orientation and rotation of images
  - zooming
  - detail level.

- Rendered images:
  - camera views, to include camera position, angle of coverage, shadow effects
  - setting up rendered views:
    - internal lighting effects
    - external lighting effects
    - weather effects
    - seasonal effects
    - sun position
    - lighting/sun on or off
    - detail level
  - processing, saving and printing of rendered images.
- Extraction of 2D and 3D drawings:
  - plans
  - elevations
  - cross sections
  - 3D models.
- Drawing output:
  - setting up borders and title block
  - orthographic drawing conventions, to include third angle
  - scale and placement of images
  - printer and screen outputs.

C Construction methods and techniques

Construction methods and techniques used in the design and construction of low- and medium-rise domestic, commercial and industrial buildings.

C1 Forms of low- and medium-rise structures

- Functional requirements of key primary and secondary elements.
- Types, characteristics and application of construction techniques and methods for:
  - offsite manufacturing, including panels, pods, volumetric with services/with finishes
  - traditional construction
  - timber frame construction
  - steel frame construction
  - light steel frame construction
  - concrete frame construction
  - modern methods of construction (MMC)
  - Passivhaus construction.

C2 Sub-structure construction

- Types, purpose and use of methods of site investigation and analysis:
  - site surveys – desk, walk-over, measured, survey reports
  - soil investigation – bore holes, trial pits, auger, test data/results/reports
  - soil assessment – classification, particle size distribution, compressive/tensile/ shear strength
  - groundwater – water table, contaminates, dewatering techniques/control.
- Factors and principles affecting foundation design:
  - structural requirements – building type, loading types, load transmission
  - ground load bearing capacity – soil type/condition
  - differential settlement and ground heave – made up ground, subsidence, underground features/mining, shrinkable clay, frost, trees, hard standings.

- Purpose, types, sizing, construction methods/techniques and details of foundations:
  - strip – traditional, deep, narrow, wide, stepped, reinforced
  - raft –edge thickening, edge beam, reinforced
  - pad – isolated, combined, reinforced
  - pile – replacement, displacement, end bearing, friction, pile caps, edge beams, reinforced.

C3 Superstructure construction

The construction requirements and detailing of the superstructure and external envelope, and their suitability for use in different scenarios.

- External walls:
  - solid masonry, cavity walls, curtain walls, infill walling, rain screen, panel, cladding, profiled sheets, rammed earth, straw bale
  - formation of openings, heads, sills, jambs/reveals, thresholds
  - weather tightness
  - thermal and acoustic insulation
  - finishes.
- Internal walls:
  - separating/party, partition/compartment
  - loadbearing, non-loadbearing
  - finishes.
- Structural frames:
  - steel, reinforced concrete, timber, structural insulated panels, light gauge steel
  - fire protection.
- Ground floors:
  - solid and suspended
  - in-situ concrete, beam and block, timber
  - thermal insulation
  - damp proofing
  - finishes
  - upper floors – composite concrete/profiled steel, pre-cast concrete slabs, in-situ concrete, beam and block, timber/engineered timber
  - fire protection.
- Roofs:
  - flat/pitched forms and terminology
  - traditional, trussed rafter, profiled decking, lattice frame, portal frame
  - weather protection, coverings.
- Stairs and landings:
  - stair and landing terminology/regulations
  - timber, in-situ concrete, precast concrete, steel.
- Doors and windows:
  - types, construction
  - uses in fire compartmentalization and escape.

C4 Sustainability

Sustainability methods and techniques used in the design of modern construction projects and in the refurbishment, remodelling and extension of existing buildings to reduce pollution, the impact on the environment and the carbon footprint of the building.

- Passive solar gain.
- Passive stack ventilation.
- Water use reduction methods:
  - grey water systems
  - rainwater harvesting
  - water efficiency measures and fittings.
- Waste reduction measures:
  - segregation of waste
  - recycling.
- Use of alternative energy sources:
  - ground source – ground source heat pump (horizontal and vertical)
  - air source – air source heat pump (indoor heat exchanger, outdoor heat exchanger, air to air, air to water)
  - wind – micro wind generator (horizontal axis; vertical axis)
  - solar – solar photovoltaic (PV) panels, solar panel (thermal).
- Energy-efficient electrical and mechanical services installations.
- Sustainable and low embodied energy materials.
- Insulation methods:
  - floors
  - walls
  - roofs.
- Sustainable urban drainage systems.
- Sustainable landscape design.
- Building Research Establishment Environmental Assessment Method (BREEAM):
  - benefits of
  - ratings and percentage of UK buildings in each category.

Grade descriptors

To achieve a grade learners are expected to demonstrate these attributes across the essential content of the unit. The principle of best fit will apply in awarding grades.

Level 3 Pass

Learners will demonstrate knowledge and understanding of the factors that influence design and development, with some consideration of how these impact on construction details. They will make some use of appropriate technical vocabulary in their work. They will be able to select, use and interpret relevant information in the context of a scenario to produce an initial project brief. They will be able to consider the spatial requirements of a project and consider suitable forms of construction to produce a design that communicates design intentions with clarity and addresses aspects of the initial project brief, with some use of annotations. They can produce a virtual model that addresses some aspects of the scenario requirements and provide printouts of 3D rendered views.

Level 3 Distinction

Learners will demonstrate a comprehensive knowledge and understanding of the factors that influence design and development, and consider in depth how these impact on construction details. They will make use of developed technical vocabulary in their work. They will be able to select, use and interpret most of the relevant information in the context of a scenario, showing a balanced consideration of this information to produce an initial project brief with minimal errors or omissions. They will be able to analyse the spatial requirements of a project and provide detailed consideration of suitable forms of construction to produce a design that communicates design intentions with clarity and comprehensively addresses the initial project brief. Learners use annotations that clearly explain the key features and operation of the design. They can produce an accurate and complete virtual model that appropriately addresses the scenario requirements and provide printouts of 3D rendered views.

Key words typically used in assessment

The following table shows the key words that will be used consistently by Pearson in our assessments to ensure learners are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Borehole report	A report that provides information on the soil types and depths within the various strata underneath the surface of the site.
Client details	Information about the client and their requirements.
External envelope	The walls and roof forming the external surfaces of a building, including features such as the windows and external doors.
Ground conditions	Soil type, composition, contamination, level of compaction, water table level, level of saturation.
Ground water table	The depth below ground level of water contained in the ground.
Initial project brief	A document providing information relating to the spatial requirements, desired project outcomes, context of the site and budget.
Internal views	3D internal views of the building.
Medium rise	A building of three- to eight storeys in height.
Sketch	A freehand drawing/hand drawn with annotations, using pens and pencils.
Specification	Details of the building fabric that will achieve the required outcomes.
Sub-soil	The soil below the topsoil.
Virtual model	A 3D computer-generated image of a CAD design that can be rotated and viewed from any angle and can be used to generate rendered images of a project.

Links to other units

The assessment for this unit should draw on knowledge, understanding and skills developed from:

- Unit 1: Construction Principles
- Unit 4: Construction Technology
- Unit 5: Health and Safety in Construction
- Unit 6: Surveying in Construction
- Unit 7: Graphical Detailing in Construction
- Unit 8: Building Regulations in Construction
- Unit 11: Site Engineering for Construction
- Unit 14: Provision of Primary Services in Construction
- Unit 15: Further Mathematics for Construction
- Unit 21: Building Services Science
- Unit 23: Construction in Civil Engineering.

This unit would relate to the teaching of:

- Unit 19: Quantity Surveying.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 3: Tendering and Estimating

Level: **3**

Unit type: **External**

Guided learning hours: **120**

Unit in brief

Learners carry out estimating procedures to produce an estimated project cost and then consider external factors and risks to develop a firm tender offer.

Unit introduction

Construction, Civil Engineering and Building Services Engineering companies obtain work via the tendering and estimating process. An estimator uses the tender documents to arrive at an estimated cost of construction. The estimator then works with commercial managers to consider the potential commercial risk and current workload, in order to arrive at a tender sum that is considered a correct and appropriate offer.

In this unit, you will learn how to consider a project scenario which will incorporate all three pathways of the programme together with relevant tender documentation, in order to produce a commercial risk assessment for use in a tender settlement meeting. You will understand and apply the principles of the estimating process as it is used on large projects to produce an estimate. You will use an estimate and a commercial risk assessment to produce an appropriate tender for a project. To complete the assessment task within this unit, you will need to draw on your learning from across your programme.

The content of this unit can be directly applied to the role of the estimator and to aspects of other roles such as quantity surveyors and contracts manager, who make the final decision relating to the tender sum. The unit gives a good foundation for studying management of construction projects at a higher level, including degree-level programmes.

Summary of assessment

This unit is assessed under supervised conditions.

The supervised assessment period is a maximum of 12 hours, which includes 30 minutes reading time, and can be arranged over a number of sessions. During the supervised assessment period, learners will be given a set task that will assess their ability to produce a tender for a project scenario. Pearson sets and marks the task.

The number of marks for the task is 63.

The assessment availability is May/June each year. The first assessment availability is May/June 2019.

Sample assessment materials will be available to help centres prepare learners for assessment.

Assessment outcomes

AO1 Apply knowledge and understanding of the tendering and estimating process and techniques to determine estimated costs

AO2 Analyse information to determine tendering and estimating outcomes in order to make evaluative judgements and commercial decisions in context

AO3 Be able to apply the tendering and estimating process, techniques and outcomes in order to produce a justified tender submission relative to the scenario

Essential content

The essential content is set out under content areas. Learners must cover all specified content before the assessment.

A Commercial risk

A1 Action on receipt of tender documentation

How the initial information contained in the tender documents is considered and how it can impact on a company's tendering strategies and commercial risk.

- Checking documents and extracting key information from:
  - bill of quantities or specifications
  - drawings
  - schedules
  - tender form and submission documentation.
- Quality and accuracy of information provided by:
  - bill of quantities supplied by the client
  - bill of approximate quantities produced by the tendering company
  - schedules of rates.
- Tender period.
- Organisational capacity to tender.
- Completion of own company's internal tender information form.
- Internal review of tender documents to assess the project's suitability in meeting their own company's needs by the:
  - estimator or bid manager
  - planning engineer
  - quantity surveyor
  - buyer
  - contracts manager.

A2 Tendering considerations and strategies

The level of potential tender importance for a company, commitment of resources and resource requirements, company attitude to commercial risk, and the need to procure further contracts to maintain company turnover or meet planned expansion, resulting in tendering strategies that are effective and appropriate.

- Decision to accept or decline the invitation to tender and level of commitment:
  - reviewing available information
  - regular tender
  - priority tender (fully committed).
- Tender preparation programme:
  - despatch of enquiries
  - receipt of quotations
  - bill of quantities production (for design and build and drawings and specification contract types)
  - visit to the site and locality
  - completion of pricing and measured rates
  - finalisation of the tender works programme
  - internal co-ordination and review meetings
  - tender adjudication, settlement meeting.

- Allocation of resources:
  - tendering budget
  - availability of appropriate estimating team
  - supply chain tendering response times.
- Site and location.

A3 Contractual arrangements

How the project's contractual arrangements impact on the level of risk, the decision to tender and potential financial returns.

- Conventional lump sum form of procurement:
  - current Joint Contracts Tribunal (JCT) standard form of building contract:
    - with quantities (elemental and trade bill of quantities)
    - without quantities.
- Design and build.
- Term contracts.

A4 Supply chain

Supply chain factors and their impact on the commercial risks associated with tender estimates.

- Quotations from suppliers and subcontractors:
  - fixed or fluctuating prices
  - variant bids
  - incomplete quotation and prices.
- Suppliers of materials:
  - number of alternative suppliers
  - capacity to supply
  - named manufacturer or generic specification
  - previous experience of supplier performance.
- Subcontractors:
  - previous experience of working relationship
  - experience of similar projects
  - number of available subcontractors in the specialist area
  - geographical area of operations
  - supervision requirements
  - references
  - insurances
  - quality assurance (QA) registration
  - health and safety record
  - collateral warranties
  - considerate contractor policies.
- Nominated suppliers and subcontractors:
  - appointment by third party
  - design elements that may be included in their package of works
  - appointment unknown at time of tender
  - value indicated via prime cost (PC) sum.

A5 Commercial risk analysis

Factors that impact on the assessment of commercial risk and the final tender decision.

- Current workload and the need to maintain turnover.
- Market conditions and economic climate.
- Project considerations:
  - buildability
  - previous experience of construction methods.
- Site and location factors:
  - ground contamination
  - soil types and ground conditions
  - existing site features
  - availability of tipping facilities
  - security requirements:
    - risk of theft and vandalism
    - proximity of schools and children's playgrounds
    - community attitude to crime reporting
    - community reputation
  - availability of skilled workforce
  - industrial relations and local labour agreements
  - geographical location in relation to contractor's office and depot
  - requirement for temporary roads and services
  - presence of protected species
  - existing trees:
    - preservation orders
  - delaying tactics of local pressure groups
  - local climatic conditions
  - availability of space for contractor's accommodation, storage and distribution.
- Programme factors:
  - commencement date:
    - weather and climate considerations
    - in relation to completion of other projects
  - specific contract conditions that:
    - affect the intended method of working
    - impose restrictions
    - affect access to the site
    - interrupt the regular flow of trades
    - affect the duration of the project
    - affect the sequencing of the project
    - are of major cost significance or difficult to quantify in terms of cost.
- Financial issues:
  - cash flow forecasting for the project and own company
  - available finance
  - contract bond
  - retention percentage
  - payment period and frequency of payments
  - financial checks on the client:
    - company accounts
    - credit reference agencies
    - confirmation of financing.

A6 Commercial intelligence

Information gathering and its impact on the final tender decision relating to assessing the level of competition, including number of competitors and likelihood of fully committed tenders.

- The advantages and disadvantages of gathering commercial intelligence methods to support the final tender decision:
  - speaking to suppliers and subcontractors
  - networking
  - press releases
  - subscribing to intelligence services or journals that publish information on successful bids.
- Competitive tendering:
  - number of competing bids
  - other tenderers:
    - recent tendering success
    - recent pricing levels
    - capacity to take on new contracts
    - current tendering workloads.

B Estimating

B1 Materials and subcontract quotations

Obtained material prices and quotations in response to enquiries for materials and subcontract work, their use to facilitate pricing the bill of quantities and how they may impact on the final tender sum.

- Supplier and subcontract quotations and the considerations applied to them, their impact on the receipt of information from suppliers and subcontractors arising from:
  - errors in the information
  - gap analysis outcomes
  - variant offers
  - abnormal quotes.

B2 Site visit

Assessment of site visit information to assist with the pricing of preliminary items, repairs and alterations and the assessment of commercial risk.

- Information obtained from the site visit and locality:
  - assessment of structures requiring demolition
  - repairs and alterations required and their cost
  - site clearance requirements
  - identified security issues
  - site access restrictions
  - community issues assessment
  - available space for site establishment and circulation
  - appropriate methods for materials distribution on site.

B3 Completion of the estimate

Use of manual methods and their application to price the bill of quantities produced in accordance with the standard methods of measurement NRM2 (Royal Institution of Chartered Surveyors New Rules of Measurement 2) and CESMM4 (Civil Engineering Standard Method of Measurement 4) to complete an estimate.

- Demolitions and associated temporary works.
- Pricing alterations, repairs and conservation.

- Building up unit rates for measured work sections:
  - selection of material price to use
  - use of coverage rates
  - use of appropriate wastage percentage
  - offloading and storage costs
  - use of 'all-in' labour rates
  - use of labour 'constants'
  - sundry plant requirements
  - addition of overheads and profits.
- Inclusion of subcontractor quotations:
  - unit rates
  - lump sums
  - pricing attendance and special attendance
  - addition of overheads and profit.
- Completing PC sums and provisional sums (PS):
  - inclusion of PS
  - inclusion of PC sums:
    - addition for overheads and profit
    - addition for attendance and special attendance
  - inclusion of contingency sums.
- Pricing dayworks:
  - labour
  - materials
  - plant.
- Pricing preliminary items:
  - employer's requirements
  - management and staff
  - security, safety and protection
  - site establishment and accommodation
  - temporary services
  - safety and environmental protection
  - fixed plant
  - scaffolding and temporary works
  - cleaning
  - insurances, bonds, guarantees and warranties
  - allowance for fixed or fluctuating price.
- Completion of the priced bill of quantities:
  - use of collections and summaries
  - checking procedures.

B4 Analysis of the estimate

Breaking down the estimate into key cost centres:

- preliminaries
- labour cost
- materials cost
- plant cost
- overhead allowance
- total of PC sums
- total of PS and contingencies
- suggested alternative tenders or variant bids.

C Commercial decisions

Factors that influence the final tender decision and how they are considered when deciding the final tender sum.

C1 Application of risk analysis to make commercial decisions

Consideration of risk in terms of time and cost, within the context of market and economic conditions:

- current workload and the need to maintain turnover
- site and location factors:
  - ground contamination
  - soil types and ground conditions
  - security requirements:
    - risk of theft and vandalism
    - proximity of schools and children's playgrounds
    - community attitude to crime reporting
    - community reputation
  - industrial relations and local labour agreements
  - presence of protected species
  - existing trees:
    - preservation orders
    - delaying tactics of local pressure groups
  - local climatic conditions.
- Programme factors:
  - commencement date:
    - weather and climate considerations
    - in relation to completion of other projects
  - duration
  - specific contract conditions that:
    - affect the intended method of working
    - impose restrictions
    - affect access to the site
    - interrupt the regular flow of trades
    - affect the duration of the project
    - affect the sequencing of the project
    - are of major cost significance or difficult to quantify in terms of cost.
- Financial issues:
  - cash flow forecasting
  - available finance
  - contract bond
  - retention percentage
  - payment period and frequency of payments
  - financial checks on the client:
    - company accounts
    - credit reference agencies
    - confirmation of financing
  - where there is the potential that the project cost exceeds the client's budget, opportunities to:
    - negotiate a bill of reductions
    - participate in value engineering workshops
    - propose contractor recommended changes.

C2 Use of commercial intelligence

- Commercial intelligence and its influence on the final tender decision.
- Competitive tendering:
  - number of competing bids
  - other tenderers:
    - recent tendering success
    - recent pricing levels
    - capacity to take on new contracts
    - current tendering workloads
    - proximity to base
    - expertise
    - apparent attitude to risk
    - apparent attitude to contractual claims.

C3 Tender adjudication and settlement meetings

- Adjustments to the final sum to take into account:
  - company overheads
  - desired profit margin
  - potential for buyers to generate further margins
  - current market conditions and economic climate
  - need to maintain workload:
    - contribution to overhead costs
    - redundancy avoidance measures
    - continuity of cash flow
  - need to retain skills and experience:
    - managers, technicians and professionals
    - craft skills
  - previous experience of similar projects
  - planned expansion
  - acquisition of new expertise
  - commercial risk
  - level of competition
    - number of competing tenderers
    - assessment of competitors' tendering intentions.
- Discounts (for the main contractor of a subcontract or package tender).
- Conversion of the estimate into a firm bid (tender).
- Director's adjustment.

C4 Communication skills

Writing and presentation skills for communications:

- appropriate use of technical language for target audience
- appropriate and concise content used to convey intended meaning
- appropriate use of tone.

Grade descriptors

To achieve a grade learners are expected to demonstrate these attributes across the essential content of the unit. The principle of best fit will apply in awarding grades.

Level 3 Pass

Learners will demonstrate some knowledge and understanding of commercial risk in a set context in order to recommend a tendering strategy. They will build up unit rates that are generally accurate, demonstrating some appropriate estimating skills and applying some appropriate methodologies. They can apply their unit rates to the bill of quantities in order to produce a final cost of measured works. Learners will produce an estimated total cost for the construction, civil engineering and building services engineering project by pricing preliminaries and completing the remaining sections of the bill of quantities, although there may be some inaccuracies. Learners will produce a justified tender that takes into account some risk factors and conflicting and complex issues that influence the final tender decision.

Level 3 Distinction

Learners will demonstrate comprehensive knowledge and understanding of commercial risk in a set context in order to recommend a tendering strategy. They will build up unit rates that are consistent and accurate, demonstrating consistency in the use of appropriate estimating skills and applying correct methodologies. They can apply their unit rates to the bill of quantities in order to produce a mostly accurate final cost of measured works. Learners will produce an estimated total cost for the construction, civil engineering and building services engineering project that is mostly accurate by pricing preliminaries, consistently using appropriate data and methodologies, and completing the remaining sections of the bill of quantities. Learners will produce a fully justified tender that takes into account most of the relevant risk factors with a developed understanding of conflicting and complex issues that influence the final tender decision.

Key words typically used in assessment

The following table shows the key words that will be used consistently by Pearson in our assessments to ensure learners are rewarded for demonstrating the necessary skills.

Please note: the list below will not necessarily be used in every paper/session and is provided for guidance only.

Command or term	Definition
Borehole report	A report that provides information on the soil types and depths within the various strata underneath the surface of the site.
Build up	An estimating process used to produce the nett cost per unit, including all the components of cost for that item.
Company profile	Information about the company that will be useful when making tendering and estimating decisions.
Complete	Input of items necessary to fill in all sections of a document.
Measured work section	The section of the bill of quantities containing measured items, with quantities, into which unit rates are inserted.

Command or term	Definition
Produce	Create required information as a result of own calculations and/or selecting and inputting from given information.
Tender sum	The final price that the company decides on and submits as a bid for the project.
Unit rates	The cost of a measured item per unit of measure, including all materials, wastage allowances, labour and sundry plant requirements.

Links to other units

The assessment for this unit should draw on knowledge, understanding and skills developed from:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 5: Health and Safety in Construction
- Unit 6: Surveying in Construction
- Unit 7: Graphical Detailing in Construction
- Unit 8: Building Regulations and Control in Construction
- Unit 9: Management of a Construction Project
- Unit 11: Site Engineering for Construction
- Unit 14: Provision of Primary Services in Construction
- Unit 15: Further Mathematics for Construction
- Unit 21: Building Services Science
- Unit 23: Construction in Civil Engineering

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 4: Construction Technology

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners examine the underlying principles and construction methods used in the construction of new buildings and their associated external works.

Unit introduction

The construction industry provides the population of the UK, and the world, with the built environment needed to sustain all aspects of life as we know it. Today's buildings can use combinations of modern and traditional techniques and materials in their construction, and this unit will give you an understanding of the technology used in the design and construction of low-rise domestic and commercial buildings.

In this unit, you will examine various forms of low-rise construction and consider the most appropriate forms for differing site conditions and client requirements. You will gain an understanding of the different types of foundation that could be used on a project and the factors that influence its selection. You will investigate superstructure, external works design and construction, considering the most appropriate specifications and details for given scenarios.

This unit will give you the underlying knowledge and understanding of construction technology that supports a wide range of other units in this qualification. A sound knowledge of construction technology is an essential aspect of many roles, including architect, site manager, quantity surveyor, planner, buyer, estimator, etc.

Learning aims

In this unit you will:

A Understand common forms of low-rise construction

B Examine foundation design and construction

C Examine superstructure design and construction

D Examine external works associated with construction projects.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand common forms of low-rise construction	**A1** Forms of low-rise construction	A report to a client that covers the use of different structural forms for the proposed project, considering the effectiveness of each structural form.
B Examine foundation design and construction	**B1** Subsoil investigation **B2** Subsoil improvement **B3** Design principles **B4** Types of foundation	A report for a given project scenario that covers the foundation design and different methods that can be used for the design and construction of the foundations, superstructures and external works.
C Examine superstructure design and construction	**C1** Walls **C2** Floors **C3** Roofs **C4** Internal finishes	
D Examine external works associated with construction projects	**D1** Foul and surface water drainage **D2** Utility services **D3** Roads and footpaths **D4** Sustainable urban drainage systems	A report for a given project scenario that covers the design and construction of the external works, including the incorporation of sustainable drainage systems.

Content

Learning aim A: Understand common forms of low-rise construction

A1 Forms of low-rise construction

The application, characteristics, use, methods of load transfer, differences in construction methods, advantages and limitations of the following forms of low-rise construction.

- Framed structures:
  - skeleton, rectangular frame:
    - steel
    - in-situ reinforced concrete
    - prefabricated concrete
  - portal frame:
    - steel
    - laminated timber
    - prefabricated concrete
  - timber frame:
    - prefabricated platform frames
    - open panel systems
    - closed panel systems
  - structural insulated panels (SIPs).
- Traditional construction:
  - cavity wall
  - masonry wall
  - cut rafter roofing
  - timber floors
  - in-situ methods.
- Modular construction:
  - four-sided modules
  - open-sided modules
    - partially open sided
    - corner supported modules
  - stair modules
  - lift modules
  - non-loadbearing modules.

Learning aim B: Examine foundation design and construction

B1 Subsoil investigation

Subsoil investigation methods to obtain data and information for foundation design and their advantages and disadvantages.

- Investigation methods:
  - desk study
  - walkover survey
  - trial pits
  - auger holes
  - percussion drilling and window sampling
  - plate bearing test.
- Information used for foundation design:
  - bearing capacity
  - subsoil classification
  - groundwater levels
  - chemical analysis of soil samples and presence of sulphates
  - presence of obstructions – naturally occurring and from previous development.

B2 Subsoil improvement

Awareness of techniques of how to improve the bearing capacity of the ground before construction work commencing on site:

- vibroflotation, including vibro replacement
- grouting
- land drainage.

B3 Design principles

Foundation design considerations, including the relationship between building load and ground bearing capacity, the foundation footprint and transfer of loads to a suitable bearing strata.

- Factors used during design to minimise settlement:
  - building load
  - soil bearing capacity and type
  - foundation depth
  - groundwater.
- Design to minimise other movement:
  - soil shrinkage
  - ground heave
  - differential settlement
  - effects of tree growth and tree removal.
- The Building Regulations 2010, Part A – use to determine the minimum:
  - width of strip foundations
  - thickness of strip foundations
  - overlap where foundations are stepped.

B4 Types of foundation

The application, characteristics, substructure detailing, advantages and disadvantages and factors affecting choice of the following foundation types for different loadings and ground bearing capacities.

- Strip.
- Trench fill.
- Raft.
- Pad.
- Pile:
  - replacement piles
  - displacement piles
  - pile caps
  - ground beams.

Learning aim C: Examine superstructure design and construction

C1 Walls

Construction methods and techniques, materials used, stability, detailing, external finishes, performance requirements, advantages and disadvantages of the following wall elements.

- External cavity walls:
  - traditional brickwork and blockwork
  - blockwork with external skin rendered.
- Solid wall with rainscreen cladding.
- Internal walls and partitions:
  - blockwork partitions
  - timber stud partitions
  - metal stud partitions
  - demountable partitions.

- Prefabricated timber frame construction:
  - external wall details
  - cladding options, including brickwork
  - internal wall details.
- Openings in walls:
  - head detailing, including methods of supporting the wall above the opening
  - jamb detailing
  - sill and threshold detailing
  - windows
  - doors.

C2 Floors

Construction methods and techniques, materials used, support, detailing, finishes, performance requirements, advantages and disadvantages of the following floor types and elements.

- Ground floors:
  - solid concrete
  - beam and block
  - prestressed concrete
  - suspended timber.
- Intermediate floors:
  - beam and block
  - prestressed concrete
  - timber
  - platform floors in timber frame construction.
- Openings and stairs:
  - forming openings
  - timber stairs
  - precast concrete stairs.

C3 Roofs

Construction methods and techniques, materials and components used, support (including bracing and lateral restraint), detailing (at eaves, verge, abutments and ridge), finishes, performance requirements, advantages and disadvantages of the following roof types.

- Pitched, including mono pitch, double pitch, gable ended and hipped:
  - trussed rafter construction
  - traditional timber roofing.
- Flat:
  - warm deck
  - cold deck
  - method of achieving required falls:
    - firrings
    - laser-cut tapered insulation
    - screed.

C4 Internal finishes

Application, characteristics, properties, advantages and disadvantages of the following finishes.

- Wall finishes:
  - traditional two-coat plasterwork
  - dry lining
  - ceramic tiling
  - wood paneling
  - decorating:
    - paint
    - wallpaper.

- Ceiling finishes:
  - plasterboard and skim
  - suspended ceilings
  - UPVC ceiling cladding
  - timber-boarded ceilings.
- Floor finishes:
  - natural timber
  - laminates
  - carpets
  - ceramic tiling
  - sheet materials.

Learning aim D: Examine external works associated with construction projects

D1 Foul and surface water drainage

The layout, falls, access, advantages and disadvantages of the following methods of disposal for foul and surface water.

- Combined drainage.
- Separate drainage.

D2 Utility services

The depth, colour coding of ducts, positioning, typical layout and building entry of the following utility services.

- Water.
- Gas.
- Electricity.
- Telecommunications.

D3 Roads and footpaths

Construction methods and techniques, materials used, edge details, performance requirements, specifications, finishes, advantages and disadvantages of the following paving types.

- Tarmacadam to footpaths.
- Tarmacadam to vehicular areas and roads.
- Block paving.
- In-situ concrete.
- Precast concrete paving.

D4 Sustainable urban drainage systems

The methods, use, characteristics, advantages and disadvantages of sustainable urban drainage systems.

- Methods of temporary storage of excess surface water:
  - swales
  - infiltration basins
  - extended detention basins
  - wet ponds
  - infiltration systems.
- Methods allowing natural percolation to groundwater:
  - filter strips
  - porous surfaces:
    - porous block paving
    - permeable tarmacadam
    - porous concrete
    - gravel.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand common forms of low-rise construction		**A.D1** Evaluate the effectiveness of different structural forms for use with a given low-rise buildings project scenario.
A.P1 Explain the different structural forms used in the construction of low-rise buildings.	**A.M1** Discuss the use of different structural forms for use with a given low-rise buildings project scenario.	
Learning aim B: Examine foundation design and construction		
B.P2 Explain the different types of investigation used to provide information required for the design of foundations for low-rise buildings. **B.P3** Explain the different types of foundation used for low-rise buildings. **B.P4** Describe the principles of foundation design and how they impact on the choice of foundation type for low-rise buildings.	**B.M2** Discuss the principles of foundation design and how they impact on the choice of foundation type for low-rise buildings.	**BC.D2** Evaluate the construction of new low-rise buildings.
Learning aim C: Examine superstructure design and construction		
C.P5 Explain the construction details used in the construction of walls, floors and roofs on new construction projects. **C.P6** Summarise the use of internal finishes for floors, walls and ceilings on new construction projects.	**C.M3** Analyse the different details and finishes used in the construction of new construction projects.	
Learning aim D: Examine external works associated with construction projects		**D.D3** Analyse the design and construction of external works for new construction projects, including the incorporation of a sustainable urban drainage system.
D.P7 Summarise the design and construction of external works on new construction projects. **D.P8** Explain the use of sustainable urban drainage systems in new construction projects.	**D.M4** Discuss the design and construction of external works for new construction projects, including the incorporation of a sustainable urban drainage system.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.M1, A.D1)

Learning aims: B and C (B.P2, B.P3, B.P4, C.P5, C.P6, B.M2, C.M3, BC.D2)

Learning aim: D (D.P7, D.P8, D.M4, D.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will demonstrate sound knowledge and understanding of the specific advantages and disadvantages of framed structures, traditional construction and modular construction methods when considered for use in the given project scenario. Learners will critically review the different forms of construction in the context of the scenario and will bring together key considerations to form a supported conclusion, drawing on information relevant to the given scenario.

For merit standard, learners will provide a coherent, logical and mostly balanced discussion that considers the application, characteristics, use, methods of load transfer, advantages and limitations of the different structural forms that could be considered for the given project scenario. They will demonstrate some understanding of the specific advantages and limitations of framed structures, traditional construction and modular construction methods when considered for use in the given project scenario.

For pass standard, learners will provide a clear explanation of different structural forms that are used in the construction of low-rise buildings. They will cover a minimum of two structural forms. Learners' work will demonstrate some knowledge of how the application, characteristics, advantages and limitations of each type of structural form affects the selection. Illustrations and/or sketches with annotations may be used, alongside written submissions, to help convey knowledge and understanding of the different structural forms.

Learning aims B and C

For distinction standard, learners will evaluate the effectiveness of the different foundation types, potential superstructure construction details and finishes to cover the basic proposals and site information for a low-rise construction scenario. Learners will demonstrate sound knowledge and understanding of the specific application, advantages and disadvantages of different foundation types, including strip, trench fill, raft, pad and various types of pile foundation, and the methods and performance requirements for the various elements of superstructure when considered for use in the given project scenario. Learners will review the different methods and details in the context of the scenario and will bring together key considerations to form a supported conclusion, including alternative specifications where appropriate, drawing on information relevant to the given scenario.

For merit standard, learners will provide a coherent, logical and mostly balanced discussion that considers the relationship between building load, ground bearing capacity, the foundation footprint, transfer of loads to a suitable bearing strata and the appropriate foundation types to cover the basic proposals and site information for a low-rise construction scenario. They will demonstrate a sound approach and competent analysis of typical details and finishes used in the construction of walls, floors and roofs. Learners must cover two details for each of the identified elements.

For pass standard, learners will provide a clear explanation of methods for determining soil type and properties, foundation types and principles of foundation design used in the construction of low-rise domestic buildings. Their explanation will cover a minimum of three different site investigation methods and foundation types, although the explanation will be generic and may only have limited focus to cover the basic proposals and site information for a low-rise construction scenario. Learners' work will cover an explanation of superstructure construction details, including walls, floors and roofs but this will be generic and not focused on the scenario. Details of internal finishes will be outlined, covering walls, ceilings and floors. Illustrations and/or sketches with annotations may be used, alongside written submissions, to help convey knowledge and understanding of the different principles and details.

Learning aim D

For distinction standard, learners will evaluate the effectiveness of external works, including sustainable urban drainage systems, to cover the basic proposals and site information for a low-rise construction scenario. Learners will demonstrate sound knowledge and understanding of the specific application, advantages and disadvantages of external works and sustainable urban drainage systems, when considered for use in the given project scenario. Learners will review the different methods and details in the context of the scenario and will bring together key considerations to form a supported conclusion, including alternative specifications where appropriate, drawing on information relevant to the given scenario.

For merit standard, learners will provide a coherent, logical and mostly balanced discussion in their work that covers how the design and construction of external works is suitable for the new construction project, including how external works are affected by the incorporation of a sustainable urban drainage system. This should include consideration of methods that delay and/or minimise the discharge of excess surface water, methods that provide for localised infiltration to groundwater and how all three approaches can be combined into a single effective system.

For pass standard, learners will demonstrate knowledge and understanding in their work of external works that incorporate sustainable drainage systems, including methods of temporary storage and methods allowing percolation to groundwater. Learners will demonstrate an awareness of the various external works requirements to cover the basic proposals and site information for a low-rise scenario. Illustrations and/or sketches with annotations may be used, alongside written submissions, to help convey knowledge and understanding of the different principles and details.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 5: Health and Safety in Construction
- Unit 7: Graphical Detailing in Construction
- Unit 10: Building Surveying in Construction
- Unit 11: Site Engineering for Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 13: Measurement Techniques in Construction
- Unit 14: Provision of Primary Services in Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers
- participation in audience assessment of presentations
- design/ideas to contribute to unit assignment/case study/project materials
- work experience
- employer's business materials as exemplars
- support from local business staff as mentors.

Unit 5: Health and Safety in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners will carry out a safe system of work and investigate the significance of safety system reviews, understanding the responsibilities of employees and employers with regard to health and safety in construction operations.

Unit introduction

Health and safety in construction operations is essential so that workers can carry out practical activities in a safe environment that is free from hazards and risks. Safety starts in the office, with planning safe systems of work, assessing the risks in construction operations and applying control measures to reduce the risks to an acceptable level. Companies aspire to achieve the target of zero accidents in the workplace, promoting their reputation as safe constructors.

In this unit, you will examine the responsibilities of employees and employers with regard to UK legislation and regulations and the procedures used to control hazards and risks for construction operations across a range of activities. You will use relevant policies and procedures to design a safe system of work that could be instigated and maintained in a construction context. You will also investigate how all aspects of health and safety are monitored to ensure they are kept up to date, employers and employees are well informed and any changes are evaluated and controlled.

This unit can help you progress to health and safety management and supervision in the construction sector as a contracts manager or site manager, or to specialist health and safety qualifications such as the National Examination Board in Occupational Safety and Health (NEBOSH) Certificate and Diploma qualifications or Higher Nationals in Construction and degrees in construction specialisms.

Learning aims

In this unit you will:

A Understand how health and safety legislation is applied to construction operations

B Carry out the development of a safe system of work for construction operations

C Understand the need for the review of safety systems for construction operations.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand how health and safety legislation is applied to construction operations	**A1** Health and Safety at Work etc. Act 1974 **A2** Construction (Design and Management) Regulations 2015 **A3** Management of Health and Safety at Work Regulations 1999 **A4** Work at Height Regulations 2005 **A5** Control of Substances Hazardous to Health (COSHH) Regulations 2002 **A6** Training and education	Presentations, explanatory leaflets or a formal report that references case studies, showing the impact of how legislation and regulations uphold and improve health and safety on construction sites. Reference to statistics could provide justification of legislation and regulation effectiveness.
B Carry out the development of a safe system of work for construction operations	**B1** Health and safety preparation **B2** Construction phase health and safety **B3** Health and safety file	A safety survey with completed documentation, including the production of a risk assessment and method statement.
C Understand the need for the review of safety systems for construction operations	**C1** Accident reporting procedures **C2** Reviewing safety systems **C3** Changes to systems and procedures **C4** Skills, knowledge and behaviours	A report evaluating how safe systems can be improved following the reporting of accidents, utilising review procedures.

Content

Learning aim A: Understand how health and safety legislation is applied to construction operations

Current legislation and regulations, including any updates, and their application in construction operations.

A1 Health and Safety at Work etc. Act 1974

- The duties defined in each section of the act. The duties of:
  - employers
  - employees and self-employed
  - designers and manufacturers
  - Health and Safety Executive (HSE):
    - powers of the HSE when visiting a site or investigating an accident
    - notices for improvements and prohibition, differences between the two types.
- Penalties for non-compliance:
  - enforcement, sanctions, loss of reputation, loss of work, corporate manslaughter
  - fines, magistrates and crown court penalties, level of fines
  - imprisonment, length of detainment.

A2 Construction (Design and Management) Regulations 2015

The content of the regulations and what aspects have to be carried out in order to comply with them during the design and construction of a building project.

- Phases to be followed:
  - pre-construction information – client's health and safety file, site survey, desktop research
  - construction phase safety plan – contents required for compliance with regulations
  - content of the health and safety file:
    - meet the requirements of the regulations
    - duty holders' participation, to include designer, client, main contractor, contractors.
- Duties of parties to the contract, to include:
  - principal designer and designers
  - client
  - principal contractor.
- General requirements for all construction sites:
  - welfare facilities – Schedule 2 in the appendix to the regulations
  - general principles of prevention to be employed on site.

A3 Management of Health and Safety at Work Regulations 1999

Aspects of the regulations relevant to construction.

- Duties, to include those defined in the following sections of the regulations:
  - risk assessment requirements under Regulation 3 of the legislation
  - health and safety arrangements and assistance provided by the employer
  - cooperation and co-ordination between all parties
  - capabilities and training of all operatives
  - specific duties of employees under this regulation.

A4 Work at Height Regulations 2005

Duties, to include:

- organisation and planning required before working at height is commenced
- avoiding risks from working at height by establishing an alternative method
- work equipment requirements for operatives
- duties of persons at work with regard to safety under this regulation
- requirements for any working platform used to gain access to working at height
- requirements for personal fall protection to be provided for employees
- the use of ladders and the regulations and duties concerning this use.

A5 Control of Substances Hazardous to Health (COSHH) Regulations 2002

Relevant aspects regarding the use of substances and chemicals during construction activities on site.

- Employer’s duties, to include provision of:
  - risk assessment of all substances used in the workplace – highlighting precautionary methods to be employed before and during use
  - control measures, use, maintenance, examination and testing – reducing the risk to an acceptable level
  - monitoring and health surveillance of employees using substances at work
  - information, instruction and training of employees.

A6 Training and education

- On-site safety training, e.g. tool box talks.
- Construction Skills Certification Scheme (CSCS) card – classification and the different types of cards available, qualifying for a card, process, validity.
- Client Contractor National Safety Group (CCNSG) Safety Passport – requirements and use.
- Fire safety.
- Off-site training requirements and links to control measures, e.g. for working at height, COSHH, noise, confined spaces.
- Training associated with equipment.
- Provision and Use of Work Equipment Regulations (PUWER) 1998.
- Purpose and provision of safety notice boards and signage.

Learning aim B: Carry out the development of a safe system of work for construction operations

Relevant administration and management tasks must be carried out to ensure that a construction site is a safe place of work.

B1 Health and safety preparation

- Notifications to HSE, the completion of the F10 documentation.
- Health and safety construction phase plan, contents and safe systems of work (SSW).
- Site induction content to be prepared, inclusions, method of delivery.
- Preparation of the site waste management plan, its content and specific requirements under the regulations for waste management.
- Safety poster provision, gate and entrance signage and notices, formal gate notifications.

B2 Construction phase health and safety

- Delivery of site inductions and retaining records of inductions.
- Identifying hazards by various methods – direct observation, checklists, audits, tool box talks, safety committees.
- Writing risk assessments and evaluating control measures – risk ratings, acceptable levels.
- Writing method statements, sequencing of statements, resources to be used.
- Delivering tool box talks – method, timing, what to cover in talk, who should be present.

- Issuing care and maintenance of personal protective equipment (PPE) and first-aid facilities.
- Preparing temporary fire and evacuation procedures.
- Instructing on waste disposal, segregation, good housekeeping.
- Managing subcontractors' safety information, site meetings.

B3 Health and safety file

- Preparing file contents in accordance with the requirements of the Construction (Design and Management) Regulations 2015:
  - a brief description of the work carried out
  - any residual hazards that remain and how they have been dealt with, e.g. information concerning asbestos, contaminated land, buried services, etc.
  - key structural information, e.g. bracing, sources of substantial stored energy – including pre- or post-tensioned members, etc.
  - safe working loads for floors and roofs, particularly where these may prohibit placing scaffolding or heavy machinery
  - hazardous materials used, to include manufacturer's data sheets, e.g. pesticides, special coatings that should not be burnt off, etc.
  - information regarding the removal or dismantling of installed plant and equipment, e.g. any special arrangements for lifting, special instructions for dismantling, etc.
  - health and safety information about equipment provided for cleaning or maintaining the structure
  - the nature, location and markings of significant services, including underground cables; gas supply equipment; fire-fighting services, etc.
  - information and as-built drawings of the structure, its plant and equipment, e.g. the means of safe access to and from service voids, fire doors and compartmentalization, etc.
- Reviewing documentation.
- File distribution.

Learning aim C: Understand the need for the review of safety systems for construction operations

Reviewing to close the safety cycle and analysing systems for any changes to processes, procedures or operations.

C1 Accident reporting procedures

- Definition of the following in accordance with reporting procedures and classification:
  - accident
  - near miss
  - minor
  - major.
- Procedures on discovering an accident:
  - first-aid actions, call for help, first aider, emergency services, individual responsibilities
  - reporting to supervisor, procedures, accident book, internal reports
  - Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 2013, over-three-day lost time injuries, reporting of a fatality
  - internal accident investigation procedures
  - fatalities and HSE investigations, documentation to produce.

C2 Reviewing safety systems

Using data to establish where unplanned events occur and to reduce incidents.

- Analysis of accident information:
  - trends in near misses and types of accidents
  - comparison with UK national averages
  - discussion with workforce, site safety meetings, interviews, safety committees
  - suggestions and recommendations for improvements, justified by statistical analysis.
- Benefits of undertaking safety reviews:
  - reduction in costs – direct and indirect
  - reputation of the company, marketing materials
  - worker morale, a better and safer place to work
  - improved performance in terms of production
  - client estimating pre-contract enquiries and getting onto employer tender lists.

C3 Changes to systems and procedures

Closing the safety cycle to ensure that any changes are reviewed, checked for compliance and monitored for effectiveness.

- Reviewing control measures, ensuring lowest possible risk achieved with reasonably practical measures, signing and dating reviews.
- Revising risk assessments in light of changes to processes, operatives and materials.
- Evaluating revised risk ratings.
- Reviewing changes and recommendations, communication to all.

C4 Skills, knowledge and behaviours

Demonstrating appropriate behaviour and its impact on outcomes, to include professionalism, etiquette, working to deadlines, accountability and individual responsibility.

- Evaluating outcomes on hazards and risks to help inform high-quality justified recommendations and decisions.
- Media and communication skills, including:
  - the ability to convey intended meaning, e.g. written (risk assessment documentation, recording documentation, reports, visual aids for presentation use), verbal communication requirements (one-to-one and group, informal and formal situations)
  - use of tone and language for verbal and written communications to convey intended meaning and make a positive and constructive impact on audience, e.g. positive and engaging tone, technical/vocational language suitable for intended audience.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand how health and safety legislation is applied to construction operations		**A.D1** Evaluate the effectiveness of health and safety related legislation, education and training in controlling health and safety in construction.
A.P1 Explain the legislative duties of employers and employees in the current legislation. **A.P2** Explain how the application of health and safety related legislation controls health and safety in construction. **A.P3** Explain how education and training improves standards of health and safety.	**A.M1** Discuss the impact of health and safety related legislation, education and training in controlling health and safety in construction.	
Learning aim B: Carry out the development of a safe system of work for construction operations		**B.D2** Justify the optimised safe system of work for a construction operation.
B.P4 Explain methods used to identify hazards and assess risks. **B.P5** Produce a safe system of work for a given construction operation, and a risk assessment to include a method statement with effective control measures.	**B.M2** Optimise the safe system of work for a construction operation.	
Learning aim C: Understand the need for the review of safety systems for construction operations		**C.D3** Evaluate how safety systems are improved following the reporting of accidents and review of procedures.
C.P6 Explain how safe systems of work are reviewed. **C.P7** Explain the procedures that follow an accident to improve future safety.	**C.M3** Discuss how safety systems are improved following the reporting of accidents and review of procedures.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.P3, A.M1, A.D1)

Learning aim: B (B.P4, B.P5, B.M2, B.D2)

Learning aim C (C.P6, C.P7, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners must thoroughly evaluate, in terms of advantages and disadvantages, the effectiveness of health and safety legislation and regulations in controlling risks on a construction site. Learners will make specific, relevant references to the role of safety education and training to produce a logical, coherent response. Learners' research must lead to a supported, convincing judgement of the impact of risk reduction, considering fatalities and major and minor accidents in order to come to a robust conclusion. Learners' research can also include the contribution of legislation and regulations in reducing 'near misses'. This can include making reasoned judgements where legislation and regulations have not reduced accident rates or incidents on construction sites.

For merit standard, learners must produce a clear, balanced discussion of the impact of how legislation and regulations, and associated training and education, control safety on a construction site. This should be in terms of what has to be provided legally, for example safety information and welfare facilities and how these are provided, depending on the choice of two other regulations in addition to the Health and Safety at Work etc. Act 1974. Learners will consider the impact in terms of relevant preliminary items and temporary features provided on site, for example mobile elevated platforms for gaining access at height, the training of operatives to use harnesses to restrain falls from height, etc.

For pass standard, learners need to explain the Health and Safety at Work etc. Act 1974 in terms of the duties placed on an employer and employee under this legislation. Learners will give mostly relevant examples of the types of provision, giving accurate details and reasons for their importance in a construction working environment. Two other regulations must be explored by learners in explaining how each controls health and safety in a construction context. Examples of on-site requirements must be provided against each regulation. Learners will also provide a realistic explanation of how education and training improves standards of health and safety.

Learning aim B

For distinction standard, learners must thoroughly evaluate how hazard identification, risk assessment and method statements support a safe system of work for a given construction operation. They must consider the strengths and potential weaknesses of the safe system of work while examining risk assessments, method statements and control measures. This will result in a reasoned conclusion with justifications supporting the effectiveness of the optimised safe system of work. Learners must demonstrate that they have developed a robust, comprehensive understanding of the methods used to ensure that construction operations can be carried out in a safe manner with minimal risk of accident, injury or near miss.

For merit standard, learners must produce an optimised safe system of work. In doing so, they must analyse how hazard identification, risk assessment and method statements support a safe system of work for a given construction operation. They must conduct a methodical and detailed examination that considers the various facets of the safe system of work, while examining risk assessments, method statements and control measures and how these can be improved. Learners must demonstrate that they fully comprehend the methods used to ensure that construction operations can be carried out in a safe manner with minimal risk of accident, injury or near miss.

For pass standard, learners must produce a realistic, appropriate explanation of the methods used to identify hazards and assess risks. Learners will produce a realistic risk assessment and method statement with effective control measures that supports a safe system of work for a given construction operation. Learners must demonstrate that they have a good understanding of the methods used to ensure that construction operations can be carried out in a safe manner with minimal risk of accident, injury or near miss.

Learning aim C

For distinction standard, learners must consider an accident report and then thoroughly evaluate how safe systems of work can be improved, utilising review procedures following the reporting of accidents. They must consider both the strengths and potential weaknesses of the safe systems of work in relation to the scenario, and arrive at a logical conclusion with accurate justifications supporting the effectiveness of the safe system of work that they are proposing. Learners must demonstrate that they have developed a robust, in-depth understanding of the methods used to review safe systems of work following the reporting of an accident.

For merit standard, learners will adopt a balanced approach in considering an accident report and discussing how safe systems of work can be improved, utilising review procedures following the reporting of accidents. Learners will provide a relevant, balanced discussion of how different aspects of safe systems of work interrelate, in relation to the scenario. Learners must demonstrate that they fully comprehend the methods used to review safe systems of work following the reporting of an accident.

For pass standard, learners must explain how safe systems of work are reviewed, and the procedures that follow an accident to facilitate safety improvements in the future. Learners' explanations will be realistic and mostly relevant. Learners must demonstrate that they have a good understanding of the methods used to review safe systems of work following the reporting of an accident.

Links to other units

This unit links to:

- Unit 4: Construction Technology
- Unit 11: Site Engineering for Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 13: Measurement Techniques in Construction
- Unit 14: Provision of Primary Services in Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- technical workshops involving staff from local construction organisations with expertise in a range of specialist areas
- contribution of ideas to unit assignments, for individual learner projects and contribution of project materials
- guest speakers from a related health and safety background
- participation in audience assessment of presentations for discussion elements
- work experience on a construction site
- employer's business materials as exemplars
- support from local business staff as mentors
- employer's health and safety policies and procedural documentation.

Unit 6: Surveying in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners develop the skills to carry out linear, levelling and land surveys, understanding the methods and technologies needed for this work.

Unit introduction

The surveying of land is concerned with the measurement of existing features of the natural and built environment, and the presentation of data in a format suitable for architects and engineers to use when designing construction projects. It plays an important role in the early stages of the design process and links with the setting out phase of construction projects.

In this unit, you will become familiar with basic surveying techniques, carry out surveying tasks and present fieldwork data in a suitable format. You will consider the nature of survey measurements, the instruments used and the errors inherent in the measurement systems, including the best ways to reduce or eliminate them.

Understanding how to carry out surveying in construction to produce suitable and accurate drawings will prepare you for employment or further study in land surveying, site supervision, civil engineering and other branches of construction. The skills you gain from this unit will help you progress to employment in a range of areas in the construction industry, including site supervision, setting out, land surveying, quantity surveying, civil engineering and other branches of construction.

Learning aims

In this unit you will:

A Understand the methods and technologies that underpin surveys

B Undertake fieldwork surveys to collect data for drawings

C Develop drawings from completed fieldwork surveys.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the methods and technologies that underpin surveys	**A1** Linear, levelling and angular measurement **A2** Equipment used to perform fieldwork surveys **A3** Sources of systematic errors	A report on the techniques and instruments used to record survey data, including potential sources of systematic errors and their minimisation to produce accurate data for plan and section details production.
B Undertake fieldwork surveys to collect data for drawings	**B1** Linear surveys **B2** Levelling surveys **B3** Read and record horizontal angles of a closed traverse **B4** Basic arithmetic operations **B5** Application of applied mathematical techniques	Linear survey and level booking sheets to demonstrate accurate recording of surveying measurements. Teacher observation sheets confirming individual understanding and contribution to the practical tasks carried out during fieldwork tasks with others. A report: • evaluating the methods used to take levelling and angular measurements in terms of accuracy • including linear survey and level booking sheets of reduced levels and check calculations • including coordinates, calculations and corrections. A series of plan and section scaled detail drawings, to include a: • linear survey line plotted accurately to scale • contoured plan of a surveyed area of land • long section detail of one surveyed line indicating rise and fall of ground between survey stations • plot of a corrected closed traverse. The drawings/details can be produced using manual or computer-aided design (CAD) drawing techniques.
C Develop drawings from completed fieldwork surveys	**C1** Conventions used in survey drawings **C2** Production of survey drawings **C3** Corrected closed traverse drawing	

Content

This unit is an introductory unit to surveying. Learners are expected to use basic surveying equipment and linear surveys that are small in nature. In this way, learners do not have to complete a full linear survey and in B.P4 this is limited to a small survey line. The overall focus of the unit is to allow learners to use modern technology to produce accurate horizontal and vertical surveys.

Learning aim A: Understand the methods and technologies that underpin surveys

A1 Linear, levelling and angular measurement

Surveying terminology principles, their application to fieldwork activity and use of surveying technology to complete fieldwork activities.

- Framework.
- Measuring horizontal and slope distances.
- Chainage:
  - running measurements
  - perpendicular offsets.
- Survey line:
  - baseline
  - check lines.
- Reading levels:
  - backsight
  - intermediate sight
  - foresight.
- Datum terminology:
  - Ordnance Survey Bench Mark (OSBM)
  - Temporary Bench Mark (TBM)
  - reduced level.
- Height of collimation.
- Rise and fall.
- Fly levelling.
- Whole circle bearings.
- Horizontal angles.
- Traverse types:
  - open
  - closed
  - fixed between points
  - rectangular coordinates
  - survey stations.

A2 Equipment used to perform fieldwork surveys

Surveying equipment, their advantages and disadvantages, and use in completing fieldwork activities.

- Tapes.
- Bands.
- Ranging poles.
- Levels:
  - automatic
  - tilting
  - dumpy and builder
  - laser.
- Digital theodolites.
- Electronic distance measurement (EDM) devices.
- Total stations, including Global Positing Systems (GPS).

A3 Sources of systematic errors

How errors impact on the accuracy of fieldwork surveys.

- Plastic tapes – stretching.
- Levels – calibration errors.
- Theodolites:
  - bubble and electronic plummets off-centre errors
  - horizontal collimation errors
  - vertical collimation errors.
- Electronic distance measurement:
  - scale and index errors.
- Performance of systematic checks on surveying instruments:
  - tapes – calibration against standardised steel tapes
  - levels – two-peg test.
- Theodolites:
  - vertical axis check
  - transit axis check
  - spire check.

Learning aim B: Undertake fieldwork surveys to collect data for drawings

Methodologies used in the production of accurate surveys, including systematic checking, instrument adjustment and accuracy of calculations.

B1 Linear surveys

Application of techniques and processes to perform a linear survey.

- Establishing survey stations for a given location.
- Using chainage, offsets, tie lines to record measurements.
- Using correct booking techniques to survey in between survey stations.

B2 Levelling surveys

Application of techniques and processes to perform levelling surveys.

- Using TBM or OSBM datum to commence exercises.
- Recording readings using correct booking techniques:
  - height of collimation method
  - rise and fall method
  - flying levels.
- Completion of check calculations on the accuracy of levelling exercises undertaken.

B3 Read and record horizontal angles of a closed traverse

Application of techniques and processes for a closed traverse survey.

- Establishing survey stations for a closed traverse.
- Technique and recording requirements for the survey of a closed traverse.
- Recording horizontal angle readings using correct booking techniques.
- Detecting and correcting errors.

B4 Basic arithmetic operations

Application of arithmetic operations during fieldwork surveying tasks used to gather data for construction drawings.

- Calculations for levelling exercises and appropriate check calculations:
  - height of collimation method
  - rise and fall method
  - flying levels.
- Calculation of recorded horizontal angles using face left/face right techniques.
- Addition and subtraction of angles.

B5 Application of applied mathematical techniques

Application of applied mathematical techniques during fieldwork surveying tasks to gather data for construction drawings.

- Calculation of rectangular coordinates.
- Adjustment of simple traverse:
  - application of Bowditch to adjust a traverse
  - balancing in traverse
  - distribution of closure error.

Learning aim C: Develop drawings from completed fieldwork surveys

Techniques used to produce accurate construction drawings.

C1 Conventions used in survey drawings

- Conventions used in survey drawings.
- Appropriate scales for survey drawings.

C2 Production of survey drawings

Production of survey drawings to incorporate:

- levels survey plan
- plotting linear survey lines accurately to scale
- spot levels
- grid levels
- contours
- site cross section
- long section detail
- cut and fill cross section.

C3 Corrected closed traverse drawing

- Application of corrected traverse station coordinates to plot a closed traverse.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand the methods and technologies that underpin surveys		**A.D1** Evaluate the methods and technologies underpinning linear, levelling and angular measurement and surveys.
A.P1 Explain the methods and technologies underpinning linear, levelling and angular measurement surveys. **A.P2** Explain systematic errors in surveying measurements.	**A.M1** Discuss the methods and technologies underpinning linear, levelling and angular measurement and surveys.	
Learning aim B: Undertake fieldwork surveys to collect data for drawings		**B.D2** Evaluate the methods used to produce accurate fieldwork survey information for the development of accurate drawings. **C.D3** Evaluate the production of drawings from completed fieldwork surveys.
B.P3 Perform systematic checks and adjustments to equipment and instruments appropriate for the fieldwork surveying activity. **B.P4** Perform linear, levelling and angular measurement surveys using appropriate equipment and booking methods. **B.P5** Perform correct calculations to support fieldwork activities.	**B.M2** Justify the selection of equipment, methods used, the application of systematic checking, instrument adjustment and accuracy of calculations to provide accurate fieldwork survey information.	
Learning aim C: Develop drawings from completed fieldwork surveys		
C.P6 Produce plans of land and section detail drawings from completed fieldwork surveys.	**C.M3** Produce plans of land and section detail drawings from completed fieldwork surveys to a high level of technical skill and accuracy.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aims: B and C (B.P3, B.P4, B.P5, C.P6, B.M2, C.M3, B.D2, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to areas of land with a range of topographic and built features where surveying practical work can be carried out safely. Health, safety and welfare issues must be considered at all times and risk assessments carried out where necessary.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate the methods and technologies that underpin how to complete linear, levelling and angular measurement surveys. The evaluation must be supported with justified, detailed and well-presented examples of the relevant instruments to be used and appropriate booking procedures.

For merit standard, learners will discuss the methods and technologies that underpin how to complete linear, levelling and angular measurement surveys. The discussion must be supported with detailed and well-presented examples of the relevant instruments to be used and appropriate booking procedures.

For pass standard, learners will explain the characteristics that underpin how to complete linear, levelling and angular measurement surveys. The explanations must be supported with examples of the relevant instruments to be used and appropriate booking procedures to record measurements. Learners will explain the types of systematic errors in surveying measurements, which must include equipment used for linear, levelling and angular measurement fieldwork surveys.

Learning aims B and C

For distinction standard, learners will draw on and make supported judgements of the methodologies used to produce their accurate surveys. This will include their choices of equipment selected in comparison to alternate surveying instruments available to complete similar fieldwork measurements, and consideration of the accuracy of fieldwork readings and calculations completed.

For merit standard, learners will present a methodical and detailed justification of their selection of equipment and methods they have used to perform fieldwork exercises in order to provide accurate and reliable data for accurate drawings. This will include showing a clear understanding of the importance of the systematic checks and equipment/instrument adjustments that are conducted to minimise fieldwork measurements inaccuracies. Their calculations show their understanding of how to adjust a simple traverse network using a standard method of calculation.

Learners will provide accurate, well-presented scaled drawings and details of their surveys, to include a:

- linear plan detail of one surveyed line
- contoured plan of a section of the area surveyed
- section detail along one survey line
- corrected traverse plan detail.

It is acceptable for their drawings/details to be produced manually or by CAD.

Learners will produce drawings and details that meet all of the intended requirements, have the correct application of scale and are presented to a high level of technical skill and accuracy.

For pass standard, learners will participate in fieldwork activities to carry out their linear, levelling and angular surveys using appropriate equipment and recognised booking methods. Their survey measurements will be recorded using an appropriate booking method. Learners will produce evidence of how they completed systematic checks and adjusted equipment/instruments used to perform their fieldwork activities. Learners will produce reduced level calculations, using both the height of collimation and rise and fall methods. Learners will produce angular measurement calculations and record using the correct booking techniques. They will provide calculations for the coordinates of survey stations from data collected for a traverse survey. In this case, correct calculations will be seen as those that show understanding of methodologies.

Learners must provide scaled drawings and details, to include a:

- linear plan detail of one surveyed line
- contoured plan of a section of the area surveyed
- section detail along one survey line
- corrected traverse plan detail.

It is acceptable for these drawings/details to be produced manually or by CAD.

Learners will produce drawings and details that meet the necessary requirements, however there will be some inaccuracies in the correct application of scale and in the presentation of the finished details.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 7: Graphical Detailing in Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 13: Measurement Techniques in Construction
- Unit 14: Provision of Primary Services in Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers such as a surveyor from a local authority or building control department
- guest speakers from specialist surveying companies
- participation in audience assessment of presentations
- design/ideas to contribute to unit assignment/case study/project materials
- work experience
- own business materials as exemplars
- support from local business staff as mentors.

Unit 7: Graphical Detailing in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners develop knowledge and apply skills to produce graphical information by manual and computer-aided design (CAD) methods.

Unit introduction

The construction industry is heavily reliant on communicating through the use of graphical information. Whether you are a designer, builder or planner, an understanding of drawn information and the ability to produce it yourself is an essential part of your work. Information can be produced using manual or CAD methods. Although the industry is fast moving towards CAD, skills in the use of manual methods remain very important, especially those to make freehand sketches.

In this unit, you will develop an understanding of the range of media, equipment and techniques required to produce drawings manually, and you will learn about CAD techniques and requirements. You will produce a number of drawings following British Standards using manual and CAD methods. This unit will help you develop the skills to produce freehand sketches.

The knowledge and skills gained in this unit are essential to prepare you for progression to various roles in architectural and landscape design. An understanding of graphical representation is essential in other roles too, such as site management, site engineering, planning and quantity surveying. It will also help you progress to a higher education programme in construction and related disciplines.

Learning aims

In this unit you will:

A Understand the resources required to produce construction drawings

B Develop construction drawings for a given construction brief

C Undertake production of two-dimensional and three-dimensional freehand construction sketches.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the resources required to produce construction drawings	**A1** Manual methods **A2** Computer-aided design (CAD) **A3** Comparison of manual and CAD methods of drawing	An evaluative report or presentation supported with illustrations, images and sketches of the equipment and media that learners used in producing their construction drawings. Learners' construction drawings produced using manual and CAD methods, following standard conventions and practices in response to a given brief.
B Develop construction drawings for a given construction brief	**B1** Construction drawings	
C Undertake production of two-dimensional and three-dimensional freehand construction sketches	**C1** Principles, techniques and conventions **C2** Freehand sketches **C3** Skills, knowledge and behaviours	A portfolio of 2D and 3D freehand sketches. The portfolio should demonstrate the skills to use two- and three-point perspectives.

Content

Learning aim A: Understand the resources required to produce construction drawings

A1 Manual methods

Purpose, function, application and use of equipment and media for the production of construction drawings manually.

- Equipment required and its use in producing construction drawings manually:
  - hand drafting equipment, e.g. pens, pencils, scale rules, erasers, erasing shields, adjustable set squares, compasses, templates and flexible curves, stencils, parallel motion drawing boards, drafting tape.
- Media section and use to produce fit-for-purpose graphical information, to include:
  - grades of pencil (HB, H, 2H)
  - ink pens, e.g. 0.2, 0.25, 0.4, 0.5 mm thick
  - paper (detail paper, cartridge paper, tracing paper, A1, A2, A3 and A4 sizes)
  - reprographics.
- Manual drawing techniques, application and use, to include:
  - drawing lines and shapes
  - drawing to a scale
  - lettering and dimensioning
  - use of graphic conventions and standard symbols in accordance with British Standard BS 1192:2007.

A2 Computer-aided design (CAD)

Hardware and software specifications for a CAD system, CAD techniques and the comparison of the use of CAD with manual methods to produce construction drawings.

- Hardware requirements:
  - requirements to run the CAD software, e.g. graphics card, speed of processor, random-access memory (RAM) capacity, memory
  - storage, e.g. hard disk, solid state drive (SSD), USB stick, network drives, cloud
  - input devices, to include keyboard, mouse, other input devices, e.g. light pen, digitiser, joystick, thumbwheel
  - output devices, e.g. monitor, printer, plotter.
- Software requirements, to include:
  - operating systems available and their suitability for use with the chosen software package
  - CAD software packages and their advantages and limitations in use
  - minimum computing system requirements for the selected software package, e.g. hard disk space, memory required, processor, video card.
- CAD techniques, such as:
  - use of common commands and their application to produce designs, to include set-up, drawing, editing, zoom
  - plotting methods, to include vector plotting, colour plotting, black and white printing, greyscale printing, colour printing
  - setting up floor and external levels
  - drawing with composite elements, e.g. cavity wall
  - inserting standard components
  - using and applying layers in drawing production
  - using and applying line weights and their interpretation
  - selecting and applying appropriate drawing scale
  - producing a 3D virtual building model

- producing 2D views, to include plan views, elevation views, cross sections and site layout
- producing camera views and rendered images.

A3 Comparison of manual and CAD methods of drawing

Comparison of manual and CAD methods to produce construction drawings, to include:

- equipment requirements and costs
- accuracy and ease of making changes
- time and cost to produce drawings
- training and support required
- conversion from 3D to 2D
- production of rendered views
- transfer of information.

Learning aim B: Develop construction drawings for a given construction brief

B1 Construction drawings

Types and production of construction drawings following BS 1192:2007 standards and conventions using manual and CAD methods:

- BS 1192:2007 standards and conventions requirements and their application to the different types of construction drawing
- site plan requirements
- two-storey building plans
- elevations
- cross-section drawing
- component or detail drawing
- structural drawings showing general arrangements
- preliminary sketch drawing.

Learning aim C: Undertake production of two-dimensional and three-dimensional freehand construction sketches

C1 Principles, techniques and conventions

Application of principles and techniques used to draw freehand sketches, to include:

- concept of proportionality
- oblique projection
- draw what you see – perspective drawings
- identifying the horizon line, perspective line and vanishing point
- sketching with vanishing points, to include two- and three-point perspective.

C2 Freehand sketches

Two-dimensional and three-dimensional freehand sketch techniques and their application to:

- the interior of a building, to include room or space showing location of doors, windows, features and fixings
- the exterior of a building, to include the showing of spatial layout and important features
- marking requirements to indicate the clear location of vanishing point(s) on sketches
- the use and appropriate application of annotations to communicate details of materials, finishes, condition or any other relevant information in sketches.

C3 Skills, knowledge and behaviours

Demonstrate behaviour and its impact on outcomes, to include professionalism, etiquette, working to deadlines, accountability and individual responsibility.

- Evaluating outcomes to help inform high-quality justified decisions.
- Media and communication skills, including:
  - the ability to convey intended meaning, e.g. written (reports, visual aids for presentational use), verbal communication requirements (one-to-one and group, informal and formal situations)
  - use of tone and language for verbal and written communications to convey intended meaning and make a positive and constructive impact on the audience, e.g. positive and engaging tone, technical/vocational language suitable for intended audience.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand the resources required to produce construction drawings		
A.P1 Explain the use of media and equipment to produce manual drawings for a given building. **A.P2** Describe the resources required to produce CAD drawings for a given building. **A.P3** Compare manual and CAD methods for the production of drawings in terms of their resource requirements, efficiency and cost.	**A.M1** Analyse the use of manual and CAD methods to produce drawings for a given building in terms of their resource requirements, efficiency and cost.	**A.D1** Evaluate the use of manual and CAD methods to produce drawings for a given building in terms of their resource requirements, efficiency and cost.
Learning aim B: Develop construction drawings for a given construction brief		
B.P4 Produce construction drawings for a two-storey building drawn to an appropriate scale, containing some technical information following BS 1192:2007 standards.	**B.M2** Produce good-quality construction drawings for a two-storey building drawn accurately to an appropriate scale, containing appropriate technical information following BS 1192:2007 standards.	**B.D2** Produce high-quality, fully annotated construction drawings for a two-storey building drawn accurately to an appropriate scale, containing detailed technical information following BS 1192:2007 standards.
Learning aim C: Undertake production of two-dimensional and three-dimensional freehand construction sketches		
C.P5 Produce annotated 2D and 3D freehand sketches, using appropriate conventions, for the interior of a building. **C.P6** Produce annotated 2D and 3D freehand sketches, using appropriate conventions, for the exterior of a building.	**C.M3** Produce good-quality, annotated 2D and 3D freehand sketches for the interior and exterior of a building with convergence to vanishing points.	**C.D3** Produce high-quality, fully annotated 2D and 3D freehand sketches for the interior and exterior of a building with accurate convergence to vanishing points.

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, A.P3, B.P4, A.M1, B.M2, A.D1, B.D2)

Learning aim: C (C.P5, C.P6, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to CAD and manual equipment for drawing and sketching.

Essential information for assessment decisions

Learning aims A and B

For distinction standard, learners evaluate manual and CAD methods to produce drawings. Learners will demonstrate a thorough understanding of the media and equipment required to produce manual and CAD drawings. They will produce a balanced evaluation of the methods used and take into account resource requirements, efficiency and cost.

Learners will produce a set of good-quality drawings using standards and conventions as laid down in BS 1192:2007 for a two-storey building. The drawings will contain correct technical information.

For merit standard, learners analyse manual and CAD methods to produce drawings. Learners will produce an analysis of the comparison of methods, which may lack balance but will take into account resource requirements, efficiency and cost.

Learners will produce a set of good-quality drawings using standards and conventions as laid down in BS 1192:2007 for a two-storey building. The drawings will include the use of both CAD and traditional drafting techniques (only one technique needs to be applied to each drawing produced) and drawings will contain appropriate technical information.

For pass standard, learners analyse manual and CAD methods to produce drawings. Learners will produce an analysis of the comparison of methods, which may lack balance but will take into account some elements of resource requirements, efficiency and cost.

Learners will produce a set of appropriately annotated drawings using standards and conventions as laid down in BS 1192:2007 for a two-storey building. This set of drawings must include the use of both CAD and traditional drafting techniques (only one technique needs to be applied to each drawing produced) and drawings will contain some technical information.

Learning aim C

For distinction standard, learners produce high-quality, fully annotated 2D and 3D freehand sketches. These will be produced using two- or three-point perspective drawing techniques for the interior and exterior of a building. Learners will demonstrate a thorough understanding of the concept of proportionality and vanishing points, although these may be outside the boundaries of the media at this level. Sketches will be fully annotated, providing details of materials, finishes, condition or any other relevant information and will show location of doors, windows, features, fixings and spatial layout.

For merit standard, learners produce good-quality, annotated 2D and 3D freehand sketches. These will be produced using two- or three-point perspective drawing techniques for the interior and exterior of a building. At this level, learners will show some understanding of proportionality and may have worked with vanishing points in the constraints of the media. Sketches will be annotated, providing details of most of the materials, finishes, condition or any other relevant information and will show location of doors, windows, features, fixings and spatial layout.

For pass standard, learners produce annotated 2D and 3D freehand sketches. At this level, learners will show some understanding of proportionality. Sketches will be annotated, providing details of some of the materials, finishes, condition or any other relevant information and will show location of doors, windows, features, fixings and spatial layout.

Links to other units

This unit links to:

- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 11: Site Engineering for Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 13: Measurement Techniques in Construction
- Unit 14: Provision of Primary Services in Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers
- technical workshops involving staff from local construction organisations
- contribution of ideas to unit assignment/project materials.

Unit 8: Building Regulations and Control in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners interpret and apply the requirements of the building regulations to existing and new-build schemes, including the application process and different methods of inspection and control.

Unit introduction

The Building Regulations are steeped in history, with many crediting their birth at the Great Fire of London in 1666, when the city was rebuilt with a view to fire prevention. However, building codes have been around even longer than this. Over the years, there have been many versions and variations of the building regulations as they have grown and evolved, leading to the documents we now use. Today's construction professionals need a wide and far-reaching knowledge to achieve compliance.

In this unit, you will learn how to apply for building regulations approval, which you will be able to use in professional practice in your future career. To enable you to do this, you will learn about the different options available, the documents required and the process of making an application. This unit is designed to be hands-on and practical and, on successful completion, you will have a good knowledge and understanding of the process.

The content of this unit will broaden your knowledge of one of the key legislative requirements in construction. It will prepare you for a range of roles in industry, ranging from the practical and production roles through to the professional and planning roles, such as building surveyors, architects, site supervisors, building inspectors and clerk of works. This unit will also prepare you for entry to higher-level courses in architecture or building construction.

Learning aims

In this unit you will:

A Understand the requirements of building regulations

B Examine the requirements of the building regulations

C Undertake a building regulations application.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the requirements of building regulations	**A1** The building regulations **A2** Control and implementation of the Building Regulations	A written report and presentation to discuss the requirements of the Building Regulations and the different methods of control and of demonstrating compliance with the Building Regulations.
B Examine the requirements of the building regulations	**B1** Approved documents **B2** Alternative methods of achieving compliance	
C Undertake a building regulations application	**C1** Types of application **C2** Preparing a building notice application **C3** Preparing a full plans application	Portfolio of evidence showing the preparation for a full plans building regulations application for a new-build domestic scheme.

Content

Learning aim A: Understand the requirements of building regulations

The specifics of the Building Act 1984 and the Building Regulations, and how to find and use the relevant information.

A1 The building regulations

- Application of the Building Act 1984.
- The requirements of the Building Act 1984:
  - definition of building work and the extent of the building regulations application
  - material alterations
  - exemptions to the regulations
  - dispensation or relaxation of the regulations.

A2 Control and implementation of the building regulations

- Application procedure and the correct use of each method:
  - full plans
  - building notice.
- Notification of commencement and certain stages of the works.
- Supervision of works and the powers of inspectors:
  - local authority
  - private inspectors
  - National House Building Council (NHBC).
- Testing and commissioning.
- Certification of the works.
- Self-certification schemes.
- Non-compliance and the consequences.

Learning aim B: Examine the requirements of the building regulations

Interpretation, application and compliance with the requirements of the Building Regulations 2010.

B1 Approved documents

Learners need to have a basic knowledge of the approved documents, how to use them and how to apply the requirements.

- Structure, covered in Approved Document A.
- Fire safety, covered in Approved Document B.
- Site preparation and resistance to contaminates and moisture, covered in Approved Document C.
- Toxic substances, covered in Approved Document D.
- Resistance to sound, covered in Approved Document E.
- Ventilation, covered in Approved Document F.
- Sanitation, hot water safety and water efficiency, covered in Approved Document G.
- Drainage and waste disposal, covered in Approved Document H.
- Combustion appliances and fuel storage systems, covered in Approved Document J.
- Protection from falling, collision and impact, covered in Approved Document K.
- Conservation of fuel and power, covered in Approved Document L.
- Access to and use of buildings, covered in Approved Document M.
- Electrical safety, covered in Approved Document P.
- Security in dwellings, covered in Approved Document Q.
- High-speed electronic communication networks, covered in Approved Document R.
- Materials and workmanship, covered in Approved Document 7.

B2 Alternative methods of achieving compliance

Methods of demonstrating compliance with building regulations for a variety of different project types, to include:

- British Standards
- European Standards
- NHBC Standards
- competent person/self-certification schemes.

Learning aim C: Undertake a building regulations application

C1 Types of application

The type of work for which each application is used and the conditions of application and expiration.

- Full plans.
- Building notice.

C2 Preparing a building notice application

Learners need to be able to make a building notice application for a given scenario, including all the relevant documentation as stipulated in the building regulations.

- Statement of application.
- Description of the proposed works.
- Location of the building.
- Current and intended use of the building.
- For schemes with an extension or addition to the building:
    - details to show the size of the extension and the relationship to the adjoining boundaries
    - the boundaries of the existing curtilage, and the positon and size of other buildings within the curtilage
    - location of the property in relation to the surrounding streets
    - a statement specifying the number of storeys
    - provisions made for drainage.
- Use of fee schedules to determine the correct fee for the application.

C3 Preparing a full plans application

Learners need to be able to make a full plans application for a given scenario, including all the relevant documentation as stipulated in the building regulations.

- Statement of application.
- Copies of the plans (multiple copies as specified by the regulating authority).
- Description of the proposed works.
- All other associated plans required to show compliance with the building regulations (which will include):
    - details to show the size of the extension and the relationship to the adjoining boundaries
    - the boundaries of the existing curtilage, and the positon and size of other buildings within the curtilage
    - location of the property in relation to the surrounding streets
    - a statement specifying the number of storeys
    - provisions made for drainage
    - details of the works and materials
    - copies of relevant calculations and relevant supporting documentation.
- Statement in relation to Regulatory Reform (Fire Safety) Order 2005.
- Request for completion certificate.
- Determination of the appropriate fee.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand the requirements of building regulations		**A.D1** Evaluate the different methods of control for a building regulations application on a variety of project types. **B.D2** Evaluate the different methods of demonstrating compliance with building regulations on a variety of project types.
A.P1 Describe the requirements of the building regulations. **A.P2** Explain the different methods of control and implementation for building regulation applications.	**A.M1** Discuss the different methods of application and control for a building regulations application.	
Learning aim B: Examine the requirements of the building regulations		
B.P3 Describe the different methods of achieving compliance with the building regulations. **B.P4** Outline the requirements of the Approved Documents.	**B.M2** Analyse the different methods of demonstrating compliance with the building regulations.	
Learning aim C: Undertake a building regulations application		**C.D3** Analyse the documentation produced for a full plans application in relation to the requirements of the building regulations.
C.P5 Describe the method and process for a building notice application from application to completion. **C.P6** Describe the method and process for a full plans application from application to completion. **C.P7** Complete the application forms and produce outline plans for a building notice and a full plans application for a new-build residential project.	**C.M3** Produce a detailed full plans building regulations application for a new-build residential project.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, B.P3, B.P4, A.M1, B.M2, A.D1, B.D2)

Learning aim: C (C.P5, C.P6, C.P7, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to:

- a range of documents relating to the building regulations (online access optional)
- completed building regulation applications, drawings, forms and any other relevant supporting documentation.

Essential information for assessment decisions

Learning aims A and B

For distinction standard, learners will evaluate a number of different types of project (provided by the teacher) that use different methods of application and control, assessing the options for each scheme and coming to a conclusion about what they believe to be the most appropriate. Learners will validate their discussion and justify why they believe the chosen methods to be the most appropriate. If they can do so, they will demonstrate higher-level thinking, which is essential at distinction level and is more important than aligning with any preconceived thoughts held by the teacher.

For merit standard, learners will discuss in detail the different methods of application and control, considering when each method of application would be used, and when and why an applicant may choose to use an alternative method of control to that of the traditional local authority route. Their discussion will be considered and will describe the options available, without necessarily being evaluative of each one individually.

For pass standard, learners will describe the basic requirements of the building regulations and the different methods of control and implementation. They will also describe the range of methods available to demonstrate compliance and expand this specifically to take into account the Approved Documents. At this level there is no need for an in-depth analysis of each aspect, but there is a requirement to demonstrate a clear understanding of the whole process and how it works in the industry. Learners should make reference to the Building Act 1984 and to how the Building Regulations 2010 relate to this. They should discuss who is responsible for the implementation and regulation and the different ways in which the applicant can demonstrate compliance. There is no requirement to go into detail about the contents of each of the Approved Documents, but it is expected that they can name them all, as well as the broad areas they cover. Learners will select one as an example and describe in greater detail how the contents of the document will ensure compliance is achieved, for example using pertinent and succinct extracts from the Building Regulations 2010, alongside the relevant part of an Approved Document, to demonstrate a sound understanding.

Learning aim C

For distinction standard, learners will produce an analytical statement to support their application, choosing the form they feel to be most appropriate, for example a letter to the client explaining what all the various documents are, why they have produced them, and how they demonstrate compliance with the requirements of the regulations. Learners should be analytical and consider other options, and conclude why the methods selected were deemed the most appropriate.

For merit standard, learners will develop the form completed at pass level and produce the supporting documentation for a full plans application for a residential project, which should be modest in scope. Learners will produce the documents specific to the scheme, for example a new stand-alone development, or a reasonable-sized extension (at least an addition of 40% to the existing property and containing at least two storeys). Each option will present its own unique set of challenges and one is not considered easier than the other. Learners' work may tie in and support work in other modules, or be bespoke for this unit. It is acceptable to provide learners with blank plans and elevations so that they may annotate the drawings and produce the supplementary documents. Learners will provide sufficient information to be able to submit the application to the relevant body. They should clarify in the submission any assumptions made with regard to issues such as connection to the mains services.

For pass standard, learners will describe the process of making an application for both a building notice and full plans using a simple narrative or a flow chart. They will then complete an application form for a new-build residential scheme. Learners should be encouraged to obtain their own forms from the local authority in their area (typically available on the local authority website). It is expected that they include details of all the relevant supporting documents and a schedule of the key dates/stages for on-site inspection from the application stage through to final sign-off.

Links to other units

This unit links to:

- Unit 4: Construction Technology
- Unit 7: Graphical Detailing in Construction
- Unit 18: Building Information Modelling
- Unit 24: Planning Application Procedures in Construction
- Unit 25: Property Law.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 9: Management of a Construction Project

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners gain an understanding of management principles and their application to the construction industry.

Unit introduction

Managing and delivering a project to a client on time and within budget is key to modern construction. With so many variables and potential unforeseen challenges, the job of the site or project manager is interesting, demanding and exacting. A satisfactory and rewarding conclusion to a project requires them to have the techniques to plan, programme, budget and manage the workforce, as well as have the skills to control these techniques in many and varied situations.

In this unit, you will examine the techniques needed to manage a project from start to completion. You will learn about the roles and responsibilities of the construction management team, which will include planning, forecasting, organising, buying, motivating and cost control. You will carry out planning and production control techniques and apply these skills to the design of building programmes.

This unit will help you to progress to a higher-level construction programme, such as the Higher National in Construction, or to a degree in project management. Additionally, the content of this unit will support progression to careers in site or project management, or to other professional roles in construction, such as architecture, quantity surveying, building services engineering and structural engineering.

Learning aims

In this unit you will:

A Understand the principles and application of management in construction

B Understand purchasing and cost management techniques

C Develop a programme of activities for construction works.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the principles and application of management in construction	**A1** Principles of management **A2** Application of construction management techniques	A report about the management systems in use in the construction company.
B Understand purchasing and cost management techniques	**B1** Application of purchasing methods **B2** Cost management techniques	A training pack for trainee site managers joining a large national housing contractor.
C Develop a programme of activities for construction works	**C1** Production control systems	A presentation in which learners consider the methods used to plan and control a programme of work for a housing development.

Content

Learning aim A: Understand the principles and application of management in construction

A1 Principles of management

Management principles and their application by the management team in the construction of low- to medium-rise buildings.

- Management style, methods and theories, to include Fayol, Maslow, McGregor.
- The roles, responsibilities and interaction of a construction project management team, to include the architect, quantity surveyor, construction manager, project manager, structural engineer, services engineer, site manager, buyer, planner.
- Planning and forecasting a project's needs, requirements and resources.
- On-site, short-term management for projects in progress:
  - pre-construction
  - site preparation
  - construction phase
  - handover.
- Claiming interim payments.
- Managing cash flow.
- Order and delivery of materials.
- Labour requirements.
- Training needs.
- Plant requirements.
- Quality assurance and control.
- Workforce supervision.
- Health and safety requirements.
- Decision making.
- Managing unforeseen events.
- Handover schedule.
- Completion.
- Managing the organisation's viable options:
  - national and local government policies, trends
  - labour requirements, recruitment, investment in skills and training
  - subcontract or direct employment
  - site management structure:
    - fully site based
    - head office based functions and support
  - plant and equipment hire, lease or purchase.
- Organising, procuring, co-ordinating and controlling:
  - materials, plant and equipment delivered to site on time
  - site storage facilities
  - site distribution methods
  - workforce requirements.
- Motivating the workforce:
  - incentives, including bonus payments
  - awards and rewards
  - job security, including contract renewal
  - training.

- Communication with the design and management team, the workforce, suppliers:
  - chains of command and management structures
  - team and site meetings
  - written forms of communication, their use and appropriateness, to include letters, architect’s instructions, site instructions
  - telecommunications, to include telephones, mobiles and site radios
  - graphical and electronic forms of communication, e.g. emails, texts, instant messaging
  - information technologies, to include building information modelling (BIM).

A2 Application of construction management techniques

Site management responsibilities and the techniques used to manage a project/site to ensure an efficient build from commencement to completion, on programme and to budget.

- Standard planning techniques and how these are applied to control work on site:
  - production and use of master programmes
  - production and use of progress monitoring techniques:
    - Gantt charts, Critical Path Analysis, Line of Balance charts
  - production of daily activity sheets
  - production of site layout plan, to include access/exit points, materials storage, crane locations, site accommodation, temporary services, temporary site roads and hard standings
  - production and monitoring of delivery schedules
  - production of method statements and risk assessments for the various phases of construction work.
- The application of quality assurance and quality-control requirements:
  - document control
  - drawing registers
  - use of the specification
  - site testing
  - offsite testing
  - site inspection
  - dimensional quality control.
- Compliance with statutory liaison, building regulations, project materials specification requirements:
  - building regulation notices and inspection
  - National House Building Council (NHBC) inspections and standards.
- Application of on-site sampling and material testing techniques.
- Supervision and inspection of the quality of outcomes produced by the workforce.
- Management of direct workforce:
  - recruitment, training, competence requirements, including Construction Skills Certification Scheme (CSCS) requirements
  - monitoring of equal opportunities
  - leadership skills, including how to motivate individual and group members, creating productive team behaviours.
- Management of subcontractors:
  - communication methods, to include language use to instruct, persuade, motivate, discipline
  - checking of insurance and legal requirements and responsibility for compliance
  - retention of payment practice and its use
  - production of snagging lists of remedial works required.

Learning aim B: Understand purchasing and cost management techniques

B1 Application of purchasing methods

Use and application of purchasing techniques to facilitate the effective supply of materials to construction projects and the benefits and drawbacks of their use.

- List of selected suppliers:
  - area of operations
  - previous performance
  - capacity to supply
  - reputation of supplier
  - stock levels
  - ability to meet changes in demand.
- Materials and subcontract enquiries:
  - number of quotations required
  - scheduling materials or extracts from bills of quantities
  - use of correct or appropriate specifications
  - receipt of and checking quotations
  - gap analysis
  - negotiating skills.
- Planning links:
  - purchasing materials to meet the requirements of the construction programme
  - items with long lead times that might impact on construction planning
  - just-in-time deliveries to programme requirements when site storage is limited.
- Ethical purchasing and supply:
  - purchasing policy
  - sustainable and local sourcing
  - minimising transportation
  - use of sustainable materials
  - fair trade agreements
  - abuse of power
  - avoidance of corruption
  - social responsibility.
- Purchase orders:
  - terms and conditions
  - discounts
  - timing of orders
  - clarity of content.
- Benefits and drawbacks of serial and term contracts:
  - annual supply contracts
  - multiple project contracts
  - serial contracts.

B2 Cost management techniques

Recognition and knowledge of cost management techniques applied during a building project and an appreciation of how these assist the manager to plan and manage the budget.

- Analysis of interim claims, to include:
  - preliminary items
  - measured work by trade or element breakdown
  - nominated subcontract values
  - materials on site.

- Cost value comparisons, to include:
  - costs from management information systems
  - monthly valuations reconciled with project costs
  - profit and loss projections
  - cash flow forecasts.
- Managing costs:
  - selection and application of techniques available to break down, itemise and control the project cost, to include:
    - unit costing
    - element costing
    - marginal costing
    - variance analysis
  - selection and use of techniques to enable prices and budgets to be prepared and compared, to include:
    - estimated costs
    - variable costs
    - target costs
    - actual costs
  - identifying cost savings, to include:
    - labour
    - plant
    - materials
    - site set-up
    - site management structure
    - methodologies
    - programme acceleration or deceleration.
- Preparing and examining elemental and project comparison costs.

Learning aim C: Develop a programme of activities for construction works

C1 Production control systems

Understand the need, and techniques, to plan and control a project on site, both in terms of physical and financial progress, and to be able to communicate this information to site and management teams.

- Production of programmes of activities:
  - planning project organisation, to include:
    - method statements
    - site layout
    - site accommodation and storage
    - waste management
    - site traffic management
  - use of Gantt charts, bar charts, linked bar charts to show and monitor progress of the construction project
  - use of Critical Path Analysis, network analysis, Line of Balance, precedence diagrams, time change diagrams to show and monitor progress of the construction project:
    - manual and computer-based techniques on site.
- Measurement of progress:
  - physical progress on site, to include:
    - regular comparison of planned progress of work on site with actual progress
    - methods to overcome the consequences of running ahead or behind project schedule
    - causes and effects of delays, the consequences of rescheduling, implementing overtime payments, extensions of time applications
  - preparation of financial progress information, to include:
    - site returns
    - interim valuations and payments
    - claims and variations
    - reviewing events, predicted and unforeseen.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand the principles and application of management in construction		**A.D1** Evaluate the different roles of the construction management team, their responsibilities and the techniques applied by a site manager to manage the project.
A.P1 Explain the roles of the members of the construction management team and their individual responsibilities. **A.P2** Explain the techniques applied by a site manager to manage the project.	**A.M1** Discuss the roles of the members of the construction management team and how their individual responsibilities are applied. **A.M2** Discuss the techniques applied by a site manager to manage the project.	
Learning aim B: Understand purchasing and cost management techniques		**B.D2** Evaluate the methods used to facilitate the ethical supply of appropriate materials to site, meeting programme requirements, and how these impact on the cost management and profitability of construction projects.
B.P3 Explain the methods used by construction companies to facilitate the supply of appropriate materials to site. **B.P4** Explain the cost management techniques used to monitor and control the cost and profitability of construction projects.	**B.M3** Assess the methods used to facilitate the cost-effective supply of appropriate materials to site. **B.M4** Analyse the cost management techniques used to effectively monitor and control the cost and profitability of construction projects.	
Learning aim C: Develop a programme of activities for construction works		**C.D3** Produce a comprehensive programme of activities, with graphical representations and highly detailed timings that show critical and non-critical elements for a given construction project, and consider the most appropriate method to monitor progress.
C.P5 Produce a programme of activities with graphical representations for a given construction project. **C.P6** Explain the methods used to monitor the progress of construction projects.	**C.M5** Produce a detailed programme of activities, with graphical representations and appropriately detailed timings for a given construction project, and consider an appropriate method to monitor progress.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.M2, A.D1)

Learning aim: B (B.P3, B.P4, B.M3, B.M4, B.D2)

Learning aim: C (C.P5, C.P6, C.M5, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners would benefit from access to project management planning software and case studies of real-world construction projects, of varying size and scope.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate the construction management team roles and responsibilities. They will demonstrate a thorough understanding of how the manager will plan, interact, communicate and motivate within their team and with the production workforce and subcontractors, and how their individual responsibilities are applied and impact on the successful construction of a building.

For merit standard, learners will discuss the different roles of the management team and how their individual responsibilities are applied in the planning and running of a building project. They will also discuss the techniques applied by a site manager to manage the project and coordinate the workforce, including the subcontractors, on site. They will consider the different aspects of site management, how they interrelate and the extent to which they are important.

For pass standard, learners will explain the roles and responsibilities of the members of the construction management team, including the roles relevant to the project scenario and their duties and involvement in the planning and implementation of a building project. They must describe the techniques applied to manage the project, including the supervision of the workforce and the subcontractors, as well as the coordination of their activities on site. In explaining, learners will demonstrate that they understand the functions and objectives of construction management techniques and their suitability for the given scenario.

Learning aim B

For distinction standard, learners will evaluate the methods used to facilitate the ethical supply of appropriate materials to site, meeting programme requirements, and how these impact on the cost management and profitability of construction projects. In doing so, they will consider the different aspects of the purchasing function and the cost management techniques used to monitor and control construction costs. When evaluating, learners will draw on their knowledge of purchasing and cost-control methodologies, as well as the concepts and principles applied to the scenario, considering their strengths and weaknesses, their interrelation, relevance or significance, leading to a justified conclusion.

For merit standard, learners will assess the methods used to facilitate the cost-effective supply of appropriate materials to site. They will analyse the cost management techniques used to effectively monitor and control the cost and profitability of construction projects. When discussing, learners will consider the different aspects of purchasing and cost control, their techniques and methodologies, how they interrelate, and the extent to which they are important.

For pass standard, learners will explain the methods used by construction companies to facilitate the supply of appropriate materials to site. They will also explain the cost management techniques used to monitor and control the cost and profitability of construction projects. In explaining, learners will demonstrate that they understand the functions and objectives of purchasing and cost-control techniques and their suitability for the given scenario.

Learning aim C

For distinction standard, learners will produce a comprehensive programme of activities, with graphical representations and highly detailed timings that show critical and non-critical elements for a given construction project. Learners will consider the most appropriate method to monitor progress and the shortest route to completion, with the placement of non-critical elements based on the identified float. The programme will be in an appropriate format with the correct sequence of activities and attention to detail. Learners will clearly explain the appropriate methods for monitoring progress on site.

For merit standard, learners will produce a detailed programme of activities, with graphical representations and appropriately detailed timings for a given construction project, and consider an appropriate method to monitor progress. Learners will clearly explain the appropriate methods for monitoring progress on site.

For pass standard, learners will produce a programme of activities with graphical representations for a given construction project. The programme will use one of the techniques noted in the specification. They will explain the methods used to monitor the progress of construction projects. In explaining, learners will demonstrate that they understand the functions and objectives of progress monitoring and the suitability of the methods for the given scenario.

Links to other units

This unit links to:

- Unit 4: Construction Technology
- Unit 5: Health and Safety in Construction
- Unit 6: Surveying in Construction
- Unit 8: Building Regulations and Control in Construction
- Unit 9: Management of a Construction Project
- Unit 11: Site Engineering for Construction
- Unit 19: Quantity Surveying.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers from specialist construction project management organisations
- participation in audience assessment of presentations
- design/ideas to contribute to unit assignment/case study/project materials
- work experience
- employer’s business materials as exemplars
- support from local business staff as mentors.

Unit 10: Building Surveying in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners develop the skills needed to survey existing buildings, establish current condition and size, and enable detailed survey reports/plans that highlight defects and identify potential issues.

Unit introduction

If something goes wrong with a building, how do you know what the problem is and how to fix it? A building surveyor carries out surveys on existing properties and advises the owners on how to repair, alter or extend the building to meet new needs.

In this unit, you will learn how to carry out a buildings survey, identify defects and record findings in a format suitable for a range of end users. You will gain a good understanding of building defects, their causes and the remedies available. You will learn how to undertake a measured survey of an existing property to produce scale plans and elevations of the building.

The skills in this unit are essential for employment as a building surveyor, and other related construction roles in a range of areas such as construction management, site supervision, quantity surveying and architecture. This unit will give you a good foundation for studying construction-related subjects at a higher level, including degree-level programmes.

Learning aims

In this unit you will:

A Understand the impact of the methods used to construct existing buildings on current and future maintenance requirements

B Explore different defects and methods of repair for low-rise residential properties

C Undertake a building survey of a low-rise residential property.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the impact of the methods used to construct existing buildings on current and future maintenance requirements	**A1** Different styles and types of residential property **A2** Traditional methods of construction **A3** Modern methods of construction	Illustrated report or presentation and information booklet on different types and styles of residential properties, their common defects and methods of repair.
B Explore different defects and methods of repair for low-rise residential properties	**B1** Defects to the external envelope **B2** Internal defects **B3** Methods of repair and remediation	Building and measured survey of a low-rise residential property. Production of survey report detailing the condition, defects, remedial works, plans and elevations.
C Undertake a building survey of a low-rise residential property	**C1** Types of survey **C2** Undertaking a building survey **C3** Undertaking measured surveys **C4** Skills, knowledge and behaviours	

Content

Learning aim A: Understand the impact of the methods used to construct existing buildings on current and future maintenance requirements

Different methods of construction, styles and periods of architecture.

A1 Different styles and types of residential property

The features and details of residential property types, periods and styles to inform maintenance requirements and remedial works.

- Types of property:
  - detached, semi-detached, terraced, end-terraced, bungalow, flat, duplex, maisonette, cottage, mansion, manor house, 'prefab'.
- Key periods and architectural styles of residential property:
  - Tudor, Elizabethan, Georgian, Victorian
  - pre-war (1900 to 1939), post-war (1945 to 1960)
  - modern, postmodern, contemporary.

A2 Traditional methods of construction

Recognition and knowledge of construction technologies found in low-rise residential properties and how material evolution and advancement impact on construction to facilitate decisions related to maintenance required and remedial works.

- Foundations:
  - strip foundations
  - raft foundations
  - spreader foundations/corbelled brickwork/masonry foundations
  - timber piles.
- Walls:
  - solid:
    - stone, brick, block
  - cavity:
    - brick and block, brick and brick, stone and block/brick, block/brick and metal cladding
  - framed:
    - cruck frame, box frame, post and beam, storey height panels.
- Roofs:
  - pitched, mono-pitched, mansard, dormer
    - traditional timber, timber truss, metal truss
    - slate, stone, clay tiles, thatch, metal sheet
  - flat:
    - timber, metal deck, concrete
    - lead, felt, asphalt.
- Floors:
  - concrete/ground-bearing slab
  - suspended timber (ground floor and upper floors).
- Internal walls:
  - concrete block
  - timber stud
  - solid plaster and plaster and lath finishes.
- Doors and windows:
  - timber, metal, single glazing, secondary glazing, leaded lights.

A3 Modern methods of construction

Recognition and knowledge of construction technologies found in low-rise residential properties and how material evolution and advancement impacts on construction to facilitate decisions related to maintenance required and remedial works.

- Foundations:
  - strip
  - trench fill
  - raft
  - short bored pile.
- Walls:
  - solid
    - thermal blocks, external insulation, internal insulation, external finishes (render, cladding)
    - rainscreen cladding
  - cavity:
    - brick and thermal block, block and block, insulated cavities, internal insulation, internal finishes (plaster, dry lining), external insulations, external finishes (render, cladding)
  - framed:
    - storey height panels, structured insulated panels (SIPs)
    - timber frame construction, platform frames
  - insulation.
- Roofs:
  - pitched and mono-pitched:
    - timber truss, metal truss, SIPs
    - slate, stone, clay tiles, thatch, metal sheet, green roof, polycarbonate, glass
  - flat:
    - timber, metal, concrete
    - felt, single ply membrane, Green Roof Professional (GRP)
  - insulation.
- Floors:
  - concrete:
    - ground-bearing slab, suspended concrete, insulation, screeds
  - suspended timber:
    - solid timber, engineered joists
  - insulation.
- Internal walls:
  - metal stud
  - timber stud
  - board and skim finishes.
- Doors and windows:
  - timber, PVCu, thermally broken metal, composite frames, composite doors, double and triple glazing, thermal coatings and gases.

Learning aim B: Explore different defects and methods of repair for low-rise residential properties

Consideration of the defects to the key elements of a building, focusing on those most commonly noted in the building survey.

B1 Defects to the external envelope

Recognition and knowledge of external building defects to facilitate decisions related to maintenance required and remedial works.

- Foundation defects:
  - settlement:
    - seasonal movement (frost, heave), mining, compression of substrata, landfill, trees
  - sulphate attack
  - overloading
  - bad design/poor construction methods.
- Wall defects:
  - bowing/bulging:
    - poor construction detailing, wall tie failure, lack of lateral support, overloading, roof thrust, alterations and changes to original structure
  - failure of arches, lintels, embedded timbers and structural elements
  - expansion of embedded steel and iron fixings
  - surface failure
    - frost, efflorescence, cracking, sulphate attach, poor specification, bad workmanship/detailing, failed pointing, incorrect pointing mixes, material failure, water ingress.
- Chimney defects:
  - tall and thin stacks with no support, failure of the internal structure, freeze thaw, sulphate attack, water ingress.
- Roof defects:
  - structural failure:
    - poor construction/detailing, lack of ties, lack of lateral restraint, change of covering, water ingress, alterations, rot/insect attack of timber, flashings (missing, sand : cement), no ventilation
  - covering failure:
    - poor construction, corrosion of mechanical fixings, delamination, efflorescence, pointing corrosion, thermal expansion, frost damage.
- Door and window defects:
  - rotten timber, putty failure, fixing failure, failure of hinges and handles, rusting to steel and iron fixings, swelling and poor operation.
- Failure of decoration.

B2 Internal defects

Recognition and knowledge of internal building defects to facilitate decisions related to maintenance required and remedial works.

- Ground floor:
  - concrete:
    - sulphate attack, membrane failure, damp ingress, poor detailing/construction, settlement, heave, screed failure, excessive spans for pre-cast
  - timber:
    - poor construction and detailing, lack of ventilation, damp ingress, excessive spans, lack of support/strutting, insect attack, fungal attack, joist ends built in with no DPC.
- Upper floors and ceilings:
  - floors:
    - poor construction and detailing, lack of support to the joist ends, lack of support and strutting causing sagging, alterations and service holes/notches, overloading, insect and fungal attack, joist ends built in with no DPC, failure of mechanical fixings

  - ceilings:
    - poor construction and detailing, failure of fixings to plaster laths or boards causing debonding of surface finish, water leaks causing stains.
- Walls:
  - masonry:
    - overloading, alterations, poor detailing and construction, damp (rising and penetrating), lack of lateral support, lack of support below
  - timber:
    - overloading, alterations, poor detailing and construction, damp, lack of lateral support, lack of support below, lack of strutting, insect and fungal attack, service holes and notches.
- Stairs:
  - overloading, insect and fungal attack, poor detailing and design, loose spindles and handrails, loose tread and risers.
- Decoration:
  - damp staining, wallpaper peeling, paint finish imperfections.

B3 Methods of repair and remediation

Determining appropriate repairs from which options are selected.

- Repair:
  - minimal intervention to affected area only
  - repairs to the obvious damage but not necessarily the root cause (stitching cracks, sealing damp areas, redecoration to cover defects).
- Methods of repair for common defects:
  - damp, cracking, insect and fungal infestation.
- Replace/renew:
  - extensive repairing option to remove root cause and makes good to wider area
  - underpinning
  - taking down and rebuilding
  - complete removal of damaged area, rebuilding with new materials, e.g. structural timbers.

Learning aim C: Undertake a building survey of a low-rise residential property

Understanding of different survey types, their use and application, and the actual process of undertaking a survey.

C1 Types of survey

Survey types, purpose, essential content and use.

- Building survey.
- RICS Level 1 Condition Report.
- RICS Level 2 HomeBuyer Report.
- RICS Level 3 Building Survey.
- Mortgage valuation.
- Schedule of Dilapidations (Landlord and Tenant).
- Schedule of Condition (Landlord and Tenant).
- Maintenance survey.
- Alteration survey.
- Stock condition survey.
- Mortgage drawdown.
- Access audits.
- Elemental survey.
- Insurance reinstatement survey.
- Defect analysis survey.
- Health and safety survey.
- Measured survey.

C2 Undertaking a building survey

Surveying a building and recording findings to produce a building survey report.

- Pre-survey protocol:
  - confirmation of instruction, access arrangements, health and safety considerations.
- Property inspection requirements:
  - inspection of the building's main elements (walls, roof, floors, doors and windows)
  - recording inspection findings – element condition, defects
  - photographic record requirements, e.g. of the property, defects
  - measurement of defects, e.g. levels of damp, width of cracks, distance of deflection or movement.
- Survey report requirements and completion: general description of the property, details of condition and specific defects, photographic record of condition and defects.

C3 Undertaking measured surveys

Measured survey requirements to produce survey drawings.

- Pre-survey protocol:
  - confirmation of instruction, access arrangements, health and safety considerations.
- Property inspection requirements:
  - sketching the layout of floor plans and elevations
  - measurements and recording requirements to produce floor plans and elevations.
- Survey drawings:
  - production of scale plans
  - production of elevations.

C4 Skills, knowledge and behaviours

Demonstrate behaviour and its impact on outcomes, to include professionalism, etiquette, working to deadlines, accountability and individual responsibility.

- Evaluating outcomes to help inform high-quality, justified recommendations and decisions.
- Media and communication skills, including:
  - the ability to convey intended meaning, e.g. written (design documentation, recording documentation, reports, visual aids for presentation use), verbal communication requirements (one to one and group, informal and formal situations)
  - use of tone and language for verbal and written communications to convey intended meaning and make a positive and constructive impact on audience, e.g. positive and engaging tone, technical/vocational language suitable for intended audience.

Assessment criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">Learning aim A: Understand the impact of the methods used to construct existing buildings on current and future maintenance requirements</td><td rowspan="2">A.D1 Evaluate the different residential housing styles and types and how their construction methods are applied and their impact on the current and future requirements for repair and remedial work.</td></tr>
<tr><td>A.P1 Describe the different styles and types of residential housing.
A.P2 Describe the different methods of traditional and modern construction used for residential housing and their impact on current and future repair and remedial work.</td><td>A.M1 Discuss the different residential housing styles and types and how their construction methods are applied and their impact on the current and future requirements for repair and remedial work.</td></tr>
<tr><td colspan="2">Learning aim B: Explore different defects and methods of repair for low-rise residential properties</td><td rowspan="4">BC.D2 Evaluate the repair and remedial work options for the defects identified in the building survey.
BC.D3 Demonstrate individual responsibility, creativity and self-management when preparing for and undertaking the building survey and producing the survey report and drawings.</td></tr>
<tr><td>B.P3 Describe a range of external and internal defects commonly occurring in residential properties.
B.P4 Explain different methods of repair and remediation to a range of internal and external defects of a residential property.</td><td>B.M2 Discuss appropriate repair and remedial measures for a range of external and internal defects for a residential property.</td></tr>
<tr><td colspan="2">Learning aim C: Undertake a building survey of a low-rise residential property</td></tr>
<tr><td>C.P5 Perform a building survey, detailing the condition and defects with required remedial works for a residential property.
C.P6 Record the findings of the survey in a survey report.
C.P7 Perform a measured survey on a residential property.
C.P8 Produce accurate scale plans and elevations for a residential property to standard conventions.</td><td>C.M3 Produce a comprehensive and detailed building survey, detailing the condition, defects and remedial works required, with plans and elevations for a residential property.</td></tr>
</table>

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aims: B and C (B.P3, B.P4, C.P5, C.P6, C.P7, C.P8, B.M2, C.M3, BC.D2, BC.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must:

- have access to a suitable property to undertake a building survey and a measured survey (ideally of typical residential scale)
- be supervised during the survey
- have measures in place to ensure health and safety, including the provision of appropriate safety briefings and the use of appropriate safety equipment.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate the evolution and development of residential housing types and styles, methods of construction and the impact on the current and future requirements for repair and remedial work. Learners will demonstrate a thorough understanding of the changes in design and style and how different methods of construction have contributed to these changes. They will demonstrate how material evolution and advancement has allowed for changes in style. For example, learners can demonstrate how, through the use of engineered joists, layouts in modern houses do not need as many supporting walls. Similarly, they can explain how developments in concrete technology in the 1960s saw an increase in concrete structures, even on a domestic scale, and show how a lack of understanding led to problems with damp and condensation. Information will be well researched and presented in a clear and coherent manner for the intended audience, with clearly described examples and annotated visual elements.

For merit standard, learners will discuss the evolution and development of housing types, styles and construction methods and the impact on the current and future requirements for repair and remedial work. They may not necessarily make the links between changing styles and material development but will consider how different techniques can allow for different designs and styles. Learners' work will be clear and provide sufficient detail as to construction methods and how the elements fit together. Information will be technically correct and at an appropriate level for the intended audience.

For pass standard, learners will describe the different methods and styles of housing used in traditional and modern methods of construction and the impact on the current and future requirements for repair and remedial work. They will be technically accurate but will not make links between different styles and changes in materials. Learners will consider the three different architectural styles, and traditional and modern construction methods, and will demonstrate a good understanding of them.

Learning aims B and C

For distinction standard, learners will demonstrate a high level of technical knowledge, autonomy and self-reliance. They will also demonstrate a high level of skill in inspecting an existing property, recording the condition and analysing the defects found. They will develop a detailed schedule for the repair and remediation of the defects noted. This will typically be located in the recommendations section of the report they produce. The report will be to a very high standard, technically accurate and will contain very few errors or omissions.

Learners will take individual responsibility for their own work, for example identifying potential issues and resolving them, reviewing their work and making improvements, and keeping their work safe and secure. They will show their creativity, for example through taking modern approaches to the solving of building defects. Learners will refer to tangible evidence, such as survey records, to support their evaluation.

For merit standard, learners will produce a detailed, illustrated survey report in a standard format that identifies the condition of the property and the defects. The report must contain at least the same level of detail as a Level 2 survey type. During the survey, learners will exhibit awareness for health and safety and produce a detailed record of field observations.

For pass standard, learners will undertake a building and measured survey, and produce a survey report and a set of plans and elevations using standard formats and conventions. The report will be limited in detail but will record the condition of the property and identify the defects. They will show gaps in knowledge and the report may not contain appropriately annotated photographs. Field observations can be limited and another surveyor may struggle to use them. Learners will act in a timely fashion and will undertake the survey and produce the report in accordance with agreed timescales.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 5: Health and Safety in Construction
- Unit 6: Surveying in Construction
- Unit 7: Graphical Detailing in Construction.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers
- ideas to contribute to unit delivery and assignments
- work experience in the construction settings where building surveying knowledge and skills are used.

Unit 11: Site Engineering for Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners undertake site engineering processes used to set out construction and built environment projects.

Unit introduction

The skills required for setting out construction and civil engineering works involves a high degree of accuracy. This is essential in meeting the tolerances of the elements that form the substructure and the superstructure so that the building, and its components, fit into position correctly. For example, the specification for the installation of roads is often in terms of +/− 3 mm in level. Also, as a site engineer, you will need to be able to read dimensions from drawings provided by the designer and produce calculations to assist in setting out the work. Building modern city landscapes requires the ability to control the verticality of multi-storey buildings to a high degree of accuracy from storey to storey.

In this unit, you will use a range of surveying equipment to set out construction work, including string lines, pegs and global positioning system (GPS) total stations to ensure that the completed structure meets the designer's specification in terms of appearance and accurate positioning.

This unit gives you the opportunity to progress to site-management, project-management and supervision roles in the construction sector as a site manager or site engineer, or to progress to specialist civil engineering qualifications such as Higher Nationals in civil engineering and degrees in construction and civil engineering specialisms.

Learning aims

In this unit, you will:

A Undertake the setting out of construction work on plan

B Undertake the setting out of infrastructure works

C Explore how to maintain horizontal and vertical control in setting out.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Undertake the setting out of construction work on plan	**A1** Setting-out terminology **A2** Basic setting-out processes **A3** Interpreting drawn information to set out construction work **A4** Site engineering equipment	A case study scenario where learners have to acquire all the information, equipment and data for a setting-out project. They will produce a method statement detailing all requirements, then set out a building on plan.
B Undertake the setting out of infrastructure works	**B1** Setting out drainage **B2** Setting out embankment and cutting profiles **B3** Interpreting drawn information to set out roads	Fieldwork practical tasks to defined levels of accuracy. Learners will evaluate methodologies used in undertaking a series of practical setting-out tasks.
C Explore how to maintain horizontal and vertical control in setting out	**C1** Vertical and horizontal control of structures **C2** Vertical and horizontal control of excavation	

Content

Learning aim A: Undertake the setting out of construction work on plan

A1 Setting-out terminology

Setting-out terminology use and its application to associated equipment and methods.

- Base line as the starting point used to offset the grid lines on plan.
- Corner pegs are used to indicate the corner points of structures.
- Profile boards are used to indicate the inside, outside and centre lines of walls and indicate levels for depth and height control.
- A traveller is used between profile boards to indicate the extent of reduced-level excavation.
- The centre line follows a midpoint between the inside and the outside face of a wall.
- Coordinates are indicated by northings and eastings using GPS, polar or Cartesian systems.
- Grids are square arrangements of intersecting lines.
- String lines are drawn between two points to denote a grid, building element face or centre line.
- Diagonal measurement is taken across two opposing corners to confirm accuracy of setting out squares and rectangles.
- Offset measurement is taken perpendicular from a base line.

A2 Basic setting-out processes

Application of techniques used to establish basic setting-out points in the field.

- Construction of a right angle using the following methods:
  - Pythagoras' theorem
  - builder's square
  - optical square
  - base line and scribing equal arcs
  - theodolite
  - coordinates from a total station
  - calculation of diagonal from two sides
  - the three, four, five technique.
- Transferral of bench mark to establish a temporary bench mark (TBM) on site:
  - sourcing a bench mark
  - digital information reference to drawings and design levels
  - methods of recording on site and protecting TBM
  - use of storey tapes for vertical heights.

A3 Interpreting drawn information to set out construction work

Fieldwork in setting out buildings on plan for initial excavation and for external wall positions.

- Setting out buildings for initial excavation to reduced level of foundations:
  - interpretation of drawings for setting-out information and dimensions on site
  - square or rectangular shapes containing voids on plan for excavation using corner pegs to indicate centre of foundation trench.
- Setting out buildings for outlines of external walls:
  - the use of profile boards for a building's external walls, centre line, foundations and position of cavity.

A4 Site engineering equipment

- How and when traditional setting-out tools and equipment are used:
  - pegs, to include basic pegs, string lines, nails, saw cuts
  - tools, to include sledgehammer, claw hammer, lump hammer, saw
  - profile rails and boards, including use of saw cuts and pins
  - road pins and tape
  - markers, to include marker spray, paint, sand, lime
  - measuring, to include tape measures, steel and fibre, retractable steel tape measure
  - optical surveying equipment, to include level, tripod, theodolites, staff.
- How to use and the benefits of digital technology, to include:
  - total station with GPS
  - equipment using laser levelling
  - laser measuring devices.

Learning aim B: Undertake the setting out of infrastructure works

The use and application of methods employed in the field to set out the following types of construction and civil engineering work.

B1 Setting out drainage

- Calculating the gradient from invert levels taken from design drawings.
- Transferring TBM to drainage position on site.
- Positioning manholes.
- Calculating heights of profile rails.
- Setting up profile boards.
- Establishing profile rails and highlighting with spray paint.
- Calculating the length of traveller.
- Constructing traveller.
- Positioning cover level indicators.

B2 Setting out embankment and cutting profiles

- Positioning base of embankment on plan, using pegs.
- Calculating embankment gradient from road levels and ground levels.
- Positioning profile sight rails to gradient.
- Checking that rails are parallel.
- Calculating drainage ditch profile.
- Positioning profile.

B3 Interpreting drawn information to set out roads

- Establishing road curve points and all data from road design drawings.
- Selecting and applying the following methods to set out curves based on given information:
  - using the chord point method, how to:
    - establish intersection points
    - establish tangent points
    - calculate the deflection angle, radius of curvature, centre of curvature
    - establish setting-out data for a number of points on the curve
    - set out road kerb curve using pins
  - using the deflection angle method, how to:
    - establish deflection angle
    - establish tangent angles
    - establish chord lengths
    - set up theodolite over starting point
    - establish each tangential point by deflection angle and chord length.

Learning aim C: Explore how to maintain horizontal and vertical control in setting out

C1 Vertical and horizontal control of structures

Techniques used and their application to control vertical structures maintaining tolerances in accordance with specifications.

- Concrete works, to include:
  - positioning of kickers for in-situ concrete columns
  - checking verticality of column shuttering in two directions
  - confirming within tolerances
  - checking squareness and diagonals of shuttering profile on plan
  - checking cover to reinforcement.
- Structural steel works:
  - positioning holding down bolt boxes in line with grid
  - checking verticality of steel columns in two directions
  - confirming within tolerances
  - checking columns' profile lines in the grid.

C2 Vertical and horizontal control of excavation

Application of techniques to record data before setting out of construction work for secondary purposes.

- Establishing and recording a grid of ground levels before excavation, to include:
  - setting out a grid over the area of the excavation
  - taking flying levels over the area
  - plotting grid of levels to reduced level.
- Interim and final grid of levels from reduced excavation to establish volumes, to include:
  - setting out a grid over the area of the excavation
  - taking flying levels over the area
  - plotting grid of levels to excavation level
  - calculating of the formation level achieved and confirmation of depth
  - providing records for quantity surveying applications.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Undertake the setting out of construction work on plan		
A.P1 Explain the setting-out procedures using traditional tools, equipment and processes to a given level of accuracy. **A.P2** Perform setting out a structure to define the centre line, and the external and internal faces of the enclosing wall to a given tolerance.	**A.M1** Discuss the selection of setting-out tools, equipment and processes for the accurate setting out of a given structure.	**A.D1** Justify the selection of setting-out tools, equipment and processes for the accurate setting out of a given structure.
Learning aim B: Undertake the setting out of infrastructure works		
B.P3 Perform setting out a drainage run to given tolerances. **B.P4** Perform setting out the position of an embankment, cutting and profiles. **B.P5** Perform setting out a complex road curve using appropriate methods.	**B.M2** Analyse the setting-out methodologies used to accurately set out infrastructure works.	**B.D2** Evaluate the setting-out methodologies used to accurately set out infrastructure works. **C.D3** Evaluate the methods used to achieve accurate setting out and excavated volume calculation.
Learning aim C: Explore how to maintain horizontal and vertical control in setting out		
C.P6 Produce a pre-excavation survey grid in a drawn format and calculate volumes. **C.P7** Calculate the volumes of excavation using an appropriate method. **C.P8** Explain how accuracy is achieved in setting out vertical and horizontal elements.	**C.M3** Discuss the methods used to achieve accurate setting out and excavated volume calculation.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aims: B and C (B.P3, B.P4, B.P5, C.P6, C.P7, C.P8, B.M2, C.M3, B.D2, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to a range of setting-out equipment to meet the needs of the practical assessment. This can be achieved using (traditional) optical equipment or digital technologies. One option could be to hire a total station, which would be an efficient way to allow learners to understand setting out from an uploaded computer-aided design (CAD) file. A suitable location that is safe to use for setting-out purposes will need to be established.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will justify the equipment used for specific setting-out tasks. This must be in terms of the accuracy that has to be achieved. Their justification will cover a range of setting-out equipment, tools and processes, and they will give reasons to support and confirm the appropriate methodologies used. Learners will perform the setting out of a structure and will refer to this during their justification.

For merit standard, learners will discuss the equipment used for specific setting-out tasks. This must be in terms of the accuracy that has to be achieved. Their discussion must cover a range of setting-out equipment, tools and processes, and they will consider the importance of elements of the process and how they interrelate. Learners will perform the setting out of a structure and will refer to this during their discussions.

For pass standard, learners will produce a report for the setting out of a rectangular structure to a given level of accuracy. Their setting out must include the positioning of profile boards or rails. The level of accuracy should reflect the application, for example excavation or external wall construction. Learners will set out a building or structure that includes profile boards or rails and establishes three grid lines. These will be completed to a given tolerance. Learners will explain the setting-out procedures, equipment and methodologies adopted to produce work to a given level of accuracy.

Learning aims B and C

For distinction standard, learners will evaluate the methods used to achieve accuracy in the setting out of infrastructure works, including horizontal and vertical elements and the production of a pre-excavation survey grid. They will complete the setting out of a drainage run, an embankment and a complex road curve that includes calculating the theoretical distances and angles using trigonometry, which is then used to compare the actual lengths and angles achieved in the setting-out exercises. They will also complete a pre-excavation survey grid. In a fieldwork book, leaners can record the communication used in setting out so that a third party can understand the notes made. Communication needs to be clear and professional in its layout and methodology. In evaluating this, learners will draw on their knowledge to consider the strengths and weaknesses of each method and their relevance or significance, leading to supported judgements.

For merit standard, learners will discuss and analyse the methods used to achieve accuracy in the setting out of infrastructure works, including horizontal and vertical elements and the production of a pre-excavation survey grid. They will complete the setting out of a drainage run, an embankment and a complex road curve that includes calculating the theoretical distances and angles using trigonometry, which is then used to compare the actual lengths and angles achieved in the setting-out exercises. They will also complete a pre-excavation survey grid. In a fieldwork book, learners can record the communication used in setting out so that a third party can understand the notes made. Communication needs to be clear and professional in its layout and methodology. In discussing this, learners will draw on their knowledge to consider the different aspects of each method, how they interrelate and the extent to which they are important. Learners will consider the different aspects of the methodologies and how they interrelate, including their importance in terms of achieving accuracy.

For pass standard, learners will set out three items: a drainage run, including the excavation for a manhole, an embankment and cutting, and a complex road curve from two straight entries and exits. Their pre-excavation survey evidence needs to be a grid of reduced levels taken across sloping or uneven ground so a range of ground levels can be established. Their booking and drawing should be to a standard that a client would expect to be given. Their explanation of accuracy for vertical and horizontal control must evidence tolerances required for functions, for example the tolerances on holding-down bolts for steel stanchions. Learners must explain how accuracy is achieved when setting out vertical and horizontal elements.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 4: Construction Technology
- Unit 6: Surveying in Construction
- Unit 10: Building Surveying in Construction.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers from a specialist setting out firm, or a project management specialist
- participation in audience assessment of presentations
- design/ideas to contribute to unit assignment/case study/project materials
- work experience
- employer's business materials as exemplars
- support from local business staff as mentors
- site visits.

Unit 12: Low Temperature Hot Water Systems in Building Services

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners develop knowledge and understanding of low-temperature hot-water (LTHW) systems that provide hot water for domestic use and heating.

Unit introduction

In most buildings in the UK, heating installations are essential for providing hot water and heating. Modern heating systems are expected to do much more than maintain the temperature of a space. They must be efficient, functional and environmentally friendly, and should contribute to sustainable development. Space heating is a major consumer of energy and therefore a significant source of carbon dioxide (CO_2) emissions. Plumbers and heating engineers are responsible for the installation of such systems.

In this unit, you will investigate the development of LTHW heating installations. This begins with the agreement of client needs and design requirements for a system, continues through the design of layouts, proceeds to the sizing, selection and specification of pipes and equipment, and concludes with the commissioning of a system and its subsequent maintenance. This ensures that hot water is delivered at the right temperature and the heating functions correctly when switched on.

This unit will support you in progressing to a higher-level construction programme such as the Higher National in Construction with the Building Services pathway, or a general construction or building services degree. Additionally, this unit will give an insight into LTHW systems for supporting site managers, quantity surveyors and so on, who need a generic understanding of these systems. It also supports progression to the workplace as a technician or direct entry as an assistant services engineer in a construction company.

Learning aims

In this unit you will:

A Understand the design requirements for an LTHW system

B Undertake the design of an LTHW installation for a domestic property

C Develop a specification for materials, components and ancillary equipment for a domestic LTHW system.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the design requirements for an LTHW system	**A1** Heating requirements **A2** Design conditions **A3** External considerations **A4** Heat losses	Learners are given a client brief, which they have to analyse in terms of all of the heating and hot water requirements.
B Undertake the design of an LTHW installation for a domestic property	**B1** Pipework circuits **B2** Pumps **B3** Heat emitters **B4** Boilers and heat generators **B5** Expansion vessels **B6** Hot-water storage tanks **B7** Access and maintenance	Learners design a LTHW system for a domestic, two-storey building from given design parameters. As part of the design, learners produce a specification for all the primary elements of the LTHW system.
C Develop a specification for materials, components and ancillary equipment for a domestic LTHW system	**C1** Pipework **C2** Pumps **C3** Heat emitters **C4** Boilers **C5** Expansion vessels **C6** Hot-water storage tanks	

Content

Learning aim A: Understand the design requirements for an LTHW system

A1 Heating requirements

The needs of the stakeholders in terms of the heating requirements in their building or structure.

- Factors that need to be considered when designing heating systems:
  - building use:
    - activity levels
    - density of occupancy
    - age profile of occupants
  - the requirement for single or multiple heating zones
  - client requirements:
    - comfort levels
    - building type
    - building users
  - environmental requirements:
    - minimising emissions
    - recommended internal temperature levels
    - sustainability
  - control of the system:
    - timing of heating
    - period of heating
    - time of year
    - temperature control
  - sustainability:
    - future requirements
    - capacities for expansion
    - life expectancy of the installation
    - reduction of fossil fuel usage
  - performance requirements:
    - temperature of zones
    - warming-up duration
    - heat retention and insulation levels
    - effect of glazed areas.

A2 Design conditions

The statutory measures that must be met in the design of an LTHW system for a domestic situation.

- Regulations and standards that have to be met.
- Emissions legislation.
- Building regulations.
- Standard Assessment Procedure (SAP) calculations.

A3 External considerations

The impact of external factors on the design of domestic heating systems.

- The desired internal temperature to be maintained.
- The heat losses through the fabric of the building.
- Solar and internal heat gains.
- Environmental considerations.
- Location with regard to external-design temperatures.
- Geographical location.
- Thermal response and risk of exceedance.
- Infiltration rates for winter heating applications.
- Boiler efficiency and green grants.
- Orientation of the building.

A4 Heat losses

- Calculation of existing u-values of a retained structure.
- Calculation of proposed u-values for the structure and fabric of the building.
- Calculated heat losses through the building fabric.
- Calculated heat losses due to air changes.
- Impact of heat losses through air leaks.

Learning aim B: Undertake the design of an LTHW installation for a domestic property

The design of a domestic heating and hot-water system, to include the primary elements of heat generation.

B1 Pipework circuits

Design of circuits that are efficient in terms of the delivery of hot water to the discharge point or tap.

- Pipe sizing calculations.
- Flow rates required.
- Friction losses.
- Maintaining a balanced system.
- Use of secondary returns.
- Means of isolation for maintenance purposes.
- Requirements for zoning of systems.

B2 Pumps

The selection of a pump to meet the design parameters of:

- sizing of pumps for volumes to be moved
- pump margin and duty
- selection in balancing design against availability
- pump efficiency
- reliability
- lifespan
- pump maintenance
- positioning and access for servicing
- use of valves to allow easy replacement.

B3 Heat emitters

The selection of a heat emitter, including the assessment of output requirements in meeting the design parameters, to include:

- size of heat emitters required for comfortable temperature, taking into account the floor area and volume of the space being heated
- heat losses associated with the area and volume being heated
- size versus available space
- aesthetics of emitter
- heat output and efficiency
- positioning and access for servicing.

B4 Boilers and heat generators

The selection of an appropriate boiler to meet the design parameters of:

- maintaining effective flow rates
- efficiency for Part L of the building regulations
- reduction in CO_2 emissions
- output required
- operating costs
- type of available fuels
- combustion and ventilation requirements
- capacity for future expansion
- positioning and access for servicing.

B5 Expansion vessels

The selection of appropriate expansion vessels to meet the system's requirements.

- Size and capacity in maintaining flow rates for heat distribution.
- Anticipated thermal expansion.
- Location in the installation.
- Means of pressure adjustment.

B6 Hot-water storage tanks

Design parameters of hot-water storage tanks.

- Storage volumes to meet anticipated demand.
- Required storage temperature of water.
- Indirect heating for the stored water.
- Immersion heater back-up requirements.

B7 Access and maintenance

Accounting within the design for the access to valves, radiators, boilers, pipework for maintenance and adaptation, to include thermal expansion consideration.

- Air bleeding of system either manually or automatically.
- Position of boiler for ventilation and combustion requirements.
- Position of boiler flue.
- Combustion air-flow requirements.
- Access panels to valves.

Learning aim C: Develop a specification for materials, components and ancillary equipment for a domestic LTHW system

C1 Pipework

The characteristics of the materials and components that will be used to carry hot water efficiently.

- Materials selection:
  - plastic
  - copper.
- Type of jointing method:
  - soldered
  - push fit
  - crimped
  - compression.
- Sizes required.

C2 Pumps

Pumps to suit heating and hot-water circuit, and to cover any zoning requirements.

- Single.
- Multiple.

C3 Heat emitters

The type and selection of a heat emitter in terms of its characteristics and appearance.

- Radiators, to include panel, sectional, low surface temperature, compact.
- Towel rails.
- Underfloor heating:
  - layout of pipework and manifold
  - position of insulation
  - finishes for solid and suspended floors.

C4 Boilers

The type of boiler used to convert fuel into heat energy and distribute water around the pipework system.

- Combination condensing systems.
- System boilers.
- Traditional/conventional boiler – vented.
- Biomass fuel boilers.

C5 Expansion vessels

- Appropriate capacity.
- Pressure valve.
- Flexible connector with inlet valves.

C6 Hot-water storage tanks

- Unvented hot-water cylinders.
- Vented hot-water cylinders.
- Provision of secondary heating source via immersion heater.

Assessment criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">Learning aim A: Understand the design requirements for an LTHW system</td><td rowspan="2">A.D1 Evaluate the factors that need to be considered when designing heating installations for a given building.</td></tr>
<tr><td>A.P1 Explain the factors that need to be considered when designing heating installations.</td><td>A.M1 Analyse the factors that need to be considered when designing heating installations for a given building.</td></tr>
<tr><td colspan="2">Learning aim B: Undertake the design of an LTHW installation for a domestic property</td><td rowspan="4">B.D2 Produce a comprehensive heating design that fully meets the needs of a given domestic property.
C.D3 Evaluate the selection of a boiler, materials and equipment that fully meets the needs of a given domestic property.</td></tr>
<tr><td>B.P2 Produce a pipework layout for a domestic situation that includes the positioning and requirements of all key components.
B.P3 Assess the required heat output for the emitters in each room for a domestic property.
B.P4 Assess the boiler output requirements for a given domestic property.</td><td>B.M2 Produce a detailed heating design that meets the needs of a given domestic property.</td></tr>
<tr><td colspan="2">Learning aim C: Develop a specification for materials, components and ancillary equipment for a domestic LTHW system</td></tr>
<tr><td>C.P5 Select a boiler to meet the needs of a given domestic property.
C.P6 Produce schedules of materials and equipment that meet some of the needs of a given domestic property.</td><td>C.M3 Justify the selection of a boiler, materials and equipment that meets most of the needs of a given domestic property.</td></tr>
</table>

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.M1, A.D1)

Learning aims: B and C (B.P2, B.P3, B.P4, C.P5, C.P6, B.M2, C.M3, B.D2, C.D3)

Further information for teachers and assessors

Resource requirements

Learners taking this unit would benefit from access to a low-temperature hot-water control rig, a solar collector, a workshop and site visits.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate the factors, in feasibility terms, that need to be considered when designing the installation of an LTHW system for a given building. They will support and fully reference these factors using their research. Their evaluation should consider the requirements of all the stakeholders in the project linked to heating requirements, design conditions, external considerations and heat losses. The evaluation will draw on their knowledge of the factors to consider and their relevance or significance to the design of the heating system for the given building.

For merit standard, learners will analyse the factors, in feasibility terms, that need to be considered when designing the installation of an LTHW system for a given building. Their analysis will include heating requirements, design conditions, external considerations and heat losses. The analysis of these factors will consider their conflicting interrelationships and present the outcome of learners' detailed and methodical examination.

For pass standard, learners will explain the factors that will be considered for the design of a heating installation for a selected building. Their explanation will include heating requirements, design conditions, external considerations and heat losses. The explanation will demonstrate that learners comprehend the need to consider these factors during the design of the system.

Learning aims B and C

For distinction standard, learners will produce, for a given building, a comprehensive design and report that is detailed in its compilation and contains full manufacturers' details, with drawings produced to a professional design standard. They will evaluate the selection of all equipment in meeting the design needs of the scenario. In their evaluation, learners will draw on their knowledge of the design of LTHW systems to consider the relevance or significance of key aspects of their designs, and their benefits and drawbacks, to the design of the heating system for the given building.

For merit standard, learners will produce, for a given building, a design and report that is detailed in its compilation and contains full manufacturers' details, with learners' drawings produced to a good design standard. They will justify their selection of all equipment in meeting the design needs of the scenario. Learners will draw on their knowledge of the design of LTHW systems to prove that key aspects of their designs are correct for the situation.

For pass standard, learners will produce, for a given building, a pipework design for a domestic installation. This should include the heat-generation equipment, its distribution and control. Heating requirements should be linked to the stakeholders who will occupy the building in terms of their human comfort. Learners will support their descriptions with diagrammatic illustrations of the heating distribution pipework and equipment manufacturers' details, including all key elements. They will assess the amount of heating required in each space and size the heat emitters accordingly, using manufacturers' published information. Learners will select the primary heat-generating plant with the output to meet the building's design requirements. They will produce a schedule of materials and equipment for the full heating system, with total quantities summarised.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 7: Graphical Detailing in Construction
- Unit 13: Measurement Techniques in Construction
- Unit 14: Provision of Primary Services in Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of guest speakers from:

- boiler manufacturers
- green technology solution firms
- gas suppliers
- low-temperature hot-water installation companies
- wholesale organisations.

Unit 13: Measurement Techniques in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners undertake the quantity surveying techniques used to apply measurement rules in the production of a bill of quantities.

Unit introduction

Measurement is the first process that turns a construction design into a monetary value. Measurement quantifies the physical resources required for a project to be constructed. Each element is measured using a standard method of measurement. These quantities are then abstracted and entered into a bill of quantities, which is then used in the tendering process to obtain quotations from the main contractors, in the form of a written tender document. The total quantities can then be published in a bill that is used to rate and value the total sum for the project.

In this unit, you will examine the processes of taking off quantities for the production of bills of quantities that are used for the financial control of a client's project. You will learn how employers and client organisations use agreed methods of measurement for construction and civil engineering work. These standard methods set out clearly the rules for measuring quantities from the drawings and schedules created by architects and other members of the design team. You will use these methods to produce quantities for structural elements and then undertake the production of a bill of quantities.

This unit gives you the opportunity to progress to construction sector roles, including estimator, bid writer, buyer, quantity surveyor or costing surveyor. It can also give you the skills for progression to Higher Nationals in Construction and degrees in construction specialisms.

Learning aims

In this unit you will:

A Examine the measurement rules for building and civil engineering

B Undertake the production of quantities for substructure and superstructure elements

C Undertake the production of bills of quantities.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine the measurement rules for building and civil engineering	**A1** Introduction to taking off quantities **A2** Standard methods of measurements	A guidance document for new learners to comprehend the use of quantities in construction and the standard methods of measurement available in the construction industry.
B Undertake the production of quantities for substructure and superstructure elements	**B1** Processes in the production of quantities **B2** Production of substructure quantities for a building **B3** Production of superstructure quantities for a building **B4** Production of quantities for a civil engineering project	A set of quantities from teacher-provided drawings for a building, substructure, elements of a superstructure and elements of external works. Bills of quantities for a building, substructure, elements of superstructure and elements of external works.
C Undertake the production of bills of quantities	**C1** Abstraction of quantities **C2** The production of a bill of quantities for a building or civil engineering project	

Content

Learning aim A: Examine the measurement rules for building and civil engineering

A1 Introduction to taking off quantities

Reasons for producing both approximate and accurate quantities and their use for:

- the production of bills of quantities
- tendering and estimating
- budgets for feasibility studies during design stages
- cost comparison of different designs
- preparation of estimates
- estimation of a project’s value
- final account measurements and variations
- ordering materials
- producing a quotation for a work element.

A2 Standard methods of measurement

The use of the Standard Methods of Measurement (SMM) rules in the production of quantities.

- Measurement rules:
  - the need for rules
  - origins of measurement rules
  - measurement initiative steering group
  - status of the Royal Institution of Chartered Surveyors (RICS) New Rules of Measurement (NRM)
  - status of the Institution of Civil Engineers (ICE) Civil Engineering Standard Method of Measurement (CESMM)
  - typical considerations:
    - units of measurement
    - deduction of voids
    - deemed to be included
    - item description
    - hierarchy of description
    - key content
    - preliminaries and measured work
    - guidance on the preparation of bills of quantities.
- The New Rules of Measurement (NRM):
  - NRM1 – order of cost estimating and cost planning for capital building works:
    - application of this to budgeting for projects
    - uses of NRM 1
  - NRM2 – detailed measurement for building works:
    - application of this to taking off quantities for projects
    - uses of NRM 2
  - NRM3 – order of cost estimating and cost planning for building maintenance works:
    - application of this to maintaining projects
    - uses of NRM 3.
- CESMM:
  - content and its application to civil engineering projects
  - differences against the NRM volumes.

Learning aim B: Undertake the production of quantities for substructure and superstructure elements

B1 Processes in the production of quantities

The use of dimension paper or direct billing paper and the techniques used to take off quantities.

- Preparation and planning, to include the compilation of a take-off list.
- The vocationally correct format and layout of quantities and calculations on dimension paper:
  - enumerated
  - linear
  - area
  - volumes
  - itemised
  - multiplying (including additional multipliers and 'dotting-on')
  - totalling dimensions
  - deductions and omission quantities
  - page numbering
  - carried-forward and brought-forward dimension totals
  - use of standard quantity surveyors' abbreviations
  - marking the extent of a calculation
  - waste calculations, to include centre lines.

B2 Production of substructure quantities for a building

- The substructure of a building, to include:
  - excavations for foundations
  - short-bored piles
  - mass concrete foundation works
  - formwork
  - earthwork support
  - substructure external and internal walls to damp-proof course (DPC) level
  - ground floor construction:
    - excavation
    - hardcore filling
    - sand blinding
    - damp-proof membrane (DPM)
    - insulation
    - concrete beds
    - finishes to concrete
    - floor finishes.

B3 Production of superstructure quantities for a building

- The superstructure of a building, to include:
  - external wall construction:
    - timber framed, to include sole plates, softwood stud frames, plywood coverings, insulation, DPM, head frames
    - masonry, to include skins of hollow walls, forming cavities, cavity insulation
  - windows, to include the formation of openings: lintels, reveals, sills, window boards
  - doors, to include the formation of openings: lintels, reveals, thresholds
  - intermediate floors, to include timber joists and precast concrete beam and block
  - roof construction, to include trussed rafter construction, traditional rafter roof construction
  - roofing, to include coverings, breather membranes, tile battens.

B4 Production of quantities for a civil engineering project

The taking off of quantities for a civil engineering project using CESMM:

- excavation works
- filling
- formwork
- reinforcement
- concreting works
- drainage, manholes.

Learning aim C: Undertake the production of bills of quantities

Abstraction from dimension sheets into item summaries.

C1 Abstraction of quantities

- Use of 'cut and shuffle' paper.
- Use of direct billing paper.
- Use of abstract paper:
  - assembly of quantities taken from dimension sheets
  - final item quantity calculations.

C2 The production of a bill of quantities for a building or civil engineering project

How the quantities and descriptions are summarised in a bill of quantities, to include:

- production of a bill of quantities for a building work section:
  - assembly of quantities taken from dimension sheets
  - writing bill items using the method of measurement for substructure and superstructure items
  - collections and summaries
  - final summary
  - format and layout of the document.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine the measurement rules for building and civil engineering		**A.D1** Evaluate the use of recognised standard methods of measurement to ensure consistency when tendering and estimating for buildings and civil engineering projects.
A.P1 Explain how approximate and accurate quantities are used for different applications by quantity surveyors. **A.P2** Explain the reasons for the use of a recognised standard method of measurement.	**A.M1** Discuss the benefits of using recognised standard methods of measurement for buildings and civil engineering projects.	
Learning aim B: Undertake the production of quantities for substructure and superstructure elements		**B.D2** Perform an accurate and comprehensive take-off of quantities for a project using a recognised standard method of measurement and a vocationally correct layout of dimensions and methodology. **C.D3** Produce comprehensive bills of quantities for a construction project.
B.P3 Perform a take-off of quantities for a project using a recognised standard method of measurement and an appropriate layout of dimensions. **B.P4** Explain the difference between the production of quantities for building projects and the production of quantities for civil engineering projects.	**B.M2** Perform an accurate take-off of quantities for a project using a recognised standard method of measurement and a vocationally correct layout of dimensions.	
Learning aim C: Undertake the production of bills of quantities		
C.P5 Produce bills of quantities for a construction project. **C.P6** Explain the different methods used to convert the take-off into bills of quantities.	**C.M3** Produce accurate bills of quantities for a construction project.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aims: B and C (B.P3, B.P4, C.P5, C.P6, B.M2, C.M3, B.D2, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to copies of standard methods of measurement, to include NRM1, NRM2, NRM3 and the CESMM.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate the use of recognised standard methods of measurement to ensure consistency when tendering and estimating for buildings and civil engineering projects. They will consider how quantities are used for construction projects during the various stages of a project, and consider the benefits and drawbacks of the use of a recognised standard method of measurement. In their evaluation, learners will consider the strengths and weaknesses of standard methods of measurement and their significance in generating accurate and consistent tender outcomes across a range of tender bids. They will provide a conclusion relating to the use of an appropriate standard method of measurement.

For merit standard, learners will discuss the benefits of using recognised standard methods of measurement for buildings and civil engineering projects. They will consider how quantities are used for construction projects during the various stages of a project and consider the relevant use of a recognised standard method of measurement. In their discussion, learners will consider the different aspects of the standard methods of measurement and the extent of their importance.

For pass standard, learners will explain how approximate and accurate quantities are used for different applications by quantity surveyors. Additionally, learners will explain the reasons for the use of a recognised standard method of measurement. In their explanation, learners will show that they comprehend the origins, functions and objectives of standard methods of measurement and the quantities that they produce.

Learning aims B and C

For distinction standard, learners will perform an accurate and comprehensive take-off of quantities for a project using a recognised standard method of measurement and a vocationally correct layout of dimensions and methodology (for example, correct centre-line calculations, dimension layout, codification etc.). Their take-off will include a substructure, elements of superstructures and elements of external works. Learners will explain the difference between the production of quantities for building projects and for civil engineering projects. They will produce comprehensive bills of quantities for a construction project with clarity of language and layout, including vocationally correct layout, bill format, units of measurement, codification of items, ordering of sizes and use of headings. They will explain the different methods used to convert the take-off into bills of quantities. In their explanation, learners will show that they comprehend the origins, functions and objectives of methods of producing bills of quantities.

For merit standard, learners will perform an accurate take-off of quantities for a project using a recognised standard method of measurement and using a vocationally correct layout of dimensions. The take-off will include a substructure, elements of superstructures and elements of external works. Learners will explain the difference between the production of quantities for building projects and for civil engineering projects. They will produce accurate bills of quantities for a construction project with appropriate use of language and layout, including vocationally correct layout, bill format, units of measurement, ordering of sizes and use of headings. They will explain the different methods used to convert the take-off into bills of quantities. In their explanation, learners will show that they comprehend the origins, functions and objectives of methods of bills of quantities production.

For pass standard, learners will perform a take-off of quantities for a project using a recognised standard method of measurement and an appropriate layout of dimensions, allowing for some computational inaccuracy. The take-off will include a substructure, elements of superstructures and elements of external works. Learners will explain the difference between the production of quantities for building projects and for civil engineering projects. They will produce bills of quantities for a construction project with appropriate use of language and layout, including vocationally appropriate layout, units of measurement and use of headings. They will explain the different methods used to convert the take-off into bills of quantities production.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 4: Construction Technology
- Unit 7: Graphical Detailing in Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 14: Provision of Primary Services in Buildings.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 14: Provision of Primary Services in Buildings

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners examine the four primary services to understand the installation, operation and integration of these services.

Unit introduction

The provision of high-quality building services differentiates modern buildings from those constructed in earlier times. There are four primary services that are essential for a building to be habitable: hot and cold water, drainage, electricity and gas. You must therefore develop a basic understanding of building services and construction methods so that you can contribute to their safe and effective integration. You also need to learn the installation, operation and maintenance of all the primary services.

In this unit, you will learn the principles and practices that underpin the design and installation of hot and cold water systems, above-ground and below-ground drainage, single-phase electrical systems and gas installations. You will examine the specification of building services systems in terms of the materials used, the appropriate dimensions, capacities and falls, and any health and safety issues. You will gain an understanding of the advantages and disadvantages of the different systems available to justify the selection of the systems used.

This unit will help you to progress to relevant higher-level programmes. Entry to higher-level building services programmes is also possible if supported by evidence of competence in mathematics and science. The unit will support progression to work in a variety of construction roles, both on site and off site, including trainee positions in architectural technology, site supervision, site engineering, estimating, buying, quantity surveying, building surveying, land surveying and town planning, among others.

Learning aims

In this unit, you will:

A Examine the practices associated with the provision of hot- and cold-water systems

B Examine the principles and approaches associated with the provision of above- and below-ground drainage systems

C Understand the principles of the provision of simple, single-phase electrical systems and domestic gas installations.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine the practices associated with the provision of hot- and cold-water systems	**A1** Direct cold-water systems **A2** Indirect cold-water systems **A3** Direct hot-water systems **A4** Indirect hot-water systems	Learners will be given construction drawings of a domestic building and associated external areas. They will be required to provide a report that includes details of an appropriate direct and indirect hot- and cold-water system.
B Examine the principles and approaches associated with the provision of above- and below-ground drainage systems	**B1** Above-ground drainage principles **B2** Above-ground drainage approaches **B3** Below-ground drainage principles **B4** Below-ground drainage approaches	
C Understand the principles of the provision of simple, single-phase electrical systems and domestic gas installations	**C1** Electrical principles **C2** Electrical components **C3** Ring final circuits **C4** Radial circuits **C5** Gas installation principles **C6** Gas installations	Learners will be given construction drawings of a domestic building. They will be required to provide a report that includes details of an appropriate layout of single-phase electrical systems to buildings, and the internal layouts of ring final circuits and radial circuits, including line drawings, materials and components.

Content

Learning aim A: Examine the practices associated with the provision of hot- and cold-water systems

The systems used to supply buildings with a supply of potable cold water for drinking, flushing toilets, bathing, laundry and to feed heating systems, including the provision of hot water, together with an understanding of the situations in which each system would be appropriate.

A1 Direct cold-water systems

- Distribution to buildings:
  - service pipe minimum of 750 mm below ground
  - pipe to pass through wall above foundations
  - pipe to be sealed at entrance to wall
  - first 600 mm of pipe to be insulated
  - stop valve
  - rising main to drinking water tap
  - storage cistern.
- Internal layout of system, to include:
  - direct supply to all outlets
  - requirement for low-capacity cistern to feed a hot-water storage cylinder if installed
  - annotated line diagram for the layout showing key components.
- Selection of materials used, dimensions and capacities:
  - externally – 22 mm diameter service pipe, generally plastic (blue polyethylene or uPVC), although copper is acceptable
  - internally – copper or plastic pipes (generally 15 mm diameter, 20 mm for baths), 115-litre feed cistern (with 22 mm diameter overflow and feed to copper hot-water storage cylinder if installed), cisterns made from polyethylene, polypropylene or polyvinyl chloride (galvanised steel in older systems).
- Situations where system is appropriate:
  - where water pressure is high (e.g. from a high-level reservoir) or where drinking water is required from all outlets; inappropriate when supply is cut off or reduced in periods of peak demand, or where there is a danger of back-siphonage.

A2 Indirect cold-water systems

- Internal layout of system, to include:
  - cold water supplied to all outlets (except the sink) from a cold-water storage cistern, sink connected directly to rising main for supply of potable water
  - annotated line diagram for the layout showing key components.
- Selection of materials used, dimensions and capacities, to include:
  - copper or plastic pipes (generally 15 mm diameter, 20 mm for bath), 115-litre feed cistern (with 22 mm diameter overflow and feed to minimum 140-litre copper hot-water storage cylinder if installed), 230-litre cisterns in polyethylene, polypropylene or polyvinyl chloride (galvanised steel in older systems)
  - situations where system is appropriate, to include where a reserve is required should supply be cut off or reduced, where there is a risk of back-siphonage.

A3 Direct hot-water systems

- Mains pressure systems, to include combi boilers.
- Traditional systems, to include water heated in boiler, rises by convection to hot-water storage cylinder, replaced by colder water from bottom of storage cylinder, hot water drawn from storage cylinder is replaced with cold water from cistern.
- Selection of materials used, dimensions and capacities to include copper pipes (28 mm diameter primary feed from boiler to hot-water cylinder, 22 mm diameter cold feed from cistern to hot-water cylinder, 22 mm for hot water supply to bath, otherwise 15 mm diameter), minimum 140-litre hot-water cylinder, 230-litre cold-water cistern.
- Situations where system is appropriate, to include in soft water areas and where there is no associated central heating circuit.
- Annotated line diagram for the layout showing key components.

A4 Indirect hot-water systems

- Mains pressure system using pressure vessels.
- Traditional system similar to direct system, but with a separate small-capacity-feed cistern to charge and top up the primary circuit, hot-water storage cylinder to act as a heat exchanger providing heat for secondary circuit from which hot water is drawn.
- Selection of materials used, dimensions and capacities:
  - as for direct systems plus 36-litre plastic feed and expansion cistern
  - situations where system is appropriate, to include hard water areas and systems with associated central heating circuits.
- Annotated line diagram for the layout showing key components.

Learning aim B: Examine the principles and approaches associated with the provision of above- and below-ground drainage systems

The above-ground and below-ground systems used to remove foul water and surface water from a building, and the plot on which the building stands, together with an understanding of the difference between combined and separate systems.

B1 Above-ground drainage principles

The design of above-ground drainage systems, to include:

- need for water seal
- reduction of siphonage effect
- provision of ventilation
- fall for the waste pipes.

B2 Above-ground drainage approaches

Single-stack and two-pipe systems designed to prevent siphoning and discharge of gases.

- Single-stack and two-pipe systems, to include:
  - single-stack, to include waste from washbasins, sinks, baths and WCs feeds into single 100 mm vertical waste pipe, vented to outside above the roof line, all appliances have U-bend trap full of water (exceptions may be kitchen sink and cloakroom WC)
  - two-pipe system, to include older properties only, WC waste fed into a large-bore soil pipe leading directly to sewage network, remaining waste waters from washbasins, bath and kitchen sink are combined and led to a gully just below ground level.
- Selection of layout, materials used, dimensions and falls, to include:
  - all in uPVC or polypropylene
  - 100 mm diameter soil and vent pipe (SVP)
  - appliances connected separately into the stack to prevent induced and self-siphonage
  - limits on the length and levels of branch connections
  - all branch pipes to have 50 mm sweep into SVP
  - compliance with regulatory requirements
  - annotated line diagram for the layout showing key components.

B3 Below-ground drainage principles

The design of below-ground drainage systems, to include:

- capacity
- fall for self-cleansing flow
- ventilation
- support
- avoidance of leakage
- access at every change in gradient (inspection chambers, manholes, rodding points)
- pipe size or bend
- minimisation of pipe runs
- all junctions oblique and in direction of flow.

B4 Below-ground drainage approaches

- Separate systems used for surface and foul water as the standard modern method, to include:
    - separate systems used for surface and foul water where surface water and foul water are conveyed in separate drains and sewers
    - surface water requires no treatment before final outfall.
- Combined systems for surface and foul water where surface water and foul water are both conveyed in the same drain and sewer, to include:
    - entire effluent requires treatment
    - simpler and cheaper to construct, but more expensive to operate
    - a traditional approach not preferred in new constructions.
- Selection of layout, materials used, dimensions, falls and capacities:
    - rigid pipes, to include vitrified clay, concrete, cast iron
    - flexible pipes, to include uPVC, polyethylene, ductile iron, glass-reinforced plastic
    - appropriate falls for surface water and foul-water drainage
    - appropriate bedding materials for pipes and surrounds
    - annotated line diagram for the layout showing key components.

Learning aim C: Understand the principles of the provision of simple, single-phase electrical systems and domestic gas installations

The systems used for single-phase electrical supplies, gas installations and understanding of good health and safety.

C1 Electrical principles

- Electrical principles, to include sufficient capacity, prevention of excess current, protection from shock, prevention of fire, means of isolation, health and safety issues.

C2 Electrical components

A typical circuit to include the following components:

- mains isolation switches, to include main service fuse, meter, main switch
- consumer control unit, to include residual current devices (RCD), miniature circuit breakers (MCB) or fuses
- earth connectors
- outlet sockets
- switches and light fittings.

C3 Ring final circuits

Ring final circuits for a maximum permissible floor area.

- Circuits, to include:
  - live conductor and neutral conductor
  - earth looped from socket to socket
  - protected by 32 amperes (A) fuse or miniature circuit breaker.
- Socket outlets, to include individual as well as spur outlets:
  - individual socket outlets to accept fused appliances up to 13 A
  - unlimited number of socket outlets
  - spur outlets not to exceed number of primary outlets
  - maximum of two outlets per spur.

C4 Radial circuits

Radial circuits for lighting and individual high-power appliances.

- Lighting, to include loop-in method using earthed twin cable with 6 A protection:
  - individual high-power appliances, to include electric cookers, showers, water heaters, protected up to 45 A depending on power taken by appliance.

C5 Gas installation principles

Gas installation principles to support combustion and disposal of combustion products.

- Adequate supply of ventilation air to support combustion.
- Effective flue arrangements to dispose of combustion products:
  - conventional flues, to include brick or stone chimney, prefabricated or precast systems
  - balanced flues, to include air for combustion drawn in through the outer pipe, inner pipe removes combustion gases to outside.

C6 Gas installations

Metering arrangement, connecting of gas mains and entry of gas service pipes into a building, in compliance with the relevant legislation.

- Compliance with relevant legislation, to include Part P of the Building Regulations 2010, and the Gas Safety (Installation and Use) Regulations 1998:
  - connection to gas main, to include slope towards house, arrangements for collecting condensate.
- Entry of gas service pipe into building:
  - arrangement, to include from side nearest main, not under foundations, not run in a cavity, sleeved if passing through solid floor or wall, not housed in an unventilated void
  - dimension, to include minimum 25 mm diameter pipe
  - enter building 375+ mm below ground
  - gas meter arrangements, to include generally external (but can be internal) meter box to contain control level, situated at height sufficient to facilitate access and reading.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine the practices associated with the provision of hot- and cold-water systems		
A.P1 Explain, with appropriately annotated illustrations, the distribution and layout of cold water by direct and indirect systems. **A.P2** Explain, with appropriately annotated illustrations, the distribution and layout of hot water by direct and indirect systems.	**A.M1** Analyse, with clear and accurate line drawings, the distribution of hot- and cold-water systems in terms of materials used and the dimensions and capacities of fittings and components, and their relative positioning.	**A.D1** Evaluate, with detailed and comprehensive line drawings, the distribution of hot- and cold-water systems in terms of materials used and the dimensions and capacities of fittings and components, and their efficient positioning.
Learning aim B: Examine the principles and approaches associated with the provision of above- and below-ground drainage systems		
B.P3 Explain, with appropriately annotated illustrations, the distribution and layout of above-ground drainage systems. **B.P4** Explain, with appropriately annotated illustrations, the distribution and layout of below-ground drainage systems.	**B.M2** Analyse, with clear and accurate line drawings, the distribution of above- and below-ground drainage systems in terms of materials used, appropriate falls, and the dimensions and capacities of fittings and components, and their relative positioning.	**B.D2** Evaluate, with detailed and comprehensive line drawings, the distribution of above- and below-ground drainage systems in terms of materials used, appropriate falls, and the dimensions and capacities of fittings and components, and their efficient positioning.
Learning aim C: Understand the principles of the provision of simple, single-phase electrical systems and domestic gas installations		
C.P5 Explain the installation of single-phase electrical systems for both radial and ring final circuits. **C.P6** Explain domestic gas installations from entry to the building to the point of use. **C.P7** Outline the important health and safety requirements relevant to the installation of single-phase electrical systems and domestic gas installations.	**C.M3** Analyse the installation of single-phase electrical systems and domestic gas installations in terms of components and layout. **C.M4** Discuss the important health and safety requirements relevant to the installation of single-phase electrical systems and domestic gas installations.	**C.D3** Evaluate the installation of single-phase electrical systems and domestic gas installations in terms of components, layout, integration of both services, and compliance with health and safety legislation.

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, B.P3, B.P4, A.M1, B.M2, A.D1, B.D2)

Learning aim: C (C.P5, C.P6, C.P7, C.M3, C.M4, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit.

Essential information for assessment decisions

Learning aims A and B

For distinction standard, learners will evaluate, with the aid of detailed and comprehensive line drawings indicating the layout of service runs, the distribution of both direct and indirect hot- and cold-water systems in terms of materials used, and the dimensions and capacities of fittings and components and their efficient and appropriate positioning. They will also evaluate, with detailed and comprehensive line drawings, the distribution of above- and below-ground drainage systems in terms of materials used, appropriate falls, access arrangements, and the dimensions and capacities of fittings and components, and their efficient positioning. In their evaluation, learners will consider the advantages and disadvantages of alternate systems and the significance of key performance requirements. Their inquiry will lead to a supported judgement showing clear links to the domestic installation scenario.

For merit standard, learners will analyse, with clear and accurate line drawings, the distribution of hot- and cold-water systems in terms of materials used, and the dimensions and capacities of fittings and components, and their relative positioning. They will also analyse, with clear and accurate line drawings, the distribution of above- and below-ground drainage systems in terms of materials used, appropriate falls, dimensions and capacities of fittings and components, and their relative positioning. In conducting their analysis, they will consider the key components of the system and how these combine to provide effective performance.

For pass standard, learners will explain, with appropriately annotated illustrations, the distribution and layout of hot and cold water by direct and indirect systems. They will also explain, with appropriately annotated illustrations, the distribution and layout of above- and below-ground drainage systems. In their work, learners will demonstrate that they understand the functional requirements of the system and whether the system can be considered to be fit for purpose.

Learning aim C

For distinction standard, learners will evaluate the installation of single-phase electrical systems and domestic gas installations in terms of components, layout, integration of both services and compliance with health and safety legislation. In their evaluation, they will consider the advantages and disadvantages of alternate systems and the significance of key performance requirements, including associated health and safety considerations. Their inquiry will lead to a supported judgement showing clear links to the domestic installation scenario.

For merit standard, learners will analyse the installation of single-phase electrical systems and domestic gas installations in terms of components and layout. In conducting their analysis, they will consider the key components of the system and how these combine to provide effective performance. They will discuss the important health and safety requirements relevant to the installation of single-phase electrical systems and domestic gas installations. In their discussions, learners will consider the key health and safety considerations and how they interrelate, together with some consideration of their relative importance.

For pass standard, learners will explain the installation of single-phase electrical systems for both radial and ring final circuits. They will also explain domestic gas installations from entry to the building to the point of use, and outline the important health and safety requirements relevant to the installation of single-phase electrical systems and domestic gas installations. In their work, learners will demonstrate that they understand the functional requirements of the systems and the associated health and safety considerations, including and whether the system, and the safety precautions, can be considered to be fit for purpose.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 7: Graphical Detailing in Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 13: Measurement Techniques in Construction.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 15: Further Mathematics for Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners develop and use skills to apply rules of transposition of formulae, arithmetical methods, calculus and statistics to construction problems.

Unit introduction

Many of the buildings and structures that we encounter in our daily lives are the result of projects that civil engineers and building services engineers have worked on. They use a range of mathematical techniques and formulae to find out important physical properties of the buildings and structures. These could include finding the centre of gravity of an irregular shaped, precast cladding unit so that it can be safely lifted, using arithmetic or trigonometric techniques to determine areas of sites, or calculating the root mean square value of an alternating electric current to make sure the supply is suitable.

In this unit, you will investigate relevant aspects of pure mathematics and explore how you can solve complex practical problems. You will learn how to solve applied mathematical problems involving statistical data, structural properties for beams and columns, complex measurements, trigonometric identities, rates of change and decay, differentiation of maxima and minima, numerical integration, and complex areas or volumes by definite and indefinite integration. These mathematical skills are transferable and will be used to support your study of other topics in the BTEC Nationals in Construction programme, for example in surveying, electrical systems or structural analysis.

As a civil engineer or building services engineer, you will need to understand and develop the skills required to solve contextual problems using mathematical methods. This unit will prepare you for progression to higher education to study in the construction, civil engineering or building services engineering sectors at Higher National or degree level. It will also prepare you for an apprenticeship or employment in a range of construction disciplines as a technician, and will help you work with professionals as part of a team working on cutting-edge products and systems.

Learning aims

In this unit you will:

A Examine how algebraic and trigonometric techniques can be used to solve a construction problem

B Examine how calculus can be used to solve a construction problem

C Investigate the use of statistical methods to solve a construction problem.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine how algebraic and trigonometric techniques can be used to solve a construction problem	**A1** Transposition techniques **A2** Trigonometric techniques **A3** Construction-related problems	A report containing the results of learners' analysis and calculation; carried out under controlled conditions, supported by text and diagrams as appropriate.
B Examine how calculus can be used to solve a construction problem	**B1** Differential calculus **B2** Integral calculus **B3** Numerical integration	A report containing the results of learners' analysis and calculation; carried out under controlled conditions, supported by text and diagrams as appropriate.
C Investigate the use of statistical methods to solve a construction problem	**C1** Statistical methods **C2** Use of statistical methods in construction contexts	A report that includes appropriate graphs and charts to represent collated statistical data for a construction activity.

Content

Learning aim A: Examine how algebraic and trigonometric techniques can be used to solve a construction problem

A1 Transposition techniques

Rearrangement of formulae to determine new subjects and their use in evaluating data.

- Mathematical formulae to transpose, to include:
  - linear, quadratic and cubic expressions
  - trigonometric functions, to include sine, cosine, tangent ratios
  - logarithmic functions
  - binomial theorem applied to errors.

A2 Trigonometric techniques

Application of trigonometric techniques to 2D scenarios to solve construction problems involving the calculation of dimensions, angles, regular areas and irregular areas.

- Trigonometric functions, to include sine, cosine, tangent ratios.
- The sine rule, including ambiguous case.
- The cosine rule.
- Area rules for triangles.

A3 Construction-related problems

Typical problems that transposition and trigonometric techniques will solve.

- Application of properties of sections:
  - simple shapes, regular shapes, irregular shapes, to include:
    - cross-sectional area
    - location of centroid
    - section modulus
    - moment of inertia
    - radius of gyration.
- Application of trigonometry to determine dimensions in 2D and 3D:
  - in surveying
  - in setting out
  - other practical contexts, to include calculating heights, lengths etc.

Learning aim B: Examine how calculus can be used to solve a construction problem

B1 Differential calculus

Application of differentiation techniques to algebraic (polynomial), trigonometric (sine, cosine), logarithmic and exponential functions, for solving construction engineering problems.

- Standard differential calculus methods:
  - polynomial equations of the form $s = 5t^2 - 3t + 4$
  - trigonometric (sine, cosine) equations of the form $y = \sin^2 4x$
  - logarithmic equations of the form $v = 8\log_e(5x)$
  - exponential equations of the form $y = 2e^{(3x+5)}$
- Differentiation by standard results, e.g. $y = ax^n$, where $\frac{dy}{dx} = nax^{(n-1)}$
- Derivatives of algebraic (powers) ax^n
- Derivatives of trigonometric (sine, cosine) $\sin ax$, $\cos ax$
- Derivatives of logarithmic functions, for example $\log_e ax$
- Derivatives of exponential functions, for example e^{ax}

- Product rule, e.g. $\frac{dy}{dx} = \frac{vdu}{dx} + \frac{udv}{dx}$
- Quotient rule, e.g. $\frac{dy}{dx} = \frac{\frac{vdu}{dx} - \frac{udv}{dx}}{v^2}$
- Function of a function (chain rule) method.
- Second order derivatives:
  - second derivative of algebraic (polynomial), e.g. $y = axn$, where $\frac{d^2y}{dx^2} = n(n-1)ax^{(n-2)}$
  - second derivative of trigonometric (sine, cosine) functions
  - the location of stationary values, to include turning points, points of inflection.

B2 Integral calculus

Application of indefinite and definite integration techniques to algebraic (polynomial), trigonometric and exponential functions, in order to solve construction problems.

- Routine functions integrated in one step without the need for manipulation, using standard integral calculus methods, to include:
  - polynomial, e.g. $\int(x^2 - 3\mathrm{x} + 4)dx$
  - trigonometric (sine, cosine), e.g. $\int(\sin 5\theta - 3\cos 4\theta)d\theta$
  - reciprocal, e.g. $\int\left(\frac{3}{x}\right) dx$
  - exponential, e.g. $\int(e^{3t})dt$
- Integration of common functions by standard results, e.g. ax^n, $\sin ax$, $\cos ax$, $\frac{1}{x}$, e^{ax}
- Indefinite integrals, constant of integration, initial conditions.
- Definite integrals – limits and square bracket notation.

B3 Numerical integration

Application of the formulae for irregular areas and volumes for numerical integration.

- Trapezoidal rule:
  - for comparison of methods in terms of complexity and accuracy.
- Mid-ordinate rule:
  - for comparison of methods in terms of complexity and accuracy.
- Simpson's rule:
  - area under a curve determined using Simpson's rule for comparison with values obtained using calculus.
- Numerical integration using a spreadsheet.
- Arithmetical calculation of various properties of sections, including:
  - cross-sectional area
  - location of centroid
  - neutral axis
  - moment of inertia
  - section modulus
  - radius of gyration.

Learning aim C: Investigate the use of statistical methods to solve a construction problem

C1 Statistical methods

How statistics are used in a construction context to convey relevant information that is in a useful format, appropriate to the audience.

- Presentation of data:
  - histograms
  - bar charts
  - pie charts
  - frequency graphs
  - cumulative frequency graphs.
- Sampling distributions:
  - normal distribution tables
  - confidence limits
  - significance testing.

C2 Use of statistical methods in construction contexts

How statistics are used in a construction context to solve problems.

- Measures of central tendency:
  - mean
  - mode
  - median.
- Measures of dispersion:
  - range
  - variance
  - standard deviation.
- Cumulative frequency:
  - quartiles, deciles and percentiles
  - interquartile range.
- Types of data:
  - discrete data
  - continuous data
  - grouped data
  - ungrouped data.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine how algebraic and trigonometric techniques can be used to solve a construction problem		**A.D1** Demonstrate, using complex algebraic and trigonometric techniques, the calculation for a given construction problem.
A.P1 Demonstrate, using simple algebraic and trigonometric techniques, the calculation for a given construction problem.	**A.M1** Demonstrate, using advanced algebraic and trigonometric techniques, the calculation for a given construction problem.	
Learning aim B: Examine how calculus can be used to solve a construction problem		**B.D2** Demonstrate, using complex differential and integral calculus techniques, the solution for a given construction problem, validating results achieved by numerical integration.
B.P2 Demonstrate, using simple differential calculus techniques, the solution for a given construction problem. **B.P3** Demonstrate, using simple integral calculus techniques, the solution for a given construction problem. **B.P4** Demonstrate, using simple numerical integration techniques, the solution for a given construction problem.	**B.M2** Demonstrate, using advanced differential calculus, solutions for each type of given routine function, for a given construction problem. **B.M3** Demonstrate, using advanced integral calculus and numerical integration, the solution for a given construction problem.	
Learning aim C: Investigate the use of statistical methods to solve a construction problem		**C.D3** Demonstrate, using complex statistical analysis and assessment techniques, the outcome of a given construction problem.
C.P5 Demonstrate simple techniques to present grouped and ungrouped statistical data related to a given construction problem. **C.P6** Demonstrate, using simple statistical analysis methods, the outcome of a given construction problem.	**C.M4** Demonstrate, using advanced statistical analysis and assessment techniques, the outcome of a given construction problem.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.M1, A.D1)

Learning aim: B (B.P2, B.P3, B.P4, B.M2, B.M3, B.D2)

Learning aim: C (C.P5, C.P6, C.M4, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to maths support websites, spreadsheet software, for example www.mathcentre.ac.uk/students/topics

Essential information for assessment decisions

Learning aim A

For distinction standard, learners must independently solve industry-related problems using appropriate algebraic, trigonometric and logarithmic functions. Their work should have a neat, efficient, logical and clear structure. They should apply the correct mathematical conventions and use the correct units throughout. Their evidence will be logically structured and easy to understand by a third party with a mathematical background, who may or may not be a construction engineer. For example, learners will use mathematical terminology correctly and use relevant units when working with functions set in construction contexts. Small and large numerical values will be correctly presented in an appropriate format, such as standard form. Learners will work to a specified numerical precision (as determined by the assessor), through the use of appropriate significant figures or decimal places.

For merit standard, learners must demonstrate throughout their work that they are able to apply appropriate transposition techniques to mathematical formulae and expressions. Learners must show evidence that they can transpose, simplify and solve by substitution, at least one example of each type of formula (linear, quadratic and cubic expressions, binomial expansions for errors, logarithms, and fractional powers). Typical problems could include the moment of inertia, section modulus or radius of gyration of given, standard symmetrical (about y-y axis only) composite cross sections. Learners' numerical work will be accurate; using an appropriate degree of precision as specified by the assessor in significant figures or decimal places, and relevant units will be used for all functions. A limited number of arithmetic follow-through errors are acceptable for more advanced functions. Learners' work will have a clear, understandable and well-presented structure. Learners should apply the correct mathematical conventions and use the correct units throughout.

For pass standard, learners must show evidence that they can transpose, simplify and solve by substitution formulae, including linear and quadratic expressions. Their work must have a logical structure, using correct mathematical conventions and appropriate units where required. Learners must use arithmetical techniques to determine values for a range of properties of sections, including irregular areas and volumes. They must find the cross-sectional area, volumes and position of the centroid for a variety of symmetrical and non-symmetrical composite shapes, using a range of arithmetic and trigonometrical formulae. Their work will have a logical structure, use correct mathematical conventions and the correct units should be stated for the final answer.

Learners will carry out calculations to give solutions that clearly show how they have approached construction engineering problems using trigonometric methods. For example, the appropriate use of labelled diagrams to determine the areas of building plots or the volume of material that would be required to fill a void. Solutions will be set out methodically and using the correct mathematical conventions clearly, but may contain numerical errors. Units must be clearly stated for the problems involving physical properties.

Learning aim B

For distinction standard, learners will demonstrate high levels of skill in applying differential and integral calculus methods to the solution of a given construction problem, using mathematical functions. For differential calculus, learners will correctly and efficiently manipulate six complex routine functions, while for integral calculus, learners will correctly and efficiently manipulate 11 complex routine functions when producing indefinite and definite integrals. Alternative methods of solution must be carried out for integration where appropriate, in order to compare the results found and the accuracy of values. For example, validating values using the mid-ordinate rule by comparing them to those achieved using calculus. The evidence will be logically structured and will be easy to understand by a third party with a mathematical background, who may or may not be a construction engineer. For example, learners will use mathematical terminology correctly and use relevant units when working with functions set in construction contexts. Small and large numerical values will be correctly presented in an appropriate format, such as standard form. Learners will work to a specified numerical precision (as determined by the assessor), through the use of appropriate significant figures or decimal places.

For merit standard, learners will apply the correct skills and methods when producing the derivatives of functions and determining their gradients. Learners will correctly manipulate six routine functions (two polynomial, two trigonometric, one logarithmic and one exponential). Some functions will be sufficiently complex to enable learners to select and apply the correct method (product, quotient, function of a function and substitution) when producing first and second derivatives. Learners will select and apply the correct methods when producing the definite and indefinite integrals of functions, and determining the properties of periodic functions. Learners will correctly manipulate eight routine functions, with a further three functions being sufficiently complex to enable learners to select and apply the correct method (substitution and by parts) when producing indefinite and definite integrals.

Numerical integration will have been accurately completed for four definitive routine functions, using each of the three techniques given (trapezoidal rule, mid-ordinate rule and Simpson's rule). Learners' numerical work will be accurate; using an appropriate degree of precision as specified by the assessor in significant figures or decimal places, and relevant units will be used for all functions. A limited number of arithmetic follow-through errors are acceptable for non-routine functions.

For pass standard, learners will apply the correct methods when differentiating at least six given routine mathematical functions. Learners will correctly manipulate at least two polynomial functions, two trigonometric functions, one logarithmic function and one exponential function. Learners will apply the correct methods when integrating at least eight given routine mathematical functions. Learners will correctly manipulate at least two routine functions for each of the different function types (polynomial, trigonometric, reciprocal and exponential). At least one of each type will be an indefinite integral and one of each type will be a definitive integral. In total, at least eight different routine functions will be solved.

Numerical integration will be completed using each of the three approaches for at least two routine functions; these can be manipulated using a spreadsheet, provided that formulae are visible (printed out). Learners must demonstrate a clear understanding that integration arises out of considering a thin strip of area summated between limits along the x-axis of a graph. There will be evidence of simple checks to determine if numerical answers are reasonable.

Learners must demonstrate the correct use of a method when differentiating and integrating functions, and use the correct units. They must also demonstrate the correct use of a method and units when integrating functions by a numerical method – minor arithmetic and scaling errors are acceptable. There will be evidence of simple checks to determine if numerical answers are reasonable.

Learning aim C

For distinction standard, learners will demonstrate high levels of skill in presenting data from given sources and applying processing and analysis of statistical data generated from construction engineering sources. When presenting data, charts and sampling distributions will be accurate and fully reflect the data (including grouped, ungrouped, discrete and continuous) that has been given. Learners must make sure that when determining the results of a statistical analysis, it is sufficiently complex to allow learners to apply a range of routine operations (skills and methods) to their solution. For example, in terms of measures of central tendency and dispersion, learners will analyse one set of measured and four sets of equivalent historical data, such as climatic information for a location or data related to structural analysis sourced from testing and simulations. Before starting to process any data, learners will establish that the sample sizes are large enough to enable reliable analysis to be carried out.

The evidence, including graphical representations, will be easily understood by a third party with a mathematical background, who may or may not be a construction engineer. There will be correct use of mathematical terminology and the application of relevant units. Learners will work to a specified numerical precision, as determined by the assessor or that is appropriate for their chosen problems being solved, through the use of appropriate significant figures or decimal places. Small and large numerical values will be correctly presented in an appropriate format, i.e. standard form.

For merit standard, learners will present accurate solutions and analysis for construction engineering problems related to measures of central tendency, dispersion and distribution, breaking them down into planned stages to complete their analysis and to obtain solutions. They will apply appropriate routine operations (skills and methods) to present and process statistical data (including grouped, ungrouped and discrete data) accurately. For example, tabulation of data, graphical presentation of grouped and ungrouped data, and accurate calculations of mean and standard deviation comparing measured values with historical data. The numerical work will be to an appropriate degree of accuracy, as specified by the assessor or appropriate for the chosen problems being solved. Graphical representations and numerical solutions will contain an explanation of the process that will be logically structured, with the correct mathematical terminology and relevant units used. There may be a limited number of minor errors or omissions in calculations or graphical representations. For example, when analysing sampled dimensional data from climatic information, learners may determine the mean and standard deviation for a sample and find a degree of correlation between samples, but not draw conclusions from the values.

For pass standard, learners will produce at least one histogram, one chart, one frequency graph, and one cumulative frequency graph to represent grouped and ungrouped data related to a construction engineering problem, such as climatic information or ground conditions for a specific location. Learners will present the solutions of construction engineering problems involving measures of central tendency, dispersion and probability distribution. Ideally, they will research their data sets, but if this is not possible then they can be given problems to solve. The analysis may not be complete and there may be some inaccuracies or omissions but there should be evidence of some proficiency of method. Learners will apply appropriate routine operations (skills and methods) required to process statistical data. For example, when interpreting sampled wind speed data from a coastal location for one year, learners will present data appropriately and determine routine values, such as the mean and standard deviation for a sample, but may not compare the values with historical data. The report must be logically structured. It may contain some arithmetic errors which ‘carry-through’. For example, the value of the mean of a set of sampled rainfall data from a weather station may be incorrect but the value is used correctly to find the standard deviation. The methods chosen may not be optimal but the chosen statistical methods will be applied correctly. Minor errors and omissions are acceptable. Learners will include evidence of simple checks to determine if numerical answers are reasonable.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 6: Surveying in Construction
- Unit 10: Building Surveying in Construction
- Unit 11: Site Engineering for Construction
- Unit 13: Measurement Techniques in Construction
- Unit 19: Quantity Surveying
- Unit 23: Construction in Civil Engineering
- Unit 26: Conversion, Adaptation and Maintenance of Buildings.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 16: Work Experience in the Construction Sector

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners explore the benefits of work experience, carrying out and reflecting on a period of work experience and planning for their personal and professional development.

Unit introduction

If you are thinking about a career in construction, you should carry out some work experience to make you aware of the kinds of tasks and activities you may be required to complete. It will help you reflect on and develop the attributes and skills required for work in the construction sector, and will also help to extend your knowledge and understanding of the roles and responsibilities of construction professionals.

In this unit, you will learn about the benefits of work experience in construction. You will examine how work experience can help you to develop personal and professional skills such as communication and teamwork, and it will help you to understand more about the expectations of different professional roles. You will develop a plan to support your learning in placement and you will monitor your progress through a reflective journal. This is a practical unit that will support your work experience placement in construction and give you a foundation to develop, apply and reflect on knowledge and skills in a realistic situation.

A work experience placement will help you prepare for further study in a variety of higher education programmes. It is an important factor in progression to higher education and is a component of many degree courses accredited by the construction sector professional bodies.

Learning aims

In this unit you will:

A Examine the benefits of work experience in construction for own learning and development

B Develop a work experience plan to support own learning and development

C Carry out work experience to meet set objectives

D Reflect on the development of own personal and professional skills and practices.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine the benefits of work experience in construction for own learning and development	**A1** Developing skills and attributes **A2** Clarifying expectations for employment in construction **A3** Exploring career options	A report evaluating the benefits of work experience in the construction sector and the importance of preparing for placement. The report must include a plan to meet personal and professional goals.
B Develop a work experience plan to support own learning and development	**B1** Preparing for work experience **B2** Setting goals and learning objectives	
C Carry out work experience to meet set objectives	**C1** Work experience tasks **C2** Work shadowing and observation	Observation of learners on work placements in the construction sector, carrying out tasks and activities and interacting with customers and staff, evidenced by an observation report signed by the assessor. Reflective log evaluating learners' own development on work placement.
D Reflect on the development of own personal and professional skills and practices	**D1** Reviewing personal and professional development **D2** Using feedback and action planning	

Content

Learning aim A: Examine the benefits of work experience in construction for own learning and development

A1 Developing skills and attributes

- Reflecting on own skills, attributes and areas for development.
- Developing professionalism.
- Communication and interpersonal skills.
- Organisational skills, e.g. time management, prioritising tasks.
- Technical and professional skills and their application in the workplace.
- Ability to link theory with practice.
- Teamwork skills.
- Confidence and personal responsibility.
- Developing a work ethos, to include a positive attitude to work.
- Understanding the importance of working relationships and agreed ways of working in construction – developing trust, mutual respect, mindfulness, open communication, welcoming diversity.

A2 Clarifying expectations for employment in construction

- Understanding the rights and responsibilities of employees.
- Respecting diversity, equality and dignity in the workplace.
- Respecting confidentiality.
- Understanding health, safety and security regulations.
- Preparing for employment in the sector.

A3 Exploring career options

- Working in different construction professional roles, e.g. quantity surveying, construction design, structural engineering.
- Working in different construction technical roles, e.g. architectural technician, assistant site engineer, planner.
- Sources of information about careers and career pathways in construction.
- Professional construction bodies and types of membership, to include Royal Institution of Chartered Surveyors (RICS), Chartered Institute of Building (CIOB), Institution of Civil Engineers (ICE), Royal Institute of British Architects (RIBA).
- Using work experience to inform career choices, confirm ideas or consider alternative options.

Learning aim B: Develop a work experience plan to support own learning and development

B1 Preparing for work experience

- Expectations for learners carrying out work experience, to include dress, behaviour, attitude.
- Responsibilities and limitations for learners carrying out work experience, e.g. restrictions due to lack of experience or training requirements to carry out tasks.
- Researching specific work experience placements, e.g. organisation, roles.
- Role of placement supervisors/mentors.
- Planning for work experience, to include own expectations, provider’s expectations, intended outcomes, negotiation of specific areas of experience.
- Initial contact with work experience provider to establish working relationship.

B2 Setting goals and learning objectives

- Reflecting on current knowledge and skills.
- Identifying own strengths and areas for development.
- Identifying established standards and values required for professionals, e.g. entry requirements for membership of professional bodies such as RIBA, CIOB, RICS, ICE.
- Identifying SMART (specific, measurable, attainable, realistic, time-related) targets for own work experience.
- Setting personal development goals, e.g. developing communication skills, confidence.
- Setting professional development goals, e.g. developing competence, technical ability.
- Recording goals and objectives in a work experience journal or record.

Learning aim C: Carry out work experience to meet set objectives

C1 Work experience tasks

- Assisting and participating in construction tasks, e.g. preparing the workplace to carry out given tasks.
- Assisting and participating in non-construction tasks, e.g. attending meetings, general office tasks.
- Participating as part of a team.
- Understanding the importance of supervision of work activities.
- Using work experience reflective journals to link theory with practice, reflecting on how work experience placement influences own professional development.
- Involvement in project work directed by the employer.

C2 Work shadowing and observation

- Observing working relationships.
- Work shadowing different professionals to appreciate the range of construction roles and activities.
- Observing specific procedures to gain new knowledge and skills.
- Reflecting on work practice and procedures observed in the setting.

Learning aim D: Reflect on the development of own personal and professional skills and practices

D1 Reviewing personal and professional development

- Understanding that reflective practice is an ongoing activity.
- Theories and frameworks for reflective practice:
  - Schön – reflection in action and reflection on action
  - Gibbs – reflective cycle
  - Kolb – experiential learning.
- Reviewing work experience reflective journal.
- Reflecting on personal and professional development.
- Monitoring, evaluating and revising own practice.
- Supporting continuous quality improvement.

D2 Using feedback and action planning

- The importance of continuing professional development (CPD).
- Identifying areas of positive and constructive feedback.
- Highlighting areas for improvement.
- Creating an action plan for personal and professional development.
- Identifying career goals.

Assessment criteria

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td colspan="2">Learning aim A: Examine the benefits of work experience in construction for own learning and development</td><td rowspan="4">AB.D1 Evaluate your own preparation and planning for work experience in the construction sector.</td></tr>
<tr><td>A.P1 Explain how your own preparation for work experience focuses on the development of personal skills and attributes.
A.P2 Explain how your own preparation provides opportunities to reflect on career choices in the construction sector.</td><td>A.M1 Discuss your own preparation for work experience in the construction sector.</td></tr>
<tr><td colspan="2">Learning aim B: Develop a work experience plan to support own learning and development</td></tr>
<tr><td>B.P3 Produce a plan for your own work experience in the construction sector.
B.P4 Explain how to meet own specific personal and professional development goals while on work placement.</td><td>B.M2 Discuss your own planning for work experience in the construction sector.</td></tr>
<tr><td colspan="2">Learning aim C: Carry out work experience to meet set objectives</td><td rowspan="4">C.D2 Demonstrate work-related skills proficiently, taking the initiative to carry out activities according to own responsibilities and setting’s procedures, and selecting appropriate skills and techniques for different situations.
D.D3 Evaluate how reflecting on skills developed during own work experience placement can inform plans for personal and professional development.</td></tr>
<tr><td>C.P5 Demonstrate work-related skills to meet set objectives for work experience tasks.
C.P6 Discuss ways in which work shadowing and observation can support development of own skills while on work placement.</td><td>C.M3 Demonstrate work-related skills with confidence and proficiency to meet objectives in different situations.</td></tr>
<tr><td colspan="2">Learning aim D: Reflect on the development of own personal and professional skills and practices</td></tr>
<tr><td>D.P7 Review own strengths and areas for development in response to feedback on work experience placement.
D.P8 Produce a personal development plan that identifies improvements to personal and professional skills.</td><td>D.M4 Discuss how self-reflection can contribute to personal and professional development and future planning, following a work experience placement.</td></tr>
</table>

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, B.P3, B.P4, A.M1, B.M2, AB.D1)

Learning aims: C and D (C.P5, C.P6, D.P7, D.P8, C.M3, D.M4, C.D2, D.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to a ten working-day equivalent work experience placement in a construction setting.

Essential information for assessment decisions

Learning aims A and B

For distinction standard, learners will reach valid judgements about the benefits of preparation for work experience placements. They must use research to justify the validity of proposals about the expectations of work experience and articulate their views concisely to justify conclusions. They must draw on and show knowledge to make suitable justifications and recommendations for their planned placement.

For merit standard, learners will make reasoned, analytical judgements involving comparison and discussion. They must use research to extend their understanding about the expectations of work experience placements. They must select and apply knowledge to demonstrate the relevance and purpose of their work experience plan to support their learning and development.

For pass standard, learners will recall key knowledge to demonstrate their understanding of how work experience can provide preparation for employment in construction. Learners must use research with relevance to given situations to explain their responsibilities and limitations in a work experience placement. They must select and organise information using appropriate knowledge and concepts to produce a plan to meet their specific personal and professional development goals while on work placement.

Learning aims C and D

For distinction standard, learners will make valid judgements about the risks and limitations of techniques and processes used in relation to desired outcomes and own skills development. They must select appropriate skills and techniques in relation to the work situation and desired outcomes, and show that they have developed their skills to achieve increased quality of outcomes while on placement. For example, they must communicate professionally using appropriate methods for their audience to achieve desired outcomes.

Learners must show initiative while acting within expected constraints and assess their contribution to at least three different work-related tasks and three work-shadowing tasks or observations. Learners must justify any decisions taken related to their work situation. They must manage themselves successfully to prioritise activities and monitor their own progress.

They must engage actively with others and on their own initiative to gain feedback and to create opportunities for personal improvement. They must evaluate the basis for taking decisions in their work experience placement and respond effectively to feedback. They must draw together their learning and experiences gained across the learning aims, demonstrating valid insights into their own planning and performance in order to plan their future personal and professional development.

For merit standard, learners will act within given work-related contexts to show required attributes and select and deploy appropriate techniques, processes and skills with increased confidence and proficiency to meet set objectives in three different work experience situations. Learners will modify techniques and processes to suit different situations and to deal with contingencies. For example, they must select and use appropriate communication methods to suit particular audiences, such as interacting with different staff or contributing to a team meeting. They will reflect on knowledge and skills gained through three work-shadowing experiences or observations. They must manage their time to prioritise activities and progress towards required outcomes.

Learners will use knowledge, skills and understanding to select and justify solutions in relation to how work experience tasks support their personal and professional development. They must monitor their achievement against their work experience plan to ensure the relevance of targets, and must reflect actively on evidence of their own performance using feedback from others.

For pass standard, learners will carry out tasks and activities fully, correctly and safely to achieve required outcomes. Learners must select appropriate techniques, processes or skills in well-defined situations, and review the success of these techniques, processes and skills in relation to three work experience tasks and three work-shadowing experiences or observations. They must identify the responsibilities of staff in the placement and relate this knowledge to occupational roles and organisational structures. They must communicate in a variety of ways, using appropriate English, vocational language and graphical methods, responding to communication from others. They must manage their time effectively to carry out work activities and manage outcomes.

Learners will apply knowledge, skills and understanding to explore solutions to realistic and vocational tasks in relation to the ways in which work shadowing and observation can support personal and professional development.

Learners must maintain structured records of their work experience that show how they have planned opportunities to develop their skills and gain feedback on their performance from others.

Links to other units

This unit links to all the other units in the qualification.

Employer involvement

This unit would benefit from employer involvement in the form of:

- opportunities for observation during the work experience
- assessment of any project work.

Unit 17: Projects in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners explore a real-life construction project and consider the different aspects of the project, from design through to impact in use.

Unit introduction

Every year across the globe both big and small construction projects take place. Have you ever considered what the thought process was for a design, why they chose to clad a building with limestone and not glass, or why they designed a flat roof and not an elaborated pitched roof with vaulted ceilings? What about the impact a building has on the local environment, or how the building design can impact on local climatic conditions?

In this unit, you will explore a real-life construction project. You will consider the categorisation of the project and the associated design considerations. You will examine the methods and techniques of construction, and the materials used in the project, before developing an understanding of the potential economic and social impacts of the project. You will consider the positive and negative impacts on the natural environment, locally and globally.

This unit will help you to progress to a higher-level construction programme, such as the Higher National in Construction, or to a degree in construction or architecture. Additionally, the content of this unit will support progression to careers in site or project management, or to other professional roles in construction, such as architecture, quantity surveying, building services engineering and structural engineering.

Learning aims

In this unit you will:

A Examine the design of a construction project

B Investigate methods and techniques used in a construction project

C Explore the impact of a construction project.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine the design of a construction project	**A1** Types of construction project **A2** Design considerations of construction projects	Part one of a presented or written and illustrated portfolio, analysing and discussing a given construction project scenario that builds on and references other learning aims.
B Investigate methods and techniques used in a construction project	**B1** Methods and techniques for different construction projects **B2** Material selection for construction projects	Part two of a presented or written and illustrated portfolio, analysing and discussing a given construction project scenario that builds on and references other learning aims.
C Explore the impact of a construction project	**C1** Economic impacts of a construction project **C2** Societal impacts of a construction project **C3** Environmental impacts of a construction project	Part three of a presented or written and illustrated portfolio, analysing and discussing a given construction project scenario that builds on and references other learning aims.

Content

Learning aim A: Examine the design of a construction project

The different sectors, design options and the context in which the project has been developed.

A1 Types of construction project

The categorisation of construction projects and how the design of the project meets the needs of stakeholders, to include new build, conversion and refurbishment.

- Commercial projects.
- Industrial.
- Residential.
- Educational.
- Leisure.
- Mixed-use.
- Civil engineering:
  - infrastructure
  - large structures.

A2 Design considerations of construction projects

The design style and considerations to meet the functional and aesthetic requirements of a construction project.

- Architectural style.
- Size and massing.
- Local vernacular.
- Design influences:
  - planning requirements
  - legislation
  - client needs
  - building use.
- Environmental influences.

Learning aim B: Investigate methods and techniques used in a construction project

B1 Methods and techniques for different construction projects

Methods and techniques of construction, their environmental impact and suitability for different building types and uses.

- Forms of construction, to include:
  - traditional
  - frame
    - rectangular skeletal
    - portal
    - prefabricated timber
    - in-situ concrete
    - precast concrete
  - crosswall
  - surface structure
  - cellular
  - modular.
- Methods and techniques used in the construction of:
  - groundworks and substructures
  - superstructures
  - external works
  - use of construction plant.

B2 Material selection for construction projects

Selection and use of different materials and why they are fit for purpose, for the following elements.

- Foundations and substructure.
- Structural elements of the superstructure.
- External envelopes.
- Internal finishes.
- Fixtures and fittings.
- Services installations.
- External works.

Learning aim C: Explore the impact of a construction project

C1 Economic impacts of a construction project

Economic benefits and drawbacks of a project.

- Growth and development of the area.
- Regeneration.
- Economic blight, to include increased rental costs and the cost of maintaining the quality of older structures.
- Employment opportunities during and after construction.
- Benefits to the local supply chain.
- Multiplier effect of local spending.
- Economic sustainability:
  - short-term versus long-term benefits of a project
  - life expectancy of a project.

C2 Societal impacts of a construction project

Benefits and drawbacks of a project in terms of its impact on the local population.

- Provision of fit-for-purpose:
  - services
  - housing
  - leisure facilities
  - infrastructure
  - public buildings
  - public spaces
  - transport links.
- Feelings of wellbeing and security.
- Improved public health.
- Provision of community focus.
- Disruption during construction:
  - noise
  - dust
  - restrictions, e.g. roads closed, service reductions.
- Increased traffic.
- Incongruent design and materials.
- Increased urban density.
- Loss of local open space.
- Obstructed views.
- Climatic changes.

C3 Environmental impacts of a construction project

Benefits and drawbacks of a project in terms of its impact on the local environment and the wider environmental consideration.

- Local environment:
  - improved public spaces
  - removal of derelict or obsolete properties
  - environmental clean-up
  - increase in pollution, to include water, ground, air, noise and light
  - increased demand on services provision
  - increased traffic flow.
- Climatic impacts.
- Wider environmental considerations:
  - reduction in natural resources
  - increased use of energy
  - micro-regeneration
  - carbon offsetting.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine the design of a construction project		**A.D1** Evaluate the design choices made in meeting the functional and aesthetic requirements of the project and the needs of stakeholders.
A.P1 Explain how the design of the project meets functional requirements. **A.P2** Explain how the design of the project meets aesthetic requirements.	**A.M1** Discuss the design choices made in meeting the functional and aesthetic requirements of the project.	
Learning aim B: Investigate methods and techniques used in a construction project		**B.D2** Justify the methods, techniques and materials used in the construction of the project.
B.P3 Explain the methods and techniques used in the construction of the project. **B.P4** Explain the selection of materials used in the construction of the project.	**B.M2** Assess the methods, techniques and materials used in the construction of the project.	
Learning aim C: Explore the impact of a construction project		**C.D3** Evaluate the overall impact of the construction project.
C.P5 Explain the economic impacts of the construction project. **C.P6** Describe the societal impacts of the construction project. **C.P7** Explain the environmental impacts of the construction project.	**C.M3** Assess the economic, societal and environmental impacts of the construction project.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aim: B (B.P3, B.P4, B.M2, B.D2)

Learning aim: C (C.P5, C.P6, C.P7, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to design plans for a project that is sufficiently detailed and sized to allow access to the higher grades. A simple single-storey house extension, for example, will not allow this. However, a new shopping centre would be too large at this level.

Essential information for assessment decisions

Centres are encouraged to allow learners the opportunity (with guidance) to self-select a project for the assessment. The assessment instrument(s) should then be written in such a way that learners can build and develop their learning. The unit is best considered holistically for assessment purposes. Learners should be encouraged to think of the project in the round and not take each aspect in isolation.

Learning aim A

For distinction standard, learners will evaluate the design choices made in meeting the functional and aesthetic requirements of the project, as well as the needs of stakeholders associated with it. They will draw on varied information to consider the strengths and weaknesses of the choices made and consider why, on a given project, some design considerations have greater importance than others. They will show an explicit understanding of how each project is unique, and how the considerations for one will be very different to others, highlighting which are more important and why. Learners will consider conflicting requirements, such as function and form, in the context of the stakeholder needs and the aesthetics specific to the location of the project.

For merit standard, learners will discuss the design choices made in meeting the functional and aesthetic requirements of the project. They will consider how these requirements interrelate, considering a range of design aspects, as well as the construction of the project and the extent to which they are important, giving reasons why.

For pass standard, learners will explain how the design of the project meets the functional requirements of the brief and the needs of the end user. They will also explain how the design of the project meets aesthetic requirements, taking into account the local vernacular and the specific location of the project. Learners will show that they comprehend the objectives of the project in terms of meeting aesthetic and functional requirements.

Learning aim B

For distinction standard, learners will justify the methods, techniques and materials used in the construction of the project, analysing the design and construction decisions of others and drawing on appropriate supporting evidence from multiple sources. (It is not acceptable to simply state that this is the best method of construction or the best material in this environment.) Learners will use sound reasoning or evidence to prove that the methods and techniques used in the construction of the project are appropriate for use in the context of the project.

For merit standard, learners will assess the methods, techniques and materials used in the construction of the project, presenting a careful consideration of the various methods and techniques that apply to the situation. They will identify the key methods and techniques that are most relevant to the project, relating them to their suitability for the project.

For pass standard, learners will explain the methods and techniques used in the construction of the project, considering why they are the most appropriate. They will focus on the rationale for the selection of materials rather than the material choice alone. Learners will show that they comprehend the reasons for the use of the various methods, techniques and materials in the project.

Learning aim C

For distinction standard, learners will evaluate the overall impact of the construction project, including detailed consideration of its economic, societal and environmental impact. They will consider both positives and negatives, and how these combine or balance. Learners will make an evidence-based, evaluative judgement on the overall impact that the specific construction project has had.

For merit standard, learners will assess the economic, societal and environmental impacts of the construction project, identifying the important factors. They will arrive at an appropriate conclusion, taking into account both positive and negative aspects of the project.

For pass standard, learners will consider the economic, societal and environmental impacts of the construction project. In describing societal impacts, learners will give a clear, objective account of the impact of the project on society, demonstrating application of knowledge and understanding relevant to the project scenario. In explaining economic and environmental impacts, they will show that they comprehend the effect that the project will have on the local and/or national economy and the environment locally, and in a wider context.

Links to other units

This unit links to:

- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 8: Building Regulations and Control in Construction
- Unit 10: Building Surveying in Construction
- Unit 24: Planning Application Procedures in Construction.

Employer involvement

This unit would benefit from employer involvement in the form of:

- site visits to both current and completed projects
- talks from designers and specifiers on projects that learners can access readily
- workplace visits to observe construction in action, especially to the offices of design professionals.

Unit 18: Building Information Modelling

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners will develop knowledge and an awareness of the principles and use of building information modelling (BIM) technologies to streamline the design, construction and usage of building projects.

Unit introduction

Working in the construction industry, you will increasingly need to know about and use BIM. It aims to coordinate all aspects of a building project, from its design, construction and operation, to its repurposing and recycling at the end of its useful life.

This unit will introduce you to the Royal Institute of British Architects (RIBA) Digital Plan of Work (DPoW) and the Common Data Environment (CDE) in which it operates for a BIM-enabled design and construct project. It will cover the information management environment, Construction Operations Building information exchange (COBie) and BIM deployment strategies, and their contribution to improved communications between all parties, statutory control approval, sustainability and potential gains from modern methods of construction. The unit will investigate the effect of policies, standards and legislation in the BIM-enabled environment on a design and construct project.

You may further your knowledge and understanding of BIM by progressing to a construction industry-related degree, and then specialising in a BIM-specific role or using BIM in your chosen construction profession.

Learning aims

In this unit you will:

A Examine the application of the RIBA Digital Plan of Work in an information management environment

B Examine the construction information management environment

C Investigate the contribution of information management technologies in a BIM-enabled design and construct project

D Investigate the effect of policy, standards and legislation on the BIM-enabled environment.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine the application of the RIBA Digital Plan of Work in an information management environment	**A1** RIBA Digital Plan of Work **A2** BIM and its implementation in the RIBA DPoW **A3** Common Data Environment (CDE) and the RIBA DPoW	A report showing the application of the RIBA DPoW and the support provided by the CDE within a BIM-enabled design and construct project.
B Examine the construction information management environment	**B1** Construction Operations Building information exchange (COBie) **B2** BIM deployment strategies **B3** Security of data **B4** Controlling the flow of information in a CDE	A presentation or report showing how information flows are kept secure and how information technologies contribute to this, including how they support sustainability, statutory control and use of modern methods of construction in a BIM-enabled environment design and construct project.
C Investigate the contribution of information management technologies in a BIM-enabled design and construct project	**C1** BIM and sustainability and statutory control approval **C2** BIM and modern methods of construction	
D Investigate the effect of policy, standards and legislation on the BIM-enabled environment	**D1** The DPoW and new working methods and practices **D2** BIM, buildability, and Construction Design and Management (CDM) regulations and working practices **D3** Industry, professional and government policies and legislation, and working practices **D4** Allocating roles and resources	A presentation or report showing the effect on a BIM-enabled design and construct project of policy, standards and legislation application, to include roles and resources.

Content

Learning aim A: Examine the application of the RIBA Digital Plan of Work in an information management environment

A1 RIBA Digital Plan of Work

Learners will need an awareness of the stages of the RIBA Digital Plan of Work (DPoW) and its application to the Employer's Information Requirements (EIR).

- The DPoW stages, their sequencing and who does what:
  - 1. Brief
  - 2. Concept
  - 3. Definition
  - 4. Design
  - 5. Build and commission
  - 6. Handover and close out
  - 7. Operation and end of life.

A2 BIM and its implementation in the RIBA DPoW

Learners will need an awareness of the characteristics of BIM and its implementation.

- BIM protocol and how it:
  - enables digital technology design
  - embeds key product and asset data in all project stages
  - manages information throughout the project lifecycle using three-dimensional (3D) computer modelling
  - provides an information repository for digital data project information throughout a design and construct project, with the capability to manipulate to produce information and support information sharing
  - produces unified information output for the client at handover.
- BIM levels of maturity:
  - requirements of each level of maturity
  - BIM maturity requirement timescales and impact on design and construct projects.

A3 Common Data Environment (CDE) and the RIBA DPoW

Learners will need an awareness of how CDE supports the operation of a BIM-led design and construct project.

- How CDE functions, including the advantages and disadvantages of composite and federated information environments.
- Measures required to ensure that:
  - a construction project's CDE is up to date
  - the content is suitable and accurate.

Learning aim B: Examine the construction information management environment

Learners will need to be introduced to the concept of Construction Information Management.

B1 Construction Operations Building information exchange (COBie)

- The contribution of COBie to the ease of and optimisation of the running, maintenance and repair of a building and its services, including:
  - facilities management benefits
  - repair and renewal scheduling.
- Source of manufacturer and supplier information and specifications in a common format, including the coding of EIR.

- Holding of the project information model:
  - end-of-work stages
  - originator and sign-off
  - multiple and single shared data
  - embedding data
  - archive and published data
  - BIM levels.

B2 BIM deployment strategies

Learners will need to have an awareness of the contribution of smart and linked technologies to remotely locate, access and manage project information and activities.

- Digital technology considerations in a BIM environment:
  - hardware capacity
  - software suitability and compatibility
  - competences to effectively apply smart technologies.
- Use digital technology to:
  - plan and carry out routine maintenance and servicing
  - determine component replacement
  - define asset end of life.

B3 Security of data

Learners will need to understand the importance of and requirements to protect data, intellectual properties, legal requirements, sensitive designs, specifications and other project information, to include:

- setting and controlling protocols and access permissions
- version control.

B4 Controlling the flow of information in a CDE

Learners will need to have an awareness of the stages of information flow in a CDE including roles of the team at each point.

- Work in progress – end of work stages.
- Shared published archive.
- Project information model.
- Originator and sign-off.
- Multiple and single shared area.
- Embedding data.
- Archive and published data.

Learning aim C: Investigate the contribution of information management technologies in a BIM-enabled design and construct project

C1 BIM and sustainability and statutory control approval

Learners will need an awareness of the contribution of BIM to sustainability and gaining statutory control approval before construction commencement.

- Sustainability requirements:
  - Building Research Establishment Environmental Assessment Method (BREEAM) assessment:
    - materials selection
    - service specifications, to include optimising renewable sources of heating and cooling, and the use of natural resources, including natural light and natural ventilation methods through the efficient orientation of the structure
    - lifestyle energy use and life cycle analysis
    - adaptability and future proofing.
- Use of BIM to obtain statutory approval, e.g. building consent and planning permission for both retrofit projects for adaptation and new builds.

C2 BIM and modern methods of construction

Learners will need an understanding of the contribution of the BIM 3D virtual environment and its support of modern methods of construction (MMC).

- Construction time and waste reduction, e.g. efficient factory production, delivery to installation, logistical planning.
- 3D printing and off-site component manufacture use, e.g. transport costs reduction, allowing for flexibility in requirements.

Learning aim D: Investigate the effect of policy, standards and legislation on the BIM-enabled environment

D1 The DPoW and new working methods and practices

Learners will need to show an awareness of the DPoW and BIM, their influence on new work methods and working practices.

- The DPoW stages:
  - 1. Brief
  - 2. Concept
  - 3. Definition
  - 4. Design
  - 5. Build and commission
  - 6. Handover and close out
  - 7. Operation and end of life.
- Effect on design, construction and maintenance roles due to streamlined information flow and connected communications.
- Data security and permissions for appropriate parties.
- New responsibilities and accountability arising from the information left by BIM and its data trail:
  - traceability of roles, responsibilities and decision making during a design and construct project
  - ability to trace errors back to their source.

D2 BIM, buildability, and Construction Design and Management (CDM) regulations and working practices

Learners will need to appreciate the ability of BIM to model designs and processes virtually and in advance of construction to enable the main parties in a design and construction project to:

- identify design issues
- consider best building methods and practices
- overcome construction planning clashes and logistical problems
- comply with Construction (Design and Management) Regulations 2015, or subsequent updates, to enable safe systems of work to be agreed on and put in place before construction commences.

D3 Industry, professional and government policies and legislation, and working practices

Learners will need to know the effect of industry bodies, government policy and legislation on BIM content, implementation and timelines on design and construct projects using information management technologies:

- national statutory instruments
- health and safety commission (HSC)/executive(HSE) requirements
- building acts
- UK Construction Project Information Committee (CPIC)
- Construction Industry Council (CIC) BIM protocol, e.g. contracts for design and construct projects
- International Standards Organisation (ISO) and British Standard Institute (BSI) standards
- CIC

- Construction Leadership Council (CLC)
- Construction Product Regulations (CPR) and CE marking.

D4 Allocating roles and resources

Learners will understand the effect of the RIBA DPow and BIM on resources required, roles, teamwork and collaboration.

- Resources, e.g. hardware and software requirements to support BIM and personnel working in this environment.
- Dealing with information and communications in a real-time environment, how it looks and works, and its security.
- The roles and responsibilities of individuals given in the RIBA DPoW roles, e.g. lead designer, BIM manager, BIM co-ordinator, CAD/IT technician, manufacturer, project manager, site manager.
- New responsibilities and accountability arising from the information left by BIM and its data trail.
- Building contract requirements and supporting industry guidelines:
    - The Construction Industry Council (CIC) BIM Protocol supplementary contract agreement for appointments by construction clients and their contractors key content:
        - BIM model production
        - delivery requirements
        - information requirements.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine the application of the RIBA Digital Plan of Work in an information management environment		**A.D1** Evaluate the application of the RIBA DPoW and CDE in a BIM-enabled design and construct project.
A.P1 Describe the application of the RIBA DPoW stages in a BIM-enabled design and construct project. **A.P2** Describe how the CDE supports a BIM-enabled design and construct project.	**A.M1** Analyse the application of the RIBA DPoW and CDE in a BIM-enabled design and construct project.	
Learning aim B: Examine the construction information management environment		**BC.D2** Evaluate the contribution of information management technologies, COBie and BIM deployment strategies for a design and construct project.
B.P3 Outline the contribution of COBie and BIM deployment strategies to support the secure flow of information for a design and construct project.	**B.M2** Explain the contribution of COBie and BIM deployment strategies to support the secure flow of information for a design and construct project.	
Learning aim C: Investigate the contribution of information management technologies in a BIM-enabled design and construct project		
C.P4 Describe the contribution of BIM use to sustainability for a specific design and construct project. **C.P5** Describe the contribution of BIM use to gain statutory control for a specific design and construct project. **C.P6** Describe the contribution of the 3D BIM environment to modern methods of construction use for a specific design and construct project.	**C.M3** Explain the contribution of BIM for a specific design and construct project.	
Learning aim D: Investigate the effect of policy, standards and legislation on the BIM-enabled environment		**D.D3** Evaluate the effect of industry, professional and government policies, legislation and standards on construction activities, roles and resources for a given BIM-enabled design and construct project.
D.P7 Outline the effect of industry, professional and government policies, legislation and standards on construction activities for a given BIM-enabled design and construct project. **D.P8** Outline the allocation of roles and resources for a given BIM-enabled design and construct project.	**D.M4** Discuss the effect of industry, professional and government policies, legislation and standards on construction activities, roles and resources for a given BIM-enabled design and construct project.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aims: B and C (B.P3, C.P4, C.P5, C.P6, B.M2, C.M3, BC.D2)

Learning aim: D (D.P7, D.P8, D.M4, D.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to suitable BIM-enabled design and construct project case studies. This may include employer engagement for the design and construct project information requirements.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will demonstrate a structured, coherent, logical and comprehensive evaluation of the application of the RIBA DPoW and the support offered by the CDE, associated with an information management environment in a BIM-enabled design and construct project. They will use technical terms and information consistently and correctly. They will use relevant graphical information, which will be clear and effective in supporting their evaluation. Their evaluation will include a supported conclusion on the application of the RIBA DPoW and CDE in a BIM-enabled design and construct project.

For merit standard, learners will produce a structured and coherent analysis of the application of the RIBA DPoW and the support offered by the CDE, associated with an information management environment in a BIM-enabled design and construct project. They will demonstrate some consistency and use of technical terms and information. They will use some relevant graphical information, although this may not always be used effectively to support their statements. Learners may have some RIBA DPoW sequencing issues or miss out a stage. They are not required to draw a conclusion.

For pass standard, learners will describe the application of the RIBA DPoW and the support offered by the CDE, associated with an information management environment in a BIM-enabled design and construct project. They will attempt to use technical terms but sometimes these may not be applied consistently and/or appropriately. Graphical information may contain some inaccuracies and may not support the BIM-enabled project.

Learning aims B and C

For distinction standard, learners will demonstrate a coherent, structured, comprehensive and wide-ranging evaluation of COBie's contribution to a design and construct project and the BIM deployment strategies required to manage and convey information securely in a CDE. Their evaluation will show the contribution of IT to current sustainability standards, including the incorporation of modern construction methods and obtaining statutory control approval. Where they use graphical information, this will be clear and effective in supporting their evaluation. The sources they quote must be widely recognised as authoritative in the construction industry.

For merit standard, learners will explain COBie's contribution to a design and construct project but their explanation may be limited with respect to the importance and value of this contribution. They will explain the BIM deployment strategies required to manage and convey information securely in the design and construct project's CDE, but this may show some imbalance. The explanation will show the contribution of IT to support current sustainability standards, including the incorporation of modern construction methods and obtaining statutory control approval. Where they use graphical information, this may not always be clearly linked and/or relevant to the explanation.

For pass standard, learners will outline COBie's contribution to a design and construct project but there will be no indication of the importance and value of this contribution. They will describe the BIM deployment strategies required to manage and convey information securely in the design and construct project's CDE, but this will show some omissions or imbalance. The description will provide some details of the contribution that IT provide to support current sustainability standards, including the incorporation of modern construction methods and obtaining statutory control approval.

Learning aim D

For distinction standard, learners will, for the given design and construct project, provide a coherent, structured, comprehensive and wide-ranging evaluation of the effect of BIM-related industry, professional and government policies, legislation and standards on processes, practices, resource requirements, work roles and responsibilities. They will give a balanced consideration of the interrelationships between these items and their relative importance to fully support their conclusions.

For merit standard, learners will, for the given design and construct project, provide a structured discussion of the effect of BIM-related industry, professional and government policies, legislation and standards on processes, practices, resource requirements, work roles and responsibilities. There may be some imbalance or omissions in their consideration of the interrelationships and their relative importance. A conclusion is not required.

For pass standard, learners will, for the given design and construct project, provide an outline description of the effect of BIM-related industry, professional and government policies, legislation and standards on processes, practices, resource requirements, work roles and responsibilities. Learners will provide an overview of their consideration of interrelationships and their consideration of their relative importance may be limited.

Links to other units

This unit links to:

- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 9: Management of a Construction Project.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers
- participation in audience assessment of presentations
- ideas to contribute to case study materials for teaching and assessment
- own BIM-enabled design and construct project materials as exemplars
- work experience in a BIM-enabled environment.

Tutors would benefit from accessing industry resource and expert training materials on BIM, for example those available through the websites of external experts, such as Offsite Ready, BIM Academy and MOBIE.

Unit 19: Quantity Surveying

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners understand the underlying principles of quantity surveying when working for both the client and main contractor.

Unit introduction

The financial management of construction projects has to be closely monitored to ensure that projects meet the financial needs of both the client and the contractor. The client needs the project to be completed within budget and the contractor needs to maximise return on the project.

In this unit, you will gain an understanding of the role of a quantity surveyor and the differences when working for a client and a main contractor. You will learn about the financial management of contracts, including the preparation of valuations and the administration of variations, through to the preparation of the final account. You will also learn about the management of cash flow in an organisation, including valuations and payments to subcontractors, suppliers and manufacturers. You will complete a final account for a given project.

This unit will support you in progressing to a higher-level construction programme, such as the Higher National in Construction (with the quantity surveying pathway), or to a general construction or quantity surveying degree. It also supports progression to the workplace as a technician, or direct entry as an assistant quantity surveyor with a construction company.

Learning aims

In this unit you will:

A Understand the functions of a quantity surveyor

B Undertake the production of bills of quantities for a project

C Undertake the production of a final account for a project.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the functions of a quantity surveyor	**A1** Professional quantity surveyor (PQS) functions **A2** Main contractor quantity surveyor functions **A3** Preparation of bills of quantities **A4** Financial management **A5** Contractual management	Learners will explain the differences between a professional quantity surveyor and a main contractor's quantity survey.
B Undertake the production of bills of quantities for a project	**B1** Taking off **B2** Abstraction and bill production	Using a set of given drawings, learners will produce bills of quantities for two elements: a substructure and an element of superstructure.
C Undertake the production of a final account for a project	**C1** Variations **C2** Valuations and final accounts	Using a scenario and information given, learners will produce a final account for a given project.

Content

Learning aim A: Understand the functions of a quantity surveyor

A1 Professional quantity surveyor (PQS) functions

The PQS acts mainly for a client in the preparation of the following in support of the feasibility of a proposal.

- The preparation of cost budgets:
  - providing guidance to the architect on the scale and type of construction that can be designed within a given budget
  - using historical cost data:
    - obtained from similar developments
    - analysis of elements
    - elemental analysis using bills of quantities data from previous projects
  - using Building Cost Information Service (BCIS) data:
    - types of available data from BCIS
    - identifying appropriate data from similar construction project types
    - applying approximate quantities
    - superficial application on a cost per m^2 basis
    - updating costs to current price levels using cost indices
  - using approximate quantities:
    - taking off from available drawn information
    - using direct billing techniques
    - interpreting missing requirements
    - formulation of the cost budget
  - comparison and feasibility:
    - project feasibility studies
    - comparison of alternative project costs
    - leading value engineering workshops.
- The preparation of tender documentation to be sent out to contractors for pricing:
  - specification and drawings:
    - drawings to be provided
    - content of the specification
    - how preliminary items are included
    - how prime cost (PC) and provisional sums (PS), including contingencies, are included
  - bills of quantities:
    - content and layout
    - preliminaries
    - preambles
    - measured work sections
    - PC and PS, including contingencies and dayworks
    - final summary
  - tender documentation:
    - covering letter
    - invitation to tender
    - form of tender and return envelope
    - bill of quantities or specification and drawings
    - pre-contract programme
    - pre-construction information
    - tender drawings
    - form of contract and terms and conditions.

- Analysis of submitted tenders:
  - checking submitted bills of quantities
  - notifying errors to the lowest tendering organisation
  - adjustment of errors – standby or withdraw
  - analysing abnormal or variant bids
  - recommending final appointment of successful tendering organisation.
- Preparation of contract documents.
- Post-contract activities:
  - providing ongoing cost advice to the client
  - administration of nominated subcontracts
  - updating the projected final cost
  - remeasuring the work as required
  - producing monthly valuations in conjunction with the main contractor's quantity surveyor
  - pricing variations
  - negotiating any contractual claims for loss and expense
  - producing the final account
  - negotiating and agreeing the final account with the main contractor's quantity surveyor.

A2 Main contractor quantity surveyor functions

The functions of the main contractor's quantity surveyor and how these differ from the PQS in terms of working for a client.

- Agreeing monthly valuations of work undertaken.
- Remeasuring the work as required.
- Pricing of variations and architect's instructions and agreement with the PQS.
- Agreeing subcontract accounts and authorising payments.
- Final account preparation:
  - providing information to the PQS to facilitate final account preparation
  - pricing dayworks
  - agreeing the final account with the PQS.
- Cost control and reconciliation, including cost value comparisons.
- Preparing claims for loss and expense:
  - contractual notification letters
  - providing information to determine extensions of time
  - calculation of loss and expense claims
  - negotiating loss and expense claims.
- How, in smaller organisations, quantity surveyors may have multiple roles, to include:
  - buying:
    - negotiating prices
    - scheduling materials
    - placing all orders for resources
  - estimating:
    - sending out materials and subcontract enquiries
    - pricing tenders
    - participating in tender settlement or adjudication
  - bonus surveying and labour only subcontract payments.

A3 Preparation of bills of quantities

The preparation of a bill of quantities, schedules and specifications for the procurement processes.

- Use of standard methods of measurement:
  - New Rules of Measurement (NRM 2)
  - Civil Engineering Standard Method of Measurement, Fourth Edition (CESMM4).
- Use of measurement and bills of quantity production software packages.
- Use of dimension paper, direct billing paper and cut and shuffle paper.
- Working up quantities and abstraction.
- Producing bill of quantities pages.
- Inclusion of PC and PS.
- Direct billing and bills of approximate quantities.

A4 Financial management

The control of construction costs to ensure that a client's budget is not exceeded. Control of main contractor's costs against the tender value to maximise contribution.

- Professional quantity surveyor:
  - changes to specifications to lower costs
  - monitoring monthly valuations
  - valuing variations
  - forecasting projected final account
  - life cycle analysis.
- Main contractor quantity surveyor:
  - buying efficiently against estimate values
  - subcontract procurement
  - main contractor's discounts
  - changes to specifications to lower costs
  - ensuring delays are minimised
  - claims for variations.

A5 Contractual management

The administration of a contract on a project in terms of the clauses relating to time, risks, insurance, compensation, payments and termination.

- Joint Contracts Tribunal Contracts (JCT).
- New Engineering Contract (NEC).

Learning aim B: Undertake the production of bills of quantities for a project

The production of quantities by taking off dimensions from drawings, in accordance with a standard method of measurement. Production of a bill of quantities page that covers a construction element by writing item descriptions presented in a vocationally correct format.

B1 Taking off

Taking off quantities using appropriate mensuration techniques to produce bills of quantities for a building element.

- Substructure elements:
  - excavation
  - earthwork support
  - treatments
  - fill
  - concrete works
  - reinforcement
  - blockwork
  - cavity walls
  - damp-proof course (DPC).

- Superstructure elements:
  - solid ground floors
  - external cavity walls
  - internal partitions
  - intermediate floors.

B2 Abstraction and bill production

- Abstraction of quantities.
- Use of cut and shuffle.
- Use of direct billing methods.
- Writing bill item descriptions in accordance with a standard method of measurements.
- Format and presentation of bill items on pages.
- Page totals, collections, bill summaries and final summary.
- Use of measurement and bills of quantity production software packages.

Learning aim C: Undertake the production of a final account for a project

C1 Variations

The administration and management of a contract variation through an Architect's Instruction (AI).

- Site instructions, confirmation and issue of an AI.
- Preparation of quotations.
- Valuation and measurement of variations.
- Remeasurement of the works.
- Adjustment of provisional quantities.
- Use of unit rates and dayworks.
- Acceptance and agreement.
- Disputes and claims.
- Changes to design and significant contract durations.

C2 Valuations and final accounts

The preparation of an interim valuation to obtain a progress payment and the compilation of the final account.

- Tender sum.
- Use of bills of quantities to value the works.
- Adjustments as additions and omissions.
- Architect's Instructions and variations.
- Dayworks.
- Adjustments to PC and PS.
- Contingency adjustments.
- Extensions of time.
- Loss and expense claims.
- Adjustment for liquidated and ascertained damages.
- Calculation of the final account sum.
- Presentation of a final account, timelines and format.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand the functions of a quantity surveyor		**A.D1** Evaluate the roles of quantity surveyors for a given project scenario.
A.P1 Explain the role of the professional quantity surveyor. **A.P2** Explain the role of the contractor's quantity surveyor.	**A.M1** Discuss the roles of quantity surveyors for a given project scenario.	
Learning aim B: Undertake the production of bills of quantities for a project		**B.D2** Produce bills of quantities for construction elements in an appropriate format, with precision, accuracy and attention to detail.
B.P3 Produce quantities for a complete substructure element. **B.P4** Produce quantities for a complete superstructure element.	**B.M2** Produce bills of quantities for construction elements, in an appropriate format.	
Learning aim C: Undertake the production of a final account for a project		**C.D3** Produce a final account in an appropriate format, with precision, accuracy and attention to detail.
C.P5 Produce costings for variations. **C.P6** Produce costings for dayworks.	**C.M3** Produce a final account in an appropriate format.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aim: B (B.P3, B.P4, B.M2, B.D2)

Learning aim: C (C.P5, C.P6, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional requirements for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners must evaluate the roles of quantity surveyors for a given project scenario. Learners will consider how the roles of the professional quantity surveyor and the contractor's quantity surveyor differ and interact in the context of a complex building project. Learners will compare the differing objectives of both roles and draw conclusions relating to the key priorities for both parties in the pre- and post-contract phases of the project. Learners will demonstrate a developed understanding of the role of the quantity surveyor.

For merit standard, learners must discuss the roles of quantity surveyors for a given project scenario. Learners will cover both professional and contractor's quantity surveyors and their roles in the given scenario. Learners will consider the objectives, key focus and content in their discussions, covering the quantity surveyor's work linked to the project scenario. This will include the work of the quantity surveyors during both the pre- and post-contract phases of construction projects. Learners will demonstrate a good understanding of the role of the quantity surveyor.

For pass standard, learners must explain the roles of the professional quantity surveyor and the contractor's quantity surveyor. Learners will consider, within their explanations, the key objectives and content of the quantity surveyor's work in generic terms but without focus on the project scenario. Learners will cover the work of the quantity surveyors during the pre- and post-contract phases of construction projects. Learners will demonstrate a generic understanding of the role of the quantity surveyor.

Learning aim B

For distinction standard, learners must produce bills of quantities for construction elements in an appropriate format and with precision, accuracy and attention to detail. These will include a substructure and a superstructure element produced using vocationally relevant mensuration techniques and in accordance with an appropriate standard method of measurement.
The production of quantities and subsequent abstracting and billing can be completed using traditional paper-based methods or by using an appropriate software package. Learners will demonstrate a developed understanding of the techniques, methodologies and standards used in the production of bills of quantities.

For merit standard, learners must produce bills of quantities for construction elements in an appropriate format. These will include a substructure and a superstructure element produced using vocationally relevant mensuration techniques and generally following an appropriate standard method of measurement. The production of quantities and subsequent abstracting and billing can be completed using traditional paper-based methods or by using an appropriate software package. Learners will demonstrate a good understanding of the techniques, methodologies and standards used in the production of bills of quantities.

For pass standard, learners must produce quantities for a complete substructure element and a complete superstructure element produced using some vocationally relevant mensuration techniques and generally following an appropriate standard method of measurement.
The production of quantities can be completed using traditional paper-based methods or by using an appropriate software package. Learners will demonstrate a generic understanding of the techniques, methodologies and standards used in the take-off of quantities for the elements.

Learning aim C

For distinction standard, learners produce a final account, in an appropriate format, with precision, accuracy and attention to detail. Learners will complete the final account accurately, using sector-specific methodologies and layout. Using the contract sum as a starting point, learners will make adjustments to consider AI, dayworks, adjustment of prime cost (PC) and provisional sums (PS), loss and expense or liquidated and ascertained damages, and adjustment of contingencies. Learners will demonstrate a developed understanding of the techniques, methodologies and standards utilised in the production of final accounts.

For merit standard, learners produce a final account in an appropriate format. Learners will complete the final account using some sector-specific methodologies and layout. Using the contract sum as a starting point, learners will make adjustments to consider AI, dayworks, adjustment of PC and PS, and adjustment of contingencies. Learners will demonstrate a good understanding of the techniques, methodologies and standards utilised in the production of final accounts.

For pass standard, learners produce costings for variations and dayworks. Learners will include a cost analysis of AI and the accurate pricing of dayworks using sector-specific methodologies. Learners will demonstrate a generic understanding of the techniques, methodologies and standards utilised in the production of aspects of final accounts.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 3: Tendering and Estimating
- Unit 4: Construction Technology
- Unit 6: Surveying in Construction
- Unit 7: Graphical Detailing in Construction
- Unit 10: Building Surveying in Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 13: Measurement Techniques in Construction
- Unit 14: Provision of Primary Services in Buildings
- Unit 22: Economics and Finance in Construction
- Unit 23: Construction in Civil Engineering
- Unit 25: Property Law
- Unit 26: Conversion, Adaption and Maintenance of Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- office visits to a quantity surveying practice
- a guest speaker in the form of a professional quantity surveyor and a contractor's quantity surveyor
- employer case studies
- site visits to study quantity surveying roles.

Unit 20: Quality Control Management in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners explore the methods used in the quality control of construction work.

Unit introduction

Quality control plays a key part in ensuring that construction projects are completed on time and are fit for purpose. It is vital in ensuring that customers get a better quality building with minimal defects and lower maintenance requirements.

In this unit, you will learn about the key roles involved in construction quality control and how they contribute to the completion of a high-quality building. You will also learn about the use of standards as a benchmark for quality construction and robust detailing, including the use of construction standards, materials standards, workmanship standards and quality assurance. You will examine the systems used to control and record the quality of construction work, together with the corrective actions that may be necessary in the event of a breach of standards.

This unit will provide you with the underlying knowledge and understanding of construction quality control that links to a wide range of other units in this qualification. A sound knowledge of construction quality control is also an essential aspect of many roles, including architect, site manager, site supervisor, clerk of works and building inspector. It will provide a good foundation for studying construction-related subjects at a higher level, including degree-level programmes in construction, project management or architecture.

Learning aims

In this unit you will:

A Investigate the sources of quality standards in construction

B Understand who is responsible for the quality of construction work

C Apply systems used to control the quality of construction work.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Investigate the sources of quality standards in construction	**A1** Building standards **A2** Materials standards **A3** Workmanship standards **A4** Quality assurance	A report detailing research into the sources of quality standards in construction and how these standards impact on the quality of outcomes.
B Understand who is responsible for the quality of construction work	**B1** Design quality **B2** Production quality	A written guide for a new entrant to the construction industry explaining how the responsibility for quality is shared and delegated throughout the construction team.
C Apply systems used to control the quality of construction work	**C1** Methods of implementing quality control **C2** Recording and reporting quality **C3** Corrective action **C4** Quality plans for construction work	Produce a quality plan for quality-control systems for a given construction project scenario that details the appropriate systems to be considered.

Content

Learning aim A: Investigate the sources of quality standards in construction

A1 Building standards

The sources of building standards, how they are used and their impact on the quality of construction outcomes.

- Building regulations approved documents.
- National House Building Council (NHBC) standards.
- Codes of practice.
- Robust detailing and standards based on local experience.
- Sector-specific regulations, e.g. the Institution of Engineering and Technology (IET – formerly IEE) wiring regulations.
- Bespoke specification documents produced by architects.
- Preamble sections of bills of quantities.

A2 Materials standards

The sources of materials standards, how they are used and their impact on the quality of construction outcomes.

- British Standards (BS).
- British Board of Agrément (BBA).
- Architectural product libraries:
  - providing product details
  - confirming specifications
  - confirming recommended use.
- Professional knowledge and experience.
- Tested materials, to include:
  - hardcore and aggregates:
    - sieve analysis or grading
    - strength
    - compaction properties
    - chemical composition
  - concrete:
    - slump testing
    - compression testing
    - core sampling
  - mortar:
    - compression testing
    - workability
  - timber:
    - visual sorting
    - stress grading, to include machine grading and visual grading.
- Architect's specifications.
- Preamble sections of bills of quantities.
- Trade advisory guidance.
- Benchmarks and key performance indicators.
- Focus on materials standards for critical functions.

A3 Workmanship standards

The sources of workmanship standards, how they are used and their impact on the quality of construction outcomes.

- Contractor selection procedures:
  - site or project visits
  - pre-tender interviews
  - references and citations
  - prior working relationships
  - resources and workload checks
  - staff training and continued professional development.
- Sample panels and mock-ups as a reference point for standards, e.g. facing brickwork.
- BS codes of practice.
- NHBC workmanship requirement (R4).
- Working to acceptable tolerances.
- Industry standards.

A4 Quality assurance

Quality management systems and their impact on the quality of construction outcomes.

- International Organization for Standardization (ISO) 9000 certification:
  - document control and recording
  - standardised systems
  - concept of company quality
  - training and development
  - competencies:
    - knowledge
    - skills
    - experience
    - expertise
  - infrastructure
  - organisational culture.

Learning aim B: Understand who is responsible for the quality of construction work

B1 Design quality

The role of the design team in the development of quality building designs, robust detailing and appropriate specifications.

- The client, to include needs and requirements:
  - initial project brief
  - client's vision statement
  - budget
  - life cycle costing.
- Building designers with responsibility for the overall design:
  - architects
  - architectural technologists
  - architectural technicians.
- Engineers with responsibility for building elements:
  - structural engineers
  - building services engineers
  - electrical engineers
  - mechanical engineers
  - civil engineers.

- Specialist subcontractors and suppliers with design responsibilities for specific components or systems:
  - nominated subcontractors
  - nominated suppliers.
- Quantity surveyors in the development of preambles.
- Consultant clerk of works with local or specialist knowledge.

B2 Production quality

- The role of site-based personnel in the implementation of quality standards:
  - resident clerk of works
  - site management
  - supervisors and gangers
  - buyers
  - construction operatives
  - subcontractors.
- The role of visiting inspectors and non-site-based personnel in the implementation of quality standards, and their communication and interaction with the site-based personnel:
  - consultant clerk of works
  - building control inspectors
  - NHBC inspectors
  - BBA inspectors
  - independent building inspectors
  - building surveyors.

Learning aim C: Apply systems used to control the quality of construction work

C1 Methods of implementing quality control

How quality control is implemented in a site-based environment.

- Use of specifications and standards:
  - contract specifications
  - published standards
  - product libraries, e.g. the Barbour Index.
- Trainings and briefings:
  - training and education
  - skills development training
  - toolbox talks
  - focused briefings.
- Robust recruitment procedures:
  - checks on training and qualifications
  - references
  - testing.
- Samples and mock-ups:
  - brickwork or masonry panels
  - cladding systems
  - finishes for in-situ work
  - materials for visual or aesthetic inspection
  - frame sections and fixing methods
  - other mock-ups relevant to the project outcomes.

- Testing of materials:
  - random selection of materials for laboratory testing
  - slump testing of concrete
  - bituminous materials testing
  - metallurgy testing
  - correct preparation and curing of concrete cubes for 7- and 28-day compression testing
  - checking materials against specification requirements
  - checking materials certification, e.g. stress grading or treatment certificates for timber
  - checking to ensure deliveries are to the correct specification.
- Ultrasound testing:
  - metals, to include steel and aluminium
  - concrete
  - other materials.
- Supervision:
  - direct supervision via the management structure
  - clerk of works:
    - resident
    - visiting
  - building inspectors
  - NHBC inspectors
  - frequency of supervision or checks.
- Dimensional checks:
  - vertical
  - horizontal
  - plumb
  - face-plane deviation.
- Level checks:
  - excavation levels
  - invert levels
  - floor levels
  - level of key element or components.
- Visual checks.
- Final inspections.

C2 Recording and reporting quality

How quality is recorded and the benefits and drawbacks of each method.

- Dimensional quality-control records:
  - vertical
  - horizontal
  - plumb
  - face-plane deviation
  - level.
- Recording sample numbers and pour location for concrete testing.
- Daily, weekly and monthly reporting systems.
- Site diary of log.
- Minutes of site meetings.
- Recording corrective action taken where:
  - replacement of the work has been required
  - remedial action has been applied.
- Confirming that the work complies with specification requirements.
- Certificate of practical completion.
- Certificate of making good any defects.

C3 Corrective action

The methods and impact of corrective action on the project.

- Communicating the requirements for corrective action:
  - verbal instructions
  - site instructions
  - defects lists.
- Early intervention to minimise the impact on the project.
- Remedial action, treatment or repair of defective work.
- Demolition or dismantling of defective work.
- Indemnities against impact of defective work.
- Compensation for defective work.
- Impacts on the construction programme.
- Handover checks:
  - snagging and making good.
- Defects liability period:
  - making good of defects.

C4 Quality plans for construction work

The development of quality plans to bring together the methodologies used to produce quality outcomes on construction projects.

- Objectives to be attained, to include:
  - specifications
  - testing
  - supervision
  - recording
  - corrective action.
- Allocation of responsibilities during different phases of the project.
- Documented standards, practices, procedures and instructions to be applied.
- Testing, inspection, examination and audit at appropriate stages.
- Procedures for changes and modifications.
- Measuring the achievement.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Investigate the sources of quality standards in construction		
A.P1 Explain how building standards impact on the quality of construction outcomes. **A.P2** Explain how materials and workmanship standards impact on the quality of construction outcomes. **A.P3** Explain how quality assurance standards can impact on the quality of construction outcomes.	**A.M1** Analyse how standards can impact on the quality of construction outcomes for a given project scenario.	**A.D1** Evaluate the requirement for standards in producing high-quality construction outcomes for a given project scenario.
Learning aim B: Understand who is responsible for the quality of construction work		
B.P4 Explain the roles of the design team in the production of quality designs. **B.P5** Explain the roles of site personnel in controlling quality on site.	**B.M2** Discuss the roles of the design team, site personnel and visiting inspectors in providing outcomes of appropriate quality.	**B.D2** Evaluate the roles of the design team, site personnel and visiting inspectors, and how they interact, in providing outcomes of appropriate quality for a given project scenario.
Learning aim C: Apply systems used to control the quality of construction work		
C.P6 Explain the systems used for implementing and recording quality control on construction projects. **C.P7** Describe the corrective actions used when quality control identifies defective or non-compliant work.	**C.M3** Assess the systems used and the corrective action available to control quality for a given project scenario.	**C.D3** Justify the systems used and the appropriate corrective actions to control quality for a given project scenario.

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.P3, A.M1, A.D1)

Learning aim: B (B.P4, B.P5, B.M2, B.D2)

Learning aim: C (C.P6, C.P7, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional requirements for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will consider many aspects of construction standards, materials standards, workmanship standards and quality assurance. Learners will use this understanding to consider their relevance or significance to the quality process and draw conclusions relating to the balanced impact of the standards on the quality of construction projects.

For merit standard, learners will consider aspects of construction standards, materials standards, workmanship standards and quality assurance. In analysing, learners will present the outcome of this methodical and detailed examination of the standards, breaking down themes in order to interpret and study the interrelationships between the differing parts.

For pass standard, learners will consider how building standards, materials and workmanship standards and quality assurance impact on the quality of construction outcomes. Learners will show that they comprehend the benefits of the standards and how they are appropriate to the quality-control process.

Learning aim B

For distinction standard, learners will consider the design team, site personnel and visiting inspectors, considering how they interact and are mutually supporting the production of outcomes of appropriate quality for construction projects. They will consider how the design team is responsible for the production of robust detailing and specifications, how the site team is responsible for the implementation of appropriate quality standards and how visiting inspectors have powers to intervene when work is not being produced to appropriate standards. Throughout their work, learners will use this understanding to consider the relevance or significance of the role to the quality process and draw conclusions relating to the balance of responsibility for the quality of construction outcomes throughout the construction process.

For merit standard, learners will consider the design team, site personnel and visiting inspectors, and how they work together to provide outcomes of appropriate quality. They will consider how the design team is responsible for the production of appropriate detailing and specifications, how the site team is responsible for the implementation of appropriate quality standards and how visiting inspectors impact on quality outcomes on site. When discussing, learners will consider the different aspects of the roles and the extent to which they are important.

For pass standard, learners will consider the design team and its responsibility for the production of appropriate detailing and specifications. They will also consider the roles of site personnel in controlling quality on site, with the implementation of appropriate quality standards and the use of appropriate recruitment and training. Learners will show that they comprehend the functions and objectives of these roles and how they are appropriate to the quality-control process.

Learning aim C

For distinction standard, learners will consider the systems used and the appropriate corrective actions to control quality for a given project scenario. They will explain how early implementation of standards by appropriate quality-control systems reduces the need for drastic and costly corrective actions. They will note how quality control is recorded and reported and the importance and use of these methodologies. Learners will provide reasons and supporting evidence to confirm that the systems in use are appropriate to the production of high-quality outcomes on site.

For merit standard, learners will consider how early implementation of standards by appropriate quality-control systems reduces the need for corrective actions. They will note how quality control is recorded and reported, and list the associated benefits of doing so. Learners will also consider how the various quality-control systems and methodologies apply to the project scenario, and their relevance to the production of quality outcomes. Learners will form an appropriate conclusion which considers an approach to the provision of quality control on the project.

For pass standard, learners will consider the systems used for implementing and recording quality control on a construction project and the corrective actions used when quality control identifies defective or non-compliant work. Learners will provide a clear and objective account of the control systems used to improve quality on construction projects. They will show that they comprehend the corrective actions and how they are appropriate for the quality-control process.

Links to other units

This unit links to:

- Unit 4: Construction Technology
- Unit 6: Surveying in Construction
- Unit 9: Management of a Construction Project
- Unit 8: Building Regulations and Control in Construction
- Unit 10: Building Surveying in Construction
- Unit 11: Site Engineering for Construction
- Unit 23: Construction in Civil Engineering
- Unit 26: Conversion, Adaptation and Maintenance of Buildings.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 21: Building Services Science

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners apply the principles of heat transfer, thermodynamics, electricity, combustion and psychrometry to solve problems related to the building services industry.

Unit introduction

Building services are primarily concerned with creating comfortable living and working environments and are an integral part of building design. Good building services design requires an understanding of the underpinning scientific principles so that internal environmental conditions can be examined and changes made to improve or modify those conditions.

In this unit, you will learn about the nature of energy, examine heat transfer mechanisms and the combustion of solid, liquid and gas fuels, all while considering the implications of incomplete combustion and the methods to prevent this. You will gain an understanding of the principles of electrical generation, transmission and distribution. You will also learn about thermodynamics and develop the skills to use psychrometric charts and pressure-enthalpy (P-H) diagrams to solve a variety of problems related to building services.

The knowledge and skills acquired in this unit will prepare you for progression to employment as an electrical engineer, a building services systems designer, an HVAC specialist or an alternative energy specialist. It will also enable entry to a higher education programme in building services or one that contains elements of building services.

Learning aims

In this unit you will:

A Understand the principles of energy, heat transfer and combustion applicable to building services systems

B Explore the characteristics of electrical supply systems applicable to building services systems

C Examine the thermodynamic properties for heating, air conditioning and refrigeration.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the principles of energy, heat transfer and combustion applicable to building services systems	**A1** Energy **A2** Heat transfer **A3** Combustion of fuels	Analysis of a given client brief in relation to the heat transfer and combustion system applicable to the context.
B Explore the characteristics of electrical supply systems applicable to building services systems	**B1** Electrical principles **B2** Generation, transmission and distribution of electricity	A report for a given project scenario that covers the different transmission methods that can be used to provide electricity to a particular site, including the use of appropriate transformers.
C Examine the thermodynamic properties for heating, air conditioning and refrigeration	**C1** Ideal gases and application to building services engineering applications **C2** Thermodynamic properties and processes **C3** Changes of state **C4** Air conditioning systems and refrigeration	A report for a given project scenario that covers the evaluation and interpretation of a P-H diagram.

Content

Learning aim A: Understand the principles of energy, heat transfer and combustion applicable to building services systems

A1 Energy

The nature of energy and its use in building services installations.

- Energy forms used in building services systems, to include electricity, thermal.
- Units of energy and power and their application, to include joule (J), British thermal unit (Btu), watt (W), kilowatt (kW), kilowatt hour (kWh).
- Principle of the conservation of energy and its use in building services contexts.
- Temperature scales, to include absolute, kelvin, Celsius, Fahrenheit.
- Specific heat capacity, to include its effect on a selection of materials and building components.

A2 Heat transfer

The principle of conservation of energy applied in heat transfer situations to the design and performance of installations and equipment.

- Methods of heat transfer, to include conduction, convection, radiation.
- Factors affecting the rate of heat transfer, to include temperature difference between an object and the surrounding area, surface area, material heat transfer properties.
- Calculating conduction through single slab and composite structures.
- Calculating free or natural convection in air from:
  - vertical and horizontal panels
  - horizontal cylindrical objects.
- Calculating radiation heat transfer from plane surfaces.

A3 Combustion of fuels

The principles of fuel combustion, to include associated calculations, and their impact on the design and performance of installations and equipment.

- Properties and constituents of common fuels, to include:
  - solids, e.g. coal, anthracite, coke, biomass
  - liquid, e.g. petrol, fuel oil, paraffin
  - gas, e.g. liquid propane gas (LPG), natural gas, e.g. methane.
- Combustion:
  - requirements for safe and efficient combustion
  - difference between complete and incomplete combustion
  - causes and implications of incomplete combustion
  - methods used to prevent incomplete combustion
  - implications of fuel-lean and fuel-rich combustion.
- Products of complete and incomplete combustion and their effects, to include excess oxygen, nitrogen, carbon monoxide, carbon dioxide, incombustible constituents of fuel.
- Minimum air requirements for stoichiometric combustion, to include stoichiometric air/fuel ratio.
- Requirements for excess air.
- Need for control of excess air quantities.

Learning aim B: Explore the characteristics of electrical supply systems applicable to building services systems

B1 Electrical principles

- Principles of direct current (DC), alternating current (AC).
- Electrical units of measurement:
  - the relationship between volts, amperes, ohms, joules and watts and what they measure.
- Calculations, to include voltage, current, resistance, energy, power.

B2 Generation, transmission and distribution of electricity

Generation and distribution of power through the national grid to local level.

- Generation of electricity, to include nuclear, coal, gas, oil, wind, tidal, hydroelectric.
- Local generation, to include solar, wind, biomass.
- Application of electromagnetic induction to generators.
- Transformer principles, to include step-up, step-down, associated calculations.
- Application of transformers in the transmission and distribution of electrical power.
- Characteristics of transmission and distribution lines to buildings, to include typical voltages during various stages.
- Calculation of AC voltage and current, to include during generation, transmission, distribution.
- Different voltage for different settings, to include portable workshop equipment (110 V), home supply (230 V), three phase (415 V).

Learning aim C: Examine the thermodynamic properties for heating, air conditioning and refrigeration

C1 Ideal gases and application to building services engineering applications

The principles and calculations of gases and their impact on the design and performance of installations and equipment.

- Relationship of pressure to temperature, volume, mass:
  - units of pressure, to include Pascal (Pa), newtons per square metre (N/m^2)
  - units of temperature, to include degrees Celsius (C)
  - units of volume, to include cubic centimetres (cm^3), cubic metres (m^3), litres (l)
  - units of mass, to include kilograms (kg).
- Application of general gas law, to include systems under pressure.
- Application of characteristic gas equations to solve problems related to building services science.
- Application of Dalton's law ($P_{total} = P_1 + P_2 + \ldots + P_n$) to solve problems involving multiple pressures.

C2 Thermodynamic properties and processes

- Relationship between pressure, saturation temperature and enthalpy.
- Thermodynamic properties for water and refrigerants.
- Identification and interpretation of various zones of a pressure-enthalpy (P-H) diagram, to include:
  - sub-cooled liquid
  - latent heat
  - super-heated vapour
  - saturated liquid
  - saturated vapour.
- Graphical representation of thermodynamic processes:
  - isothermal evaporation
  - adiabatic compression
  - simple vapour compression
  - refrigeration cycles.
- Use of tables and P-H diagrams to obtain values in solving problems, to include:
  - saturation temperature and enthalpy of dry saturated vapour at n bar pressure
  - enthalpy at n bar pressure with x degrees of superheat
  - refrigeration plant and equipment.

C3 Changes of state

- Kinetic theory of matter.
- Reasons for change of state, to include changes in temperature, changes in pressure.
- Sensible and latent heat, to include latent heat of fusion, latent heat of vaporisation.
- Application of the theory of enthalpy to solve problems where change of state occurs and latent heat is encountered.

C4 Air conditioning systems and refrigeration

- Air conditioning processes and cycles.
- Psychrometric terms and properties of air and water vapour, to include calculation, measurement, tables, charts.
- Psychrometric process lines, to include:
  - sensible heating and cooling
  - dehumidification and humidification (using different types of humidifiers)
  - resulting condition from mixture of two air streams.
- Plotting summer and winter psychrometric cycles for given arrangements of air conditioning plant and operating conditions, to include:
  - heater batteries
  - cooler batteries (operating in sensible cooling and dehumidification mode)
  - humidification, to include steam, adiabatic, humidity ratio, relative humidity
  - air mixing applications.
- Determine plant duties from psychrometric chart.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand the principles of energy, heat transfer and combustion applicable to building services systems		**A.D1** Evaluate the significance of heat transfer and combustion in the design and performance of installations and equipment, taking into account the principles of conservation of energy, and the combustion and characteristics of fuels.
A.P1 Explain the methods for calculating heat transfer in conduction, convection and radiation through materials and structures. **A.P2** Explain the principles of fuel combustion and their impact on the design and performance of installations and equipment.	**A.M1** Assess the implications of heat transfer and combustion in the design and performance of installations and equipment, taking into account the principles of conservation of energy and combustion of fuel.	
Learning aim B: Explore the characteristics of electrical supply systems applicable to building services systems		**B.D2** Justify, for a given scenario, the use of transformers in the transmission and distribution of electrical power, with reference to generation and end use.
B.P3 Explain the principles of generation, transmission and distribution of electrical energy.	**B.M2** Assess the use of different voltages during generation, transmission and distribution of electrical energy.	
Learning aim C: Examine the thermodynamic properties for heating, air conditioning and refrigeration		**C.D3** Evaluate produced solutions to thermodynamic and psychrometric problems to heating, air conditioning and refrigeration.
C.P4 Produce a solution to a thermodynamic problem where there are multiple pressures, with reference to enthalpy. **C.P5** Produce a solution to a thermodynamic problem involving identification, interpretation and plotting of P-H diagrams and processes. **C.P6** Interpret a given psychrometric chart involving properties of air and water vapour mixtures and air conditioning systems in order to determine relative humidity and temperature.	**C.M3** Produce clear and accurate solutions to thermodynamic problems with reference to enthalpy and P-H diagrams and processes. **C.M4** Produce clear and accurate solutions to psychrometric problems involving properties of air and water vapour mixtures and air conditioning systems in order to determine relative humidity and temperature.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aim: B (B.P3, B.M2, B.D2)

Learning aim: C (C.P4, C.P5, C.P6, C.M3, C.M4, C.D3)

Further information for teachers and assessors

Resource requirements

Learners taking this unit would benefit from access to experiments, a workshop and site visits.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate, with the aid of detailed and comprehensive line drawings, the significance of heat transfer and combustion in the design and performance of an installation. They will also evaluate, with a detailed report, the principles surrounding the conservation of energy and the combustion and characteristics of the fuel selection. In evaluating, they will also consider the advantages and disadvantages of alternative systems and the significance of performance requirements, including what equipment will be required. Learners' enquiries will lead to a supported judgement, showing clear links to the installation scenario.

For merit standard, learners will analyse, with clear and accurate line drawings, the implications of heat transfer and combustion in the design and performance of an installation. They will also analyse, with a clear and accurate report, the principles surrounding the conservation of energy and the combustion of fuel. In conducting their analysis, learners will consider the key components and equipment required in the system and how these combine to provide effective performance.

For pass standard, learners will explain, with appropriately annotated illustrations, the methods for calculating heat transfer in conduction, convection and radiation through structures and materials. They will also explain, with appropriately annotated illustrations, the principles of fuel combustion and the impact they have on the design and performance of installations and equipment. In their work, learners will demonstrate that they understand the functional requirements of the system and whether the system can be considered fit for purpose.

Learning aim B

For distinction standard, learners will evaluate, with the aid of detailed and comprehensive line drawings, the use of transformers in the transmission and distribution of electrical power with reference to generation and end use. In evaluating, they will also consider the advantages and disadvantages of alternative systems and the significance of key performance requirements. Learners' enquiries will lead to a supported judgement, showing clear links to the scenario.

For merit standard, learners will analyse, with clear and accurate line drawings, the use of different voltages during the generation, transmission and distribution of electrical energy. In conducting their analysis, learners will also consider the key components and equipment required within the system and how these combine to provide effective performance.

For pass standard, learners will explain, with appropriately annotated illustrations, the principles of the generation, transmission and distribution of electrical energy. Within their work, learners will demonstrate that they understand the functional requirements of the system and whether the system can be considered fit for purpose.

Learning aim C

For distinction standard, learners will evaluate, with the aid of detailed and comprehensive line drawings, a minimum of two solutions to thermodynamic and psychrometric problems to heating, air conditioning and refrigeration systems using tables and diagrams. In evaluating, they will also consider the advantages and disadvantages of alternative systems and the significance of performance requirements, including what equipment will be required. Learners' enquiries will lead to a supported judgment, showing clear links to the installation scenario.

For merit standard, learners will produce, with clear and accurate line drawings, a minimum of two solutions to thermodynamic problems with reference to enthalpy and P-H diagrams and processes. They will also produce a clear and accurate report relating to psychrometric problems involving properties of air and water vapour moistures and air conditioning systems in order to determine relative humidity and temperature. In producing the report, learners will also consider the key components and equipment required within the system and how these combine to provide effective performance.

For pass standard, learners will produce a solution, with appropriately annotated illustrations, to a thermodynamic problem where there are multiple pressures, with reference to enthalpy. They will also produce a solution to thermodynamic problems involving identification, interpretation and plotting of P-H diagrams and processes. They will interpret a given psychrometric chart involving properties of air and water vapour mixtures and air conditioning systems in order to determine relative humidity and temperature. In their work, learners will demonstrate that they understand the functional requirements of the system and whether the system can be considered fit for purpose.

Links to other units

This unit links to:

- Unit 9: Management of a Construction Project
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 14: Provision of Primary Services in Buildings
- Unit 17: Projects in Construction
- Unit 26: Conversion, Adaptation and Maintenance of Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- site visits to manufacturers and suppliers to view equipment
- a guest speaker, such as an air conditioning or boiler and heating sales representative
- a guest speaker from an air conditioning or heating subcontractor or organisation
- a guest speaker from an electrical installations company
- a guest speaker from a services design consultant
- services engineer case studies
- professional bodies associated with the building services sector
- participation in audience assessment of presentations
- design/ideas to contribute to the unit.

Unit 22: Economics and Finance in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners investigate economic principles and how the availability of resources and the impact of the economic environment affect the financial planning, costing and feasibility of construction projects.

Unit introduction

The financial success of construction projects depends on timescales, location, the economic climate and meeting customer needs. This, in turn, creates employment, secures the efficient use of natural resources and underpins economic growth both locally and nationally.

In this unit, you will gain an insight into how the economic principles of demand, supply and price interact. You will learn how the availability of resources and the economic environment can determine which projects to develop, where they will be developed and when construction will commence, including how government policies on regeneration, taxation and sustainability impact on activities.

In developing a sound knowledge of construction economics and finance, this unit will help you to progress to employment or to study construction-related subjects at a higher level, including degree-level programmes in construction, quantity surveying, building surveying, housing and planning.

Learning aims

In this unit you will:

A Examine how economic principles underpin the construction industry

B Investigate the impact of economic factors on construction projects

C Explore how to plan and control construction costs

D Examine the factors determining the feasibility of construction projects.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine how economic principles underpin the construction industry	**A1** Structure and size of the construction industry **A2** Market structures, supply and demand **A3** Interaction of supply, demand and price	A report, presentation or booklet that examines the effects of economic principles, resources and environment on a sector of the construction industry and how it has/will react to economic changes.
B Investigate the impact of economic factors on construction projects	**B1** Economic resources **B2** Internal environment **B3** External environment	
C Explore how to plan and control construction costs	**C1** Cost control **C2** Cost planning **C3** Cost-control techniques **C4** Budgeting **C5** Reconciliation of costs	A report that investigates the consideration of cost planning and control and the financial viability of a construction project.
D Examine the factors determining the feasibility of construction projects	**D1** Business analysis methods **D2** Feasibility factors **D3** Modelling and testing of factors impacting on projects	

Content

Learning aim A: Examine how economic principles underpin the construction industry

The characteristics of the construction industry and the impact of the principles of supply, demand and markets on price.

A1 Structure and size of the construction industry

How the structure and size of the industry influences supply and demand and the impact on tender prices or the cost of construction projects.

- Size, range and legal status:
  - sole traders, partnerships, small and medium-sized limited companies and large public limited companies (PLCs)
  - range of activities – local, regional, national and international activities
  - private, partnership, public and cooperative ownership.
- Sectors and activities:
  - housing, commercial, industrial, civil engineering, infrastructure
  - new build, maintenance, renovation, refurbishment, extension, regeneration
  - greenfield development, brownfield development.

A2 Market structures, supply and demand

How the competitive environment and market structures influence supply and demand and their impact on tender prices or the cost of construction work.

- Competitive environment:
  - competition – local, national and international
  - competitive advantage – differentiation, pricing policies, reputation, market share
  - level of commercial intelligence
  - market structures
  - perfect competition, imperfect competition, monopoly
  - features of markets – number of firms, freedom of entry, nature of product
  - barriers to entry – tariffs, quotas, contractor selection, other limiting factors.

A3 Interaction of supply, demand and price

- Demand theory and what influences demand, including affordability, substitutes, competition, incentives.
- Supply theory and what influences supply, including availability of resources, government policies, proximity to market, profitability.
- Elasticity – price elasticity of demand.
- Impact on pricing and output decisions:
  - supply and demand graphs
  - pricing decision
  - output decisions
  - impact of movements of the supply and demand curve.
- Responses to pricing and output.
- Impact of supply and demand in different market structures.
- Market changes:
  - impact on contractors in a declining market or economic environment
  - impact on contractors in an improving market or economic environment.

Learning aim B: Investigate the impact of economic factors on construction projects

The relationships between the availability of economic resources and changes in the internal and external economic environment, and how they influence production in the construction industry.

B1 Economic resources

- Land:
  - types of land and location
  - factors affecting price and availability.
- Capital and finance:
  - types of finance and availability
  - capital and revenue income and goods
  - income and taxation
  - cash flow.
- Labour:
  - demographics
  - availability and mobility
  - efficiency and quality of labour
  - skills and incentives.
- Enterprise and entrepreneurship:
  - innovation, business efficiency, profitability, new opportunities
  - benefits and risks, including improvements, development of new products and markets, recognition and reputation, culture and failure
  - market data, trends and forecasting
  - commercial intelligence and networking.

B2 Internal environment

- Organisational culture:
  - attitude to risk
  - attitude to change
  - sphere of comfort
  - organisational flexibility.
- Corporate social responsibility (CSR) and sustainability:
  - impacts
  - opportunities
  - benefits and drawbacks.
- Ethics and their impact throughout the supply chain.

B3 External environment

- Political:
  - government legislation and policies, e.g. health and safety and planning/building control, funding for regeneration, sustainability, Considerate Constructors Scheme (CCS), Affordable Homes Programme, Help to Buy scheme.
- Economic:
  - fiscal and monetary policies, exchange rates, interest rates.
- Social:
  - attitudes to saving, spending, debt, social responsibility requirements, changes in demographic trends, personal tastes and preferences.
- Technological changes:
  - innovation in communications, research and development, and automation.

- Environmental and ethical factors:
  - sustainability, recycling, public attitudes, carbon offsetting, ethical purchasing and supply.
- Legal environment:
  - changes in government, legislation, legal requirements and regulations.

Learning aim C: Explore how to plan and control construction costs

The reasons why costs need to be controlled in construction projects and the methods used to plan and control costs.

C1 Cost control

- History of cost control.
- Need for cost control – aim, objectives and strategies.
- Cost control:
  - estimated cost
  - planned performance cost
  - actual cost
  - cash flow.
- Budgeting:
  - elemental
  - trade
  - alternative cost centres.
- Comparison of alternative schemes.
- Cost, price and value.
- Construction cost price indices.

C2 Cost planning

- Reasons for cost planning.
- Cost value engineering:
  - value engineering workshops
  - appropriate participation
  - costing outcomes.
- Financial appraisal.
- Sources of cost data:
  - building cost information service
  - historical data
  - tender analysis
  - use of indices to update costs.
- Sources of finance.

C3 Cost-control techniques

- Standard techniques:
  - cost modelling
  - use of appropriate cost per m^2
  - use of ICT-based systems.
- Purchasing decisions.
- Types of contract and effects on costs:
  - transfer of risk
  - impact of the contract on cash flow
  - commercial decisions.
- Resources and costs, e.g. materials, labour, plant and machinery.
- Calculation and monitoring of resources.

C4 Budgeting

- Preparation of preliminary estimates:
  - use of New Rules of Measurement (NRM) 1, 2 and 3
  - use of the Code of Estimating Practice.
- Land purchase and other costs:
  - updating land stock to current valuation
  - associated legal costs
  - compensation for planning gain, Section 106 (Town and Country Planning Act 1990) agreements.
- Construction costs.
- Profit and loss.

C5 Reconciliation of costs

- Cost and value reconciliation.
- Value-time relationships.
- Cost-time relationships.

Learning aim D: Examine the factors determining the feasibility of construction projects

D1 Business analysis methods

- Feasibility study methodology and approaches.
- Other feasibility and viability methods:
  - PESTEL (political, economic, social, technological, environmental, legal) analysis
  - SWOT (strengths, weaknesses, opportunities, threats) analysis
  - 5 Cs (customer, company, competition, collaborators, context) analysis
  - Porter's Five Forces
  - cost-benefit analysis
  - residual method of valuation.

D2 Feasibility factors

- Changes in floor area, volume, elements price indices and use.
- Availability of land, labour and finance.
- Client requirements.
- Planning and regeneration policy changes.
- Legal and environmental requirements.
- Specification standards.
- Local property market and rental yield.
- Client's approach/attitude to sustainability and the impact on the environment.

D3 Modelling and testing of factors impacting on projects

- Modelling and testing of current costs, opportunities and constraints.
- Modelling and testing of alternative scenarios.
- Forecasting and reporting techniques:
  - cost forecasting, including cash flow, profit, return, cost and value
  - liquidity, including borrowing, working capital and profitability.
- Use of software packages.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine how economic principles underpin the construction industry		**A.D1** Evaluate how the structure of the construction industry and the changes in the market impact on a given sector, allowing it to plan for future changes. **B.D2** Evaluate how resources and the economic environment can be managed for a given project.
A.P1 Explain how the construction industry is structured and its features. **A.P2** Explain how the interaction of supply and demand, price, and market structures affect the pricing and production decisions for a given sector of the construction industry.	**A.M1** Analyse how the structure of the construction industry allows a given sector to respond to market constraints and changes.	
Learning aim B: Investigate the impact of economic factors on construction projects		
B.P3 Explore the range of resources required to deliver a given construction project. **B.P4** Explain the internal and external economic environmental factors on a given project.	**B.M2** Analyse how resources and the economic environment affect a given project.	
Learning aim C: Explore how to plan and control construction costs		**C.D3** Evaluate how changes in costs occur and how this impacts on the detailed cost budget produced, and the efficacy of using appropriate cost-control techniques for a given construction project. **D.D4** Justify the feasibility of a given project as factors change.
C.P5 Examine how cost control and planning and budgeting techniques are used in construction projects. **C.P6** Produce a cost budget for a given construction project.	**C.M3** Produce, having considered appropriate techniques, a detailed cost budget for a given construction project.	
Learning aim D: Examine the factors determining the feasibility of construction projects		
D.P7 Explain the factors that influence the feasibility of a given construction project. **D.P8** Explore the relationship between the factors that influence the feasibility of a given construction project.	**D.M4** Analyse how the feasibility of a given construction project is affected by changes in factors.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, B.P3, B.P4, A.M1, B.M2, A.D1, B.D2)

Learning aims: C and D (C.P5, C.P6, D.P7, D.P8, C.M3, D.M4, C.D3, D.D4)

Further information for teachers and assessors

Resource requirements

There are no specific additional requirements for this unit but centres must give learners access to information on a range of businesses and projects, including local, regional, national and international.

Essential information for assessment decisions

It is expected that learners will individually select and research different sectors of the construction industry.

Learning aims A and B

For distinction standard, learners will carry out in-depth research on the extent to which economic principles affect a given sector of the construction industry. They will look at how they could affect the sector in the future and how resources and the economic environment impact on a specific project. They should make judgements on how risks can be mitigated through business planning methods. The report, booklet or presentation will be professionally written and structured, use correct economic terminology and be of a high quality.

For merit standard, learners will apply the effects of economic principles to a given sector of the construction industry and explain how it has responded to changes in the market. They will select and assess how relevant resources and the environment influence a given project. The report, booklet or presentation will be professional, logically structured, use appropriate economic terminology, and will be of a very good written quality, demonstrating that they fully comprehend the interaction of these economic theories on the construction industry.

For pass standard, learners will carry out research that allows them to explain the effect of economic principles on a given sector of the construction industry. They will show a good understanding of how resources and the economic environment influence a construction project. The report, booklet or presentation will be structured, use some economic terminology and will be of a good written quality.

Learning aims C and D

For distinction standard, learners will carry out detailed research on costs and the wider factors affecting the budget for a given construction project. They will evaluate how these can vary over the construction planning and development phases of a given construction project through the generation of comprehensive calculations. Learners must make qualified judgements to justify the feasibility of the proposed options for the given construction project based on cost and wider business analysis processes. The report and calculations will be professional, totally accurate and of a high quality, demonstrating a developed understanding of construction economics and financial processes.

For merit standard, learners will develop a detailed budget and feasibility study for a given construction project, considering the interaction of cost planning and management over the planning and construction phases. Learners will make recommendations based on their calculations, their review of budgeting techniques and their analysis of the factors influencing the project. The report will be of a very good professional standard, calculations will be mostly accurate and the submission will demonstrate a full comprehension of construction economics and financial processes, using appropriate terminology.

For pass standard, learners will produce a simple budget based on research and explain the variations that can occur during the project planning and construction phases. They will show an understanding that the feasibility of a project can change as costs and circumstances change. The report and calculations will be structured and of a good quality, containing some economic terminology, and will be generally accurate.

Links to other units

This unit links to:

- Unit 2: Construction Design
- Unit 3: Tendering and Estimating
- Unit 9: Management of a Construction Project
- Unit 18: Building Information Modelling
- Unit 19: Quantity Surveying.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers
- site visits
- input into unit assignment, case-study/project materials
- work experience
- business materials as exemplars
- support from local business staff as mentors.

Unit 23: Construction in Civil Engineering

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners develop designs for the substructures and superstructures in large-scale construction projects, for example roads, drainage and public facilities at railways, airports and harbours.

Unit introduction

The civil engineering industry covers the heavy side of construction and requires knowledge of the large plant and equipment used for earthworks and concreting operations. Civil engineers are involved in the construction of some of the world's largest and most iconic building and construction projects. These projects can include everything from the tallest skyscrapers, to the highest bridges and busiest airports. The expertise of civil engineers is needed all over the world, and they can expect to travel to the biggest international economic hubs to be involved in big and important projects.

In this unit, you will gain an understanding of the substructures and earthworks associated with civil engineering. You will learn how water is contained and controlled, and how the excavation of earth forms cuttings, trenches and deep excavations. The pouring of concrete and the formation of bridges, walls, foundations and other civil engineering structures is covered in terms of the plant and equipment used in construction. You will consider the building of superstructures and retaining walls in terms of the different structural frames and the methods used to retain earth at different levels.

This unit will support you to progress to a higher-level civil engineering programme such as the Higher National in Civil Engineering, or to a general construction or civil engineering degree. It also supports progression to the workplace as a technician, direct entry as a trainee designer with a civil engineering company or work as a trainee site engineer with a contractor.

Learning aims

In this unit you will:

A Understand the methods and techniques used to perform earthwork activities

B Develop a substructure design for a civil engineering project

C Develop a superstructure design and specification for a civil engineering project.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand the methods and techniques used to perform earthwork activities	**A1** Earthwork activities **A2** Earthmoving and compaction equipment **A3** Concreting equipment **A4** Temporary works **A5** Dewatering operations **A6** Piling operations	A written evaluation of the methods that could be used in a large-scale excavation for a given scenario.
B Develop a substructure design for a civil engineering project	**B1** Foundations **B2** Design and drainage systems **B3** Utilities	A design for a civil engineering substructure, drainage system and utilities distribution for a given scenario.
C Develop a superstructure design and specification for a civil engineering project	**C1** Structural frames **C2** Retaining walls	A design for a civil engineering superstructure and a retaining structure for a given scenario.

Content

Learning aim A: Understand the methods and techniques used to perform earthwork activities

A1 Earthwork activities

Features and use of excavation methods to reduce ground levels down to formation levels for services, foundations and basements.

- Excavation methods and their advantages and disadvantages in installing substructures:
  - trench excavation:
    - trenching machines
    - tracked and wheeled excavators
    - 360 degree back-actor excavator
  - basement excavations:
    - trench method
    - open excavation
    - supported systems
  - formation of cuttings
  - formation of embankments
  - earthwork support:
    - diaphragm wall
    - trench boxes
    - traditional timber.

A2 Earthmoving and compaction equipment

Features of plant and equipment used in earth moving and compaction, and the advantages and disadvantages of each in terms of their use, time and cost.

- Excavation plant:
  - 360 degree tracked and wheeled excavators
  - tracked loader
  - towed scrapers
  - motorised scrapers.
- Earthmoving plant:
  - large dumpers
  - bulldozers
  - conveyor delivery systems
  - tipper trucks.
- Compaction plant:
  - graders
  - compactor rollers
  - sheep’s foot rollers/tamping roller.

A3 Concreting equipment

Features and comparison of equipment that is used to transport, place and compact in-situ concrete into formwork.

- Concrete pumping:
  - static
  - boom.
- Rollover skip delivery.
- Conveyor belt delivery system.
- Compaction and vibration equipment:
  - poker vibrators
  - external shuttering compactors
  - beam screeders
  - vacuum dewatering.

A4 Temporary works

Features of temporary support systems and the advantages and disadvantages of each in terms of effectiveness.

- Support systems to excavations:
  - diaphragm walling
  - contiguous piling
  - bentonite slurry
  - trench sheets
  - propping systems
  - sheet piling
  - trench boxes.

A5 Dewatering operations

Features of equipment used to reduce the impact from groundwater on excavation works and their advantages and disadvantages.

- Sump pumping.
- Well points dewatering.
- Permanent exclusion:
  - diaphragm walling
  - filter drains.

A6 Piling operations

Types of piling operations to support foundations, retain earth and act as permanent dewatering, and their advantages and disadvantages.

- Interlocking sheet steel piling.
- Driven precast.
- Contiguous.
- Secant.
- Cut-off walls.

Learning aim B: Develop a substructure design for a civil engineering project

Design and construction of foundation types for commercial applications and their advantages and disadvantages.

B1 Foundations

The design and construction of the following types of foundation:

- piled and ground beam
- isolated pad
- pad supported on piles or pile cap
- basements.

B2 Design and drainage systems

The design and use of drainage installations:

- installation of deep sewers
- pipework
- reinforced concrete culverts for stream and river containment and diversion.

B3 Utilities

Application of techniques used for the installation of water, electrical, gas and data services:

- infrastructure developments
- cable trenching
- deep sewer installation
- water discharge pipes
- service tunnels
- structured cable installation.

Learning aim C: Develop a superstructure design and specification for a civil engineering project

C1 Structural frames

Design of steel and concrete-framed buildings, including connections between elements, and the advantages and disadvantages of each method.

- Steel frames:
  - universal columns
  - universal beams
  - pad and column connections
  - column and beam connections
  - wind-bracing
  - composite floor decks.
- Concrete frames:
  - columns
  - beams
  - pad and column connections
  - column and beam connections
  - floors
  - reinforcement
  - formwork requirements for columns, beams and floors.
- Composite construction:
  - integration of concrete and steel
  - combination of alternative materials and their detailing
  - slip form cores.

C2 Retaining walls

Design of retaining structures using a variety of methods, and the evaluation of their effectiveness over their life cycle, to include:

- gabions
- precast concrete systems
- in-situ reinforced concrete
- earth-retaining structures
- integral drainage to retaining structures
- revetment works to sloping walls.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand the methods and techniques used to perform earthwork activities		**A.D1** Evaluate the excavation methods, earthwork support and dewatering systems required for large-scale excavations.
A.P1 Explain the methods and plant used for large excavations. **A.P2** Describe the earthwork support and dewatering systems required for large-scale excavations.	**A.M1** Compare the excavation methods, earthwork support and dewatering systems required for large-scale excavations.	
Learning aim B: Develop a substructure design for a civil engineering project		**B.D2** Evaluate the design for a foundation, drainage installation and utility provision for given ground conditions.
B.P3 Produce designs for civil engineering foundations for given ground conditions. **B.P4** Produce designs for civil engineering drainage and utilities for given ground conditions.	**B.M2** Justify the design produced for a foundation, drainage installation and utility provision for given ground conditions.	
Learning aim C: Develop a superstructure design and specification for a civil engineering project		**C.D3** Evaluate the specifications produced for the superstructure frame and a retaining structure against design parameters.
C.P5 Produce a specification for a superstructure frame that meets design parameters. **C.P6** Produce a drawing and specification for a retaining structure that meets design parameters.	**C.M3** Assess the specifications produced for the superstructure frame and a retaining structure against design parameters.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aim: B (B.P3, B.P4, B.M2, B.D2)

Learning aim: C (C.P5, C.P6, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional requirements for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate the excavation methods, earthwork support and dewatering systems required for large-scale excavations on civil engineering projects. They will consider a wide range of different options and methods, including the plant used in the overall task, and arrive at a supported conclusion. Learners will demonstrate a developed understanding of the methods used in civil engineering for performing earthwork activities.

For merit standard, learners will compare the excavation methods, earthwork support and dewatering systems required for large-scale excavations. They will consider a range of different options and methods, including the plant used in the overall task, and will provide some logical comparisons. Learners will demonstrate a good understanding of the methods used in civil engineering for performing earthwork activities.

For pass standard, learners will explain some of the methods and plant used for large-scale excavations. They will describe the earthwork support and dewatering systems required for large-scale excavations and explain why the different methods are appropriate for the given scenario. Learners will demonstrate a generic understanding of the methods used in civil engineering for performing earthwork activities.

Learning aim B

For distinction standard, learners will evaluate their designs for a foundation, drainage installation and utility provision for a given scenario and ground conditions. They will produce designs for civil engineering foundations, drainage systems and utility distribution. They will consider a range of different foundation methods, drainage systems and utility layouts, and arrive at a supported conclusion relating to the suitability of their designs. Learners will demonstrate a developed understanding of the methods used in civil engineering for foundation work, drainage and utility distribution.

For merit standard, learners will justify their designs produced for a foundation, drainage installation and utility provision for given ground conditions. Their justification will consider some different foundation methods, drainage systems and utility layouts to arrive at a justification relating to the suitability of their designs. Learners will demonstrate a good understanding of the methods used in civil engineering for foundation work, drainage and utility distribution.

For pass standard, learners will produce designs for civil engineering foundations, drainage and utilities distribution for given ground conditions. Learners will demonstrate a generic understanding of the methods used in civil engineering for foundation work, drainage and utility distribution.

Learning aim C

For distinction standard, learners will evaluate their specifications for a superstructure frame and a retaining structure against given design parameters. They will produce a drawing for a retaining structure that meets design parameters. They will consider a range of different frame options and retaining methods, arriving at a supported conclusion relating to the suitability of their specifications. Learners will demonstrate a developed understanding of the methods used in civil engineering for the construction of framed structures and retaining walls.

For merit standard, learners will assess their specifications produced for the superstructure frame and a retaining structure against design parameters. They will produce a drawing for a retaining structure that meets design parameters. They will consider a range of different frame options and retaining methods, and consider how the designs can meet the design parameters provided. Learners will demonstrate a good understanding of the methods used in civil engineering for the construction of framed structures and retaining walls.

For pass standard, learners will produce an appropriate specification for a superstructure frame that meets the design parameters and a drawing and specification for a retaining structure that meets the design parameters. Learners will demonstrate a generic understanding of the methods used in civil engineering for the construction of framed structures and retaining walls.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 5: Health and Safety in Construction
- Unit 6: Surveying in Construction
- Unit 7: Graphical Detailing in Construction
- Unit 8: Building Regulations and Control in Construction
- Unit 11: Site Engineering for Construction.

Employer involvement

This unit would benefit from employer involvement in the form of:

- site visits to observe heavy civil engineering equipment in operation
- a guest speaker in the form of a technical plant sales representative
- a guest speaker from a structural engineering design company
- employer case studies
- Institution of Civil Engineers (ICE) good practice seminars.

Unit 24: Planning Application Procedures in Construction

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners examine application processes, planning permission for new buildings, major renovations and/or significant changes to the use of a building or land, and other laws relating to property.

Unit introduction

Town and country planning law and procedures play a critical role in identifying what development is needed and where, and which areas need to be protected or enhanced through special designation controls. It also determines whether proposed development submitted for approval by individuals or businesses is compatible with local development plans and current land use.

In this unit, you will learn how planning applications are produced and processed within development plan and legal frameworks. You will study how appeal procedures work, how conditions can be attached to planning permission as part of the approval procedure, and how both the application and appeal processes must be conducted in a timely way to support individuals, communities and the economy. You will review the measures used to protect buildings and land such as listed buildings, conservation areas and the creation of national parks. You will understand more about how wildlife and vegetation are protected through preservation orders and green belts. You will also learn how the general public can get involved in the planning process as individuals, groups and as organisations.

A sound knowledge of planning law and procedures is essential for employment roles involving the purchase, construction and maintenance of property. This unit will provide a good foundation for studying construction-related subjects at a higher level, including degree-level programmes in construction, property, housing and planning.

Learning aims

In this unit you will:

A Examine statutory frameworks and administrative processes for obtaining planning permission

B Understand the processes for approving and appealing planning decisions and enforcement

C Understand the measures to control, protect and enhance buildings and land

D Understand how the general public can engage in the planning process.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine statutory frameworks and administrative processes for obtaining planning permission	**A1** Planning legal framework **A2** Development plans **A3** Planning application processes	A report for a client for a given project scenario that demonstrates the statutory framework, administrative processes and other measures impacting on securing planning permission and the remedial actions available if permission is refused.
B Understand the processes for approving and appealing planning decisions and enforcement	**B1** Planning approval and conditions **B2** Planning appeals **B3** Enforcement of planning control	
C Understand the measures to control, protect and enhance buildings and land	**C1** Listed buildings **C2** Conservation areas **C3** Environmental and wildlife protection	A report or presentation for a given project scenario that evaluates the measures used to protect and enhance land and buildings.
D Understand how the general public can engage in the planning process	**D1** Public participation in development planning **D2** Public consultation in the planning application process **D3** Organisations involved with planning issues	A report or presentation that evaluates how the public, as individuals, groups or as organisations, can influence the outcome of planning decisions.

Content

Learning aim A: Examine statutory frameworks and administrative processes for obtaining planning permission

A1 Planning legal framework

Planning law and frameworks to support the making of development plans and approval of planning permission.

- The National Planning Policy Framework.
- Key decision makers, to include local authority planning officers, local authority planning committees, the Secretary of State.
- Legislation:
  - acts of Parliament
  - regional statutes.

A2 Development plans

The processes for the creation of development plans.

- Local plans, to include:
  - role and content
  - preparation
  - publication and examination
  - adoption and monitoring.
- Neighbourhood plans:
  - role and content
  - relationship with a local plan.
- Neighbourhood Development Orders.

A3 Planning application processes

Law and procedures used to apply for and obtain planning permission and processes for appeal if permission is refused or conditions have been attached. The role of the general public and systems used when planning law is not observed.

- When permission is required.
- When permission is not required.
- Legislation:
  - Town and Country Planning Acts
  - Town and Country Planning (Use Classes) Order 1987
  - case law and legal precedent.
- Permitted development:
  - types
  - limitations.
- Stages in the planning application process:
  - application forms
  - data and information required:
    - Environmental Impact Assessment (EIA), including purpose, legislation, stages and Schedule 2 developments
    - land use and traffic surveys
  - fees.

Learning aim B: Understand the processes for approving and appealing planning decisions and enforcement

B1 Planning approval and conditions

Types of planning permission and permission with conditions.

- Outline planning permission.
- Full planning permission.
- Rules for setting conditions.
- Conditions attached to mitigate the effect of planning objections, to include:
  - Section 106 of the Town and Country Planning Act 1990
  - Section 38 of the Highways Act 1980.
- Time limits.

B2 Planning appeals

The procedures used to appeal against the non-granting of planning permission or conditions attached to planning permission.

- Right of appeal.
- Timelines.
- Appeal procedures.
- Appeals by written and hearing processes.
- Appeals to the Secretary of State.

B3 Enforcement of planning control

How land and building use is regulated through enforcement processes.

- Planning contravention notices.
- Stop notices.
- Enforcement notices.
- Time limits.
- Appeals.
- Action as a result of enforcement:
  - building demolition
  - building remodelling
  - return to former use
  - return to former condition.

Learning aim C: Understand the measures to control, protect and enhance buildings and land

C1 Listed buildings

Measures used to protect individual buildings and monuments and the impact on securing planning permission to build or alter such buildings and monuments.

- Legislation and procedures for listing or delisting buildings.
- Classification system:
  - Grade I buildings
  - Grade II* buildings
  - Grade II.
- Other protected structures.
- Seeking demolition, alteration or extension approval processes.

C2 Conservation areas

Methods employed to protect and preserve areas of land and groups of buildings, and the impact on securing planning permission to build or alter property.

- Legislation and procedures for creating conservation areas.
- Seeking planning permission for building demolition, alteration or extension approval processes.

C3 Environmental and wildlife protection

Planning processes used to protect and conserve plants, wildlife and land, and the impact on securing planning permission to build or alter property.

- Tree Preservation Order (TPO).
- Green belts.
- Areas of Outstanding Natural Beauty (AONB).
- National parks.
- Protection of animals, plants and habitats.
- Seeking demolition, alteration or extension approval processes.

Learning aim D: Understand how the general public can engage in the planning process

D1 Public participation in development planning

How the general public is involved in approving development plans:

- notification and publicity processes
- time periods.

D2 Public consultation in the planning application process

- Statutory consultees on applications for planning permission.
- Non-statutory consultees – identified in national planning policy and guidance.
- Notification and publicity processes.
- Time periods.
- Grounds for objection.
- Group actions.
- Call-in procedures.

D3 Organisations involved with planning issues

The role of local, regional and national groups in enhancing and preserving land and buildings.

- National Trust.
- English Heritage.
- Campaign to Protect Rural England (CPRE).
- Campaign for Better Transport.
- World Wide Fund for Nature.
- Sustrans.
- Local resident groups.
- Pressure groups.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine statutory frameworks and administrative processes for obtaining planning permission		
A.P1 Produce a planning application for a given residential development, observing the statutory framework controlling the development at local and national level. **A.P2** Explain how a given residential development complies with the requirements of local development plans and the requirements of the legislation surrounding planning applications.	**A.M1** Discuss the planning application process for a given residential development and the impact of the local development plan, taking into account the requirements of the legislation surrounding planning applications.	**A.D1** Evaluate the planning application process for a given residential development and the impact of the local development plan, taking into account the requirements of the legislation surrounding planning applications. **B.D2** Evaluate how a developer would appeal against refusal of planning permission for a given residential development.
Learning aim B: Understand the processes for approving and appealing planning decisions and enforcement		
B.P3 Explain how a planning application decision is reached and the types of permission and conditions. **B.P4** Describe how appeals and enforcement procedures are used when planning processes result in a non-approval or breach of planning conditions.	**B.M2** Assess how a developer would appeal against refusal of planning permission for a given residential development.	
Learning aim C: Understand the measures to control, protect and enhance buildings and land		
C.P5 Explain a range of measures used to protect buildings, monuments, land, animals, plants and habitats. **C.P6** Explain how measures to control, protect and enhance buildings and land can be overcome.	**C.M3** Assess the impact of the measures used to control, protect and enhance buildings and land on the refurbishment on a given construction project scenario.	**C.D3** Evaluate the impact of the measures used to control, protect and enhance buildings and land on a given construction project scenario.
Learning aim D: Understand how the general public can engage in the planning process		
D.P7 Explain how the public is consulted in the plan making and planning application processes. **D.P8** Describe the role of organisations in protecting and enhancing land and buildings.	**D.M4** Discuss how the public and organisations can engage in the planning application process of a given construction project scenario.	**D.D4** Evaluate how the public and organisations can impact on the granting of planning permission for a given construction project scenario.

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, B.P3, B.P4, A.M1, B.M2, A.D1, B.D2)

Learning aim: C (C.P5, C.P6, C.M3, C.D3)

Learning aim: D (D.P7, D.P8, D.M4, D.D4)

Further information for teachers and assessors

Resource requirements

There are no specific additional requirements for this unit.

If there is a conservation area or listed building nearby, a visit may be useful to support contextualisation of the unit content.

Essential information for assessment decisions

Learning aims A and B

For distinction standard, learners will produce a comprehensive planning application, together with an associated evaluative report for a residential development, including environmental, traffic and surrounding land use surveys. They must apply the requirements of the statutory planning framework at local and national level to the proposed development and make judgements on the likelihood of obtaining planning permission for the proposed residential development.

Learners will consider why refusal of planning permission or imposition of conditions attached to a planning permission for a residential development could come about, and evaluate the methods of appeal available to a developer to obtain approval or removal of the conditions. They will arrive at a conclusion on the most appropriate appeal method to use and generate evidence to support the appeal. Learners must demonstrate that they have a developed understanding of the appeal methods available to a developer.

For merit standard, learners will produce a detailed planning application, together with an associated discursive report, including traffic and surrounding land use surveys. They must consider the requirements of the statutory planning framework at local and national level and how these could influence the outcome of the planning application. Learners will demonstrate that they fully comprehend the relationship between the statutory framework controlling development and its application to obtaining planning permission for construction projects at a local level.

Learners will assess how refusal of planning permission, or approval with conditions for a single residential building, could arise. They will evaluate the grounds available to a developer to appeal the refusal, or the conditions and the methods of appeal available to a developer. They will make recommendations on the appeals method to use and suggest evidence to support the appeal. Learners must demonstrate that they fully comprehend the methods used to appeal planning decisions following the decision to refuse an application or approve it with conditions.

For pass standard, learners will produce a planning application and explain how the national and local statutory planning framework operates for making development plans, and how it interacts with the process for obtaining planning permission for a residential development. Learners will demonstrate that they have a good understanding of the processes for creating development plans and the requirements for a planning application.

Learners will explain how planning application decisions are made and how their application is likely to comply with requirements. This should be in terms of types of permission, duration, conditions that can be attached to permission and reasons for refusal. Learners will also explain what statutory actions are available to local authorities where development is carried out with no planning permission or where it is not compliant with the conditions of the planning permission. Learners must demonstrate a good understanding of the planning application decision-making process and the possible outcomes.

Learning aim C

For distinction standard, learners will evaluate how planning control measures support the protection and enhancement of land, buildings and natural features, but also consider their impact on the design, costs, construction phase operations and financial feasibility of a new construction project. Learners must demonstrate that they have a developed understanding of all of the considerations to meet the requirements of the planning control measures, yet ensure feasibility of the proposed development.

For merit standard, learners will assess how planning control measures impact on the design of a construction refurbishment or extension project. They will carry out a detailed examination that considers the choice of materials and style of the design when developing a planning application, and the processes involved in submitting the application, gaining approval and during the works. Learners must demonstrate that they fully comprehend the design considerations to meet the requirements of the planning control measures.

For pass standard, learners will explain how planning measures, including conservation areas, listed buildings and AONBs, are used and operate to support the control, protection and enhancement of land, buildings and natural assets. They will also explore how these measures can be appealed or how a developer can take steps to meet their requirements. Learners must demonstrate that they have a good understanding of the methods used to ensure that land and buildings are not built on, demolished or altered without regulation.

Learning aim D

For distinction standard, learners will consider a range of case studies and evaluate how the public, as individuals, groups and organisations, can influence the outcome of a development plan or planning application. The impact should be in terms of delays, design and other changes and cost implications. They will consider how developers can improve on how they engage with the public to gain support for construction activities. Learners must demonstrate a developed understanding of how the methods used to inform and engage the public can be used to minimise delays and cost increases and secure public support.

For merit standard, learners will discuss how the public, groups and organisations participate in a given scenario. They will assess the advantages and disadvantages of consultation and participation. Learners must demonstrate that they fully understand the methods used by planning authorities and the information required as part of the planning application from the developer to support public consultation and participation. The impact should be in terms of planning applications being processed efficiently and effectively to minimise delays and costs rising.

For pass standard, learners will explain why and how the public are consulted in the plan-making and planning application processes, and how informal groups and formal local, regional and national organisations can also engage in these processes. Learners must demonstrate that they have developed an understanding of the methods used to involve the public and how these operate in the development of new plans and processing planning applications.

Links to other units

This unit links to:

- Unit 8: Building Regulations and Control in Construction
- Unit 25: Property Law
- Unit 26: Conversion, Adaptation and Maintenance of Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers from public and private planning practitioners, planning interest groups or construction firms
- participation in audience assessment of presentations
- work experience in a public or private planning office, planning interest group or in the planning team of a construction firm
- employers' business materials as exemplars
- employers' planning and appeal documentation
- support from local business staff as mentors.

Unit 25: Property Law

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners study the ownership of land and how it is bought, rented and sold. They will cover the legal responsibilities of owners, landlords and tenants.

Unit introduction

How land and property are owned, leased or used impacts on their value and how they can be legally transferred. Land and property can be enjoyed by a number of people at once. With this in mind, property law has evolved to provide rules to accommodate multiple interests in its ownership and access, and often determines whose interests have priority.

In this unit, you will learn how land ownership has evolved over time and how the current system of land ownership operates, including its registration and freehold and leasehold ownership. You will gain a good understanding of the law of contract and how it is used in the buying and selling of property. You will examine landlord and tenant law, which applies when property is rented out, and develop an understanding of how leases are created and operated. You will also learn how other laws, such as the law of tort, impacts on occupiers' liability.

A sound knowledge of property law is an essential aspect for employment roles involving the purchase, construction and maintenance of property. This unit will give you a good foundation for studying construction-related subjects at a higher level, including degree-level programmes in construction, property, housing, building surveying and planning.

Learning aims

In this unit you will:

A Understand different types of land ownership and responsibilities

B Examine the law of landlord and tenant

C Examine the system for buying and selling property.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Understand different types of land ownership and responsibilities	**A1** Land ownership and registration **A2** Freehold and leasehold land **A3** Other areas of law impacting on use of land and buildings	A report/information booklet/case study on ownership of land and other areas of law impacting on this.
B Examine the law of landlord and tenant	**B1** Types of tenancy **B2** Restrictions and covenants in a lease **B3** Bringing leases to an end	A report or information booklet on the development of a lease for a given case-study scenario.
C Examine the system for buying and selling property	**C1** Essentials of a contract in the conveyancing process **C2** Conditions of a contract **C3** Searches, contract procedures and costs in exchange of property	A report or information booklet on the different types of application of the law of contract in the property conveyancing market.

Content

Learning aim A: Understand different types of land ownership and responsibilities

A1 Land ownership and registration

- How land is owned:
  - current legal system and legislation, administration of the law and sources of law
  - historical development of land ownership, definition of land, boundaries and tenure
  - estates and land registration:
    - registered
    - unregistered.
- How concurrent ownership arises, expression of creation or co-ownership by implication:
  - joint tenancy, the rights of survivorship and the four unities, to include time, title, interest, possession
  - tenancy in common, rights of survivorship and the four unities, to include time, title, interest, possession
  - conversion of a joint tenancy into a tenancy in common, ending co-ownership.

A2 Freehold and leasehold land

- How land is owned when it is freehold, its benefits and drawbacks:
  - forms of freehold
  - restrictions on ownership:
    - easements, to include requirements and extinguishment
    - rights similar to easements
    - wayleaves.
- How land is owned when it is leasehold, its benefits and drawbacks:
  - forms of leasehold
  - ground rent
  - restrictions imposed under leasehold ownership
  - service charges.

A3 Other areas of law impacting on use of land and buildings

Implications for construction where there are boundaries and party walls.

- Types of wall, to include party walls, party structures, boundary walls, retaining walls, building envelopes.
- Legislation, regulations and case law.
- Trespass and nuisance considerations in the context of maintenance access.
- Procedures and obligations on neighbour notification and agreement.
- Occupier liability and the law of tort:
  - negligence, to include duty of care and breach of duty
  - the Occupiers' Liability Act 1957 and Occupiers Liability Act 1984
  - nuisance, to include private and public nuisance
  - defences
  - remedies, including damages, injunctions and other remedies.
- Housing legislation, regulations and public agencies.
- Health and safety legislation, regulations and requirements.
- Building regulations, legislation, processes, work covered by building regulations, penalties, appeals and determinations.
- Town and country planning law:
  - controlling the use of land
  - controlling the development of land.

Learning aim B: Examine the law of landlord and tenant

B1 Types of tenancy

The types of tenancy in landlord and tenant law.

- Fixed-term leases, to include definitions and examples.
- Periodic tenancies, to include definitions and examples.
- Other types of lease, to include leases for life and perpetually renewable leases.
- Statutory protection for landlords and tenants through legislation and case law.

B2 Restrictions and covenants in a lease

The terms and conditions of a lease.

- Covenants:
  - requirements of the parties to the lease
  - undisturbed possession
  - restriction of use.
- Payment of rent and rent review covenants.
- Repair obligations for landlords and tenants.
- Service charges.
- Breach of covenants, to include:
  - disputes about administration
  - fulfilment of the term of the covenant.
- Procedures for dealing with disputes, to include mediation processes.

B3 Bringing leases to an end

- Forfeiture of a lease for breach of covenant.
- Expiry, notice and enlargement.
- Notice requirements.

Learning aim C: Examine the system for buying and selling property

How the law of contract applies to the buying and selling of land and property, including associated costs, benefits and drawbacks.

C1 Essentials of a contract in the conveyancing process

- Relevant contract legislation.
- Offer and acceptance, requirements, communication of acceptance, termination of offers, conditions and use of relevant case law to explain these terms.
- Intention to create legal relations.
- Capacity, special rules, dealing with companies and partnerships.
- Consideration, to include value, definition and sufficiency.

C2 Conditions of a contract

- Law Society Standard Conditions of Sale.
- Standard conditions and express and implied conditions.
- Remedies for breach of contract, to include damages, compensation for loss.

C3 Searches, contract procedures and costs in exchange of property

- Property searches, their use, benefits and drawbacks:
  - local searches
  - land registry
  - environmental-related searches, to include contaminated land, natural ground subsidence, energy, river flooding, coastal flooding, surface water flooding
  - mining searches
  - other searches
  - indemnity policies.

- Contract procedures:
  - legal processes in drafting contracts
  - legal advice before signing
  - signing contracts
  - exchanging contracts
  - deposits
  - termination of a contract
  - completion of sale
  - transfer of ownership.
- Costs:
  - Land Registry fees
  - search fees
  - stamp duty
  - legal fees.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Understand different types of land ownership and responsibilities		**A.D1** Evaluate how laws governing the use of land and buildings impact on property ownership in a given situation.
A.P1 Explain the principles of land registration and concurrent ownership. **A.P2** Explain the principles of freehold and leasehold ownership of land. **A.P3** Explain the impact other areas of law can have on the use of land and buildings.	**A.M1** Discuss the benefits and drawbacks of freehold, leasehold and concurrent ownership of land in a given situation. **A.M2** Discuss the impact that other areas of law can have on the use of land and buildings in a given situation.	
Learning aim B: Examine the law of landlord and tenant		**B.D2** Evaluate the different approaches that can be taken to develop, operate and end a lease for a given situation.
B.P4 Describe the types of lease in landlord and tenant law. **B.P5** Explain how a lease is developed for a property.	**B.M3** Discuss the operation of a lease for a given scenario.	
Learning aim C: Examine the system for buying and selling property		**C.D3** Evaluate the interaction between the law of contract, property conveyancing processes and the requirements of all parties involved for a given situation.
C.P6 Explain contractual requirements in the property conveyancing process. **C.P7** Describe the searches and costs associated with buying land and property in the conveyancing process.	**C.M4** Discuss the stages and requirements in the law of contract in the property conveyancing process for a given situation.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.P3, A.M1, A.M2, A.D1)

Learning aim: B (B.P4, B.P5, B.M3, B.D2)

Learning aim: C (C.P6, C.P7, C.M4, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit. If there are law courts nearby, it may be useful to visit them to support contextualisation of the unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners must evaluate how land law and ownership, housing law, building control law, and the law of tort combine to control land and property use and regulate construction work. They must assess the impact of these statutory requirements, with reference to legislation, case law and case studies, to make judgements on the impact of these legal constraints on the feasibility of construction projects, making recommendations on how a development company can take steps to reduce or remove them.

For merit standard, learners must discuss how land ownership and other areas of law shape how land and property are used, and how construction work is planned and managed while on site, referring to legislation and case law. They should consider how easements and concurrent forms of ownership affect land use. Learners must demonstrate that they fully comprehend the interaction of the areas of law on property construction planning and operational activities.

For pass standard, learners must explain how land law and two other areas of law have evolved to govern how land and property are developed and used. Learners must explain how land use can be restricted by measures apart from planning permission, such as easements and wayleaves, and that ownership and control of land can sit with more than one person or organisation. Learners must demonstrate that they have a good understanding of the legal framework controlling land use and land ownership.

Learning aim B

For distinction standard, learners must evaluate how landlord and tenant law is used to create leases, and how lease terms and conditions are used to regulate the use of property to maintain its value and respect the amenity of surrounding landowners. Learners must make judgements on the impact of these conditions on how land and buildings are used, and on the landlord and tenant. Learners must also make judgements about the remedies available to both parties in the event of non-compliance by either or both parties. They must demonstrate that they have a developed understanding of all of the considerations to ensure the professional management of a lease.

For merit standard, learners must discuss how a lease can be created for a given commercial setting using lease terms and conditions to ensure that properties with different uses can operate simultaneously, without impacting on the amenity of adjacent landowners. They should make recommendations on the types of restrictions and covenants to be included to ensure payment of rent, undertaking of repair and control of business operations.

For pass standard, learners must describe how different types of lease are constructed for commercial properties. They should demonstrate a good understanding of the different types of leases that can be created and the terms and conditions that can be included in leases, as well as the legal and practical processes available for effective property management before a lease commences.

Learning aim C

For distinction standard, learners must evaluate how the law of contract and the property conveyancing processes interact in the property disposal process. The evaluation must be underpinned by legislative and case-law considerations. Learners must demonstrate that they have a developed understanding of the law to allow the legal transfer of property ownership, yet ensure feasibility of a development project for a given situation.

For merit standard, learners must discuss the stages and requirements of the law of contract when applied to the property conveyancing process for a given situation. They must carry out a detailed review of legislative requirements and consequence of case-law decisions on the transfer of ownership of land and buildings. They must demonstrate that they fully comprehend the legal processes and procedures involved to meet statutory requirements of buying and selling land.

For pass standard, learners must explain how the law of contract operates and its stages and requirements, with reference to key legislation and case law. They must describe the requirements and costs associated with the preparation of transfer of ownership of land and buildings. Learners must demonstrate that they have a good understanding of the processes and procedures used in the system of buying and selling land and property.

Links to other units

This unit links to:

- Unit 8: Building Regulations and Control in Construction
- Unit 22: Economics and Finance in Construction
- Unit 24: Planning Application Procedures in Construction
- Unit 26: Conversion, Adaptation and Maintenance of Buildings.

Employer involvement

This unit would benefit from employer involvement in the form of:

- guest speakers from local legal practices, construction firms or commercial estate agency practices involved in lease and property management
- participation in audience assessment of presentations
- work experience in a commercial estate agency practice or within the land acquisition team of a construction firm
- employers’ business materials as exemplars
- support from local business staff as mentors.

Unit 26: Conversion, Adaptation and Maintenance of Buildings

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners gain an understanding of how to adapt, convert and maintain buildings, and develop the skills for the processes involved.

Unit introduction

This unit focuses on existing properties and how to ensure their suitability for continued use, both now and for future generations. The UK has millions of existing properties that require ongoing maintenance, alterations, changes and upgrades in particular to improve efficiency to meet reduce carbon footprint and help meet NetZero targets.

In this unit, you will understand the reasons why buildings need to be converted or adapted and why maintenance is so important in the preservation of the fabric of a property. You will learn the processes involved, as well as the methods employed to develop a successful project, before applying these skills to your own design scheme.

This unit provides the essential knowledge and skills for all disciplines as it broadens construction knowledge. It particularly supports careers in building surveying, architecture and design, project management, property development and construction management. It also provides progression opportunities to higher education, including HND and degree programmes in construction-related disciplines.

Learning aims

In this unit you will:

A Examine the need for conversion, adaptation and retrofit of a property

B Develop a maintenance plan for a property

C Develop a scheme design and specification for the conversion, adaptation or retrofit of a property.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine the need for conversion, adaptation and retrofit of a property	**A1** Conversion, adaptation and retrofit **A2** Levels of intervention	A written report that considers the need for conversion and adaptation, looking at the options for and levels of intervention.
B Develop a maintenance plan for a property	**B1** Need for maintenance **B2** Maintenance approaches **B3** Levels of maintenance intervention and repair	A written report that considers the need for maintenance of a property, and the different options, to allow for the production of a maintenance plan for a specified property.
C Develop a scheme design and specification for the conversion, adaptation or retrofit of a property	**C1** Process of conversion, adaptation and retrofit **C2** Legislative requirements **C3** Options for conversion and adaptation **C4** Proposals for conversion, adaptation and retrofit schemes	A written report, annotated drawings and specification for a conversion and adaptation project for a given scenario.

Content

Learning aim A: Examine the need for conversion, adaptation and retrofit of a property

Why properties require conversion and adaptation, and the different levels of intervention and approaches available.

A1 Conversion, adaptation and retrofit

Reasons why existing properties need to be adapted, converted or retrofitted.

- Old and dilapidated properties:
  - properties no longer fit for the intended purpose
  - lack of maintenance
  - historic properties not suitable for modern life
  - listed building status.
- For increased brownfield development:
  - government requirements
  - lack of available greenfield sites
  - pressure groups/public discontent with overdevelopment of greenfield sites
  - public image and the desire for sustainable development.
- Legislative changes.
- Preservation of the historic environment.
- Architectural trends and fashion changes.
- Building obsolescence:
  - technical
  - economic
  - social.
- Changes in societal needs:
  - ageing population
  - increase in need for single-person households
  - people living longer
  - cohabitation due to unaffordable properties
  - increased cultural diversity.
- Financial:
  - maintaining property values
  - need for affordable housing
  - promoting urban regeneration.
- Technological advancements:
  - construction materials
  - smart buildings
  - electronic infrastructure advancements.
- Retrofitting to improve energy efficiency:
  - increased insulation
  - photovoltaic
  - solar panels
  - ground-source heat pumps
  - smart energy monitoring
  - building management systems.
- Increased human comfort requirements:
  - air conditioning
  - comfort cooling
  - efficient heating systems.

A2 Levels of intervention

Different levels of intervention and determination of when they would be suitable for adapting or converting a building.

- Preservation to halt the general deterioration in the fabric – general maintenance.
- Upgrade of a specific element or space, e.g. new roof, bathroom.
- Refurbishment of the whole property.
- Internal alterations, e.g. to alter the space internally, removing or adding walls etc.
- Retaining a facade and elevation, with a new building behind it.
- Extension to add more space.
- Restoration to put the property back into the original condition
- Retrofit: the types of interventions and the suitability of buildings for retrofit remedies including insulation, renewables, improved glazing, modernising heating sources.

Learning aim B: Develop a maintenance plan for a property

B1 Need for maintenance

Consideration of the reasons why properties need ongoing maintenance to preserve their fabric and ensure their longevity.

- Material failure.
- Inappropriate specification, detailing and design.
- Poorly constructed.
- Climatic impact.
- Structural failure.
- Thermal movement.
- Lack of or inappropriate maintenance.
- Human impact.
- Regular cyclical requirements.

B2 Maintenance approaches

Maintenance approaches and their advantages and disadvantages in maintaining and extending the life of a property.

- Emergency (unplanned):
  - reactive to issues as they arise
  - often exacerbates ongoing issues
  - availability of appropriate resource(s).
- Planned:
  - regular maintenance to agreed timescales and relevant to specific materials and plant
  - asset management plans.
- Scheduled:
  - maintenance after a specified time/number of uses
  - maintenance schedules.
- Condition-based:
  - preventative at predetermined periods or intervals
  - legislative compliance inspections, e.g. compliance with fire regulations etc.

B3 Levels of maintenance intervention and repair

The scope, scale and resource requirements for intervention.

- Emergency repairs to stop the immediate problem and prevent further issues.
- Temporary or short repairs to stop or prevent problems.
- Targeted repairs.
- Planned/cyclical repairs.
- Renewal/replacement.

Learning aim C: Develop a scheme design and specification for the conversion, adaptation or retrofit of a property

The methods for undertaking a conversion and adaptation project, detailing the processes and legislative consideration for a project.

C1 Process of conversion, adaptation and retrofit

Process for undertaking a conversion and adaptation project.

- Initial need (strategic definition).
- Preparation and brief.
- Property inspection.
- Concept design.
- Detailed and technical design.
- Construction.
- Completion.
- Building use.

C2 Legislative requirements

Legislative requirements and their impact on a building conversion and adaptation project.

- Planning legislation:
  - planning permission
  - listed building consent
  - specific planning permission for conservation areas
  - Areas of Outstanding Natural Beauty (AONB)
  - sites of specific scientific interest (SSSI).
- Building regulations:
  - building regulation approvals
  - building notices
  - building regulation inspections.
- Current health and safety legislation:
  - Health and Safety at Work etc. Act 1974
  - Construction (Design and Management) Regulations 2015
  - fire risk assessments.
- Property-related legislation:
  - Party Wall etc. Act 1996
  - 'right to light'
  - Tree Preservation Orders (TPO)
  - current legislation relating to property
  - legislation linked to netzero targets including amount of insulation, glazing, fossil fuels in new builds.

C3 Options for conversion and adaptation

Consideration of the options available for the conversion and adaptation of a property.

- Initial project brief, to include analysis and interpretation of the client requirements in relation to the property and feasibility.
- Structural alterations, to include internal alterations to remove or add walls, floors, doors, windows.
- Lateral adaptation, to include extensions to add space to the property.
- Vertical adaptation, to include loft conversions, additional storey, basement conversions.
- Energy efficiency measures, to include zero carbon energy source, insulation and glazing.

C4 Proposals for conversion, adaptation and retrofit schemes

Use of building survey reports and plans to determine the size and condition of a property to produce a conversion and adaptation scheme.

- Analysis and interpretation of plans, elevations and sectional details.
- Analysis and interpretation of building survey reports.
- Plans of the proposed scheme.
- Sections detailing the levels and all changes to be made.
- Specifications.
- Ongoing maintenance plans.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine the need for conversion, adaptation and retrofit of a property		
A.P1 Explain why properties may need to be converted and adapted. **A.P2** Explain the intervention options for the conversion and adaptation of properties.	**A.M1** Discuss the reasons for intervention options for the conversion and adaptation of a given property.	**A.D1** Evaluate the needs and intervention options for the conversion and adaptation of a given property.
Learning aim B: Develop a maintenance plan for a property		
B.P3 Explain how the different approaches to maintenance can preserve and extend the life of properties. **B.P4** Describe the different levels of maintenance intervention. **B.P5** Produce a maintenance plan for a given property.	**B.M2** Assess how the different approaches to and levels of maintenance can preserve and extend the life of a given property. **B.M3** Produce a detailed maintenance plan for a given property.	**B.D2** Evaluate the maintenance requirements and the maintenance plan, and their impact in preserving and extending the life of a given property.
Learning aim C: Develop a scheme design and specification for the conversion, adaptation or retrofit of a property		
C.P6 Explain the legislative requirements for a conversion and adaptation of buildings. **C.P7** Compare the design options for conversion and adaptation of a given property. **C.P8** Produce an outline scheme design and specification for the conversion and adaptation of a given property.	**C.M4** Produce a detailed scheme design and outline specification that meets legislative requirements for the conversion and adaptation of a given property.	**C.D3** Justify the proposed scheme design and specification, ensuring that it meets legislative requirements for a conversion and adaptation project of a given property.

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aim: B (B.P3, B.P4, B.P5, B.M2, B.M3, B.D2)

Learning aim: C (C.P6, C.P7, C.P8, C.M4, C.D3)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to:

- a range of resources, including appropriate books, internet resources, industry exemplars and example projects
- blank copies of drawings (on which learners can express their ideas)
- the built environment for exploration purposes: to analyse existing conversion and adaptation schemes in the locality, as this will enhance an understanding of options and how buildings can change to suit new demands.

There is a requirement for drawing in the unit but there is no expectation that this will be formal technical drafting: accurately scaled and annotated sketches are acceptable.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will evaluate the specific needs of a given property. They will consider its suitability for conversion and adaptation, discussing the various options and levels of intervention, and concluding with a coherent, reasoned discussion on the most appropriate option for that property. The evaluation must be detailed and the analysis of the options, and the reasons for non-selection, must be justified. Learners must demonstrate a thorough understanding of the options and possibilities – a broad-brush approach is not acceptable at this level. To achieve this standard, learners must produce a detailed, referenced, annotated report.

For merit standard, learners will link their discussion to a particular property and will consider all options. However they will also have a specific focus on the suitability of the options discussed for a particular property. Learners must show a broad understanding of all the options, and take this broad narrative and apply it to a particular scenario.

For pass standard, learners will produce a wide-ranging narrative on the reasons why properties need to be converted and adapted. The discussion may not focus on any specific project and will consider a wide range of reasons, levels of intervention and the different options available. This does not need to be specific to a particular building, or link to the reasons given for the need to convert or adapt. Learners must produce a well-researched and wide-ranging consideration of the options.

Learning aim B

For distinction standard, learners will develop the discussion to include an evaluative discussion as to how and why the maintenance plan they have produced will preserve and extend the life of a given property. They will be specific to the given property and demonstrate a detailed understanding of how their specified interventions will benefit all aspects of the building. The discussion must include the relative merits of each intervention and state specifically how each one will prolong the life of the building.

For merit standard, learners will apply their discussion to the given property. They will consider all of the available options in relation to this property, assessing why they may or may not be applicable to that particular situation. In addition to the detailed and applied narrative, learners will produce a detailed maintenance plan, considering all of the options and requirements for the property, such as maintenance requirements, cyclical requirements (dates) and the different levels of intervention at each inspection. For example, it may be appropriate to inspect a roof annually from the ground, but perhaps every three years it may be more appropriate to inspect it at close quarters from a scaffold or mobile elevating work platform (MEWP).

For pass standard, learners will produce a broad explanation of the different options, methods and approaches to maintenance, culminating in a basic maintenance plan for a given property. The explanation must be detailed but it may cover a wide range of issues without specifically focusing on any one building. The maintenance plan should focus on a particular building to give learners some direction as to what to include. The plan will be sufficiently detailed to enable it to be a useful document for a typical domestic property, and will contain the works required and the dates these works would be expected to be carried out. The format is not as important as the actual content. Learners must demonstrate an understanding of the need for a plan and how it would be used in a given scenario.

Learning aim C

For distinction standard, learners will fully justify their final design solution. They will take into account all the design options and provide a detailed narrative of the relative merits and demerits of each. They will assess the impact of legislation on their thinking and conclude with a detailed analysis of their final design solution, explaining why they felt it most appropriate for the given property.

For merit standard, learners will provide an appropriate level of detail in their initial proposals, showing a deep understanding of the design process and the options available for selection of materials. Their drawings and specification will contain appropriate detail and provide a thorough understanding of the scheme and the materials used to construct it. There is no requirement to produce original drawings and learners can put specification notes onto the drawings. However, to provide sufficient evidence to demonstrate merit-level understanding, learners will produce a detailed specification of work items and a range of drawings.

For pass standard, learners will consider different design options for a given project. They must be given plans and a brief of sufficient size and scope to allow them to develop a range of design ideas and solutions, as well as legislative requirements (a small domestic extension may not provide sufficient scope). Learners will explore different options (at least three) and discuss the legislative impact, and the implications, for each design. There is no expectation that learners should produce their own plans – drawing on or tracing originals is acceptable – and there is no requirement to draw office equipment. Once learners have decided on their final proposal, they will produce a number of drawings and a specification to communicate their ideas. They do not have to produce their own drawings, and the specification can be in the form of notes on the drawing, as long as there is sufficient clarity and detail to allow the reader to be able to ascertain exactly what the final design will look like. Learners will produce plans, elevations and sections to support the specification (which must contain sufficient information to convey a clear understanding of the process). For example; if a lintel is to be inserted to form a new opening, learners are not required to produce design calculations, but would be expected to state the type, style and material, for example 'a new steel box lintel with minimum 200 mm bearing inserted to form a new opening' – and not 'a new lintel over the opening'.

Links to other units

This unit links to:

- Unit 4: Construction Technology
- Unit 8: Building Regulations and Control in Construction
- Unit 10: Building Surveying in Construction
- Unit 21: Building Services Science
- Unit 24: Planning Application Procedures in Construction.

Employer involvement

Centres can involve employers in the delivery of this unit if there are local opportunities to do so. There is no specific guidance related to this unit.

Unit 39: Housing Design Project

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners will develop skills in producing housing design proposals in response to a client brief and stakeholder constraints.

Unit introduction

'*Home is the most important piece of architecture in our lives.'* (George Clarke, 2019)

Housing design is often driven by market forces, which have a huge impact on innovation and the use of creative design solutions. Ideally, housing design should consider aesthetics, location, user, lifestyle and quality of life. Advances in technology and design systems, and demand for innovative housing mean that there are now more opportunities than ever to come up with inventive housing design solutions.

In this unit, through engaging with the housing design project process, you will produce and present a housing design. You will demonstrate your understanding of industry standard systems for sharing design information with the designer, the client and wider construction stakeholders. You will look at all of the design criteria to inform concepts and designs, and to engage with the design process and detail design in order to produce a proposal. You will then present these using industry conventions.

This unit will give you underlying knowledge that you can use in other units in the qualification. For example, taking this unit along with *Unit 18: Building Information Modelling*, *Unit 40: Offsite and Onsite Alternative Construction Methods*, *Unit 41: Renewable Energy for Housing* and *Unit 42: The Housing Industry*, will give you a good understanding of modern home building and design. This unit also gives you a foundation to study construction management and housing design subjects at a higher level, including degree-level programmes and the new Higher National Certificate and Diploma in Future Homes Design and Construction.

Learning aims

In this unit, you will:

A Explore the housing design process

B Develop a housing design proposal for a given client brief

C Present a housing design proposal for a given client brief.

Summary of unit

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<tr><th>Learning aim</th><th>Key content areas</th><th>Recommended assessment approach</th></tr>
<tr><td>A Explore the housing design process</td><td>A1 Housing design project process
A2 Design information</td><td>A report covering housing design process and design information.</td></tr>
<tr><td>B Develop a housing design proposal for a given client brief</td><td>B1 Design criteria
B2 Design process
B3 Design detail</td><td rowspan="2">A presentation of a housing design proposal in either audio-visual or document/portfolio form, with arguments in support of the process and outcome.</td></tr>
<tr><td>C Present a housing design proposal for a given client brief</td><td>C1 Presentation factors</td></tr>
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Content

Learning aim A: Explore the housing design process

A1 Housing design project process

- Feasibility.
- Design.
- Construction information.
- Statutory information:
  - planning applications:
    - permitted developments
    - constraints
  - Party Wall Act 1996
  - The Building Regulations 2010
  - Construction Design Management (CDM)
- Site operations:
  - variations/architect's instructions
  - onsite design.
- Offsite manufacture design.
- Handover.
- Post-occupancy.

A2 Design information

- Formats and systems:
  - CAD formats
  - BIM Models
  - digital collaboration systems.
- Roles, responsibilities and relationships:
  - Roles:
    - client
    - lead consultant, for example architect, designer, general contractor
    - consultants, for example engineers, cost planners, suppliers, BIM managers, contractors.
  - Relationships:
    - client
    - consultant
    - contractor.
- Managing information:
  - distribution/transmittal
  - approval
  - managing changes.

Learning aim B: Develop a housing design proposal for a given client brief

B1 Design criteria

- Stakeholder needs:
  - multiple/single occupancy
  - material preferences
  - building style
  - allocations of space
  - maintenance and upkeep
  - budget.
- Housing standards.
- Environment/sustainability.
- Location.

B2 Design process

- Design research:
  - historic
  - contextual
  - environmental
  - technical
  - financial.
- Concept design:
  - sketches
  - models
    - physical
    - digital
  - advanced – artificial intelligence, virtual reality, robotics.
- Design development:
  - design iteration
  - refinement
  - feedback.
- Design visualisation:
  - materials
  - textures
  - colours
  - surroundings.

B3 Detail design

- Drawings:
  - site
  - floor plans
  - details
    - wall details
    - roof details.
- Outline specification:
  - materials
  - manufacturing
  - quality.

Learning aim C: Present a housing design proposal for a given client brief

C1 Presentation factors

- Format:
  - audio-visual
  - document/portfolio-based
  - appropriate for audience.
- Information:
  - use of industry terminology
  - legibility
  - line weight
  - colour
  - font size
  - layout and styling.
- Structure:
  - linear/chronological
  - process-driven
  - narrative:
    - introduction and framing of concept
    - order of information
    - key information addressing how each aspect of the brief has been met
    - effective use of prompts
    - conclusion justifying decisions and design process.
- Justification:
  - evidence-based argument
  - illustrated argument
  - design decisions.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Explore the housing design process		**A.D1** Assess the relationships between different roles in a housing design process related to the sharing and distribution of information.
A.P1 Explain the stages and activities of the housing design process. **A.P2** Describe industry standards for information sharing.	**A.M1** Assess how information is shared and managed at each stage of the housing design process.	
Learning aim B: Develop a housing design proposal for a given client brief		**B.D2** Produce drawings and outline specifications for a housing proposal that clearly integrate design research, concept development and detailed resolution in response to a client brief.
B.P3 Explore the design criteria that inform the housing design proposal. **B.P4** Produce concept and detail designs for a housing design proposal.	**B.M2** Produce a housing design proposal informed by research and application of industry conventions, for information sharing and collaboration.	
Learning aim C: Present a housing design proposal for a given client brief		**C.D3** Present a housing design proposal, communicating design decisions for a housing proposal, using evidence-based and illustrated argument.
C.P5 Present the process and outcomes of a housing design proposal. **C.P6** Use industry standard conventions for presenting a housing design proposal in a format appropriate to a given audience.	**C.M3** Present a housing design proposal that details the ways in which design decisions are informed by research related to a given brief.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.D1)

Learning aims: B and C (B.P3, B.P4, C.P5, C.P6, B.M2, C.M3, B.D2, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit. However, it is recommended that learners have access to appropriate CAD and/or 3D modelling software so that they can develop their designs and use outputs in their presentations.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will provide effective information on the different roles involved in the housing design process, the type of information produced within each role and with whom the information is shared, and processes to manage the flow of accurate information. They will base this on a detailed assessment of the design process and the types of information required for effective sharing.

For merit standard, learners will show careful consideration of the different stages of the housing design process and an ability to conduct an assessment of how information is managed at each stage of the design process. They will appraise critical points of information requirements and who is responsible for developing them, and in what form. They will do this while applying the standards and conventions that ensure collaboration through the sharing of appropriate design information.

For pass standard, learners will provide some detail, reasons and explanation of the different stages of the housing design process, with some appreciation of how the activities performed at each stage. Learners will also be able to describe the standards and conventions that ensure collaboration through the sharing of appropriate design information.

Learning aims B and C

For distinction standard, learners will communicate well-structured and logical arguments that use evidence and illustrated points to justify design decisions. Learners will be able to engage the audience confidently and will have a developed grasp of professional practice for presenting, demonstrated in their selection of format, information and structure. Learners will demonstrate how they balance stakeholder constraints with creative opportunities in response to the brief. Learners will select industry-relevant formats for the production of design information and clearly show detailed consideration of stakeholder needs. Learners will develop an effective proposal through an iterative process that reflects a clear understanding of the stages of a design project and integrates concept, research, development and detailed resolution.

For merit standard, learners are able to present their housing design decisions logically, using industry terminology appropriate to the audience. They will provide some evidence as to how design decisions are informed by research. Learners will have selected industry-relevant formats for their presentation and clearly show consideration for the audience. The structure and narrative will be logical at most points. Learners will be able to engage the audience effectively and have a developed grasp of professional standards, demonstrated in their selection of format, information and structure. Housing design proposals will be clearly informed by and iteratively developed through consideration of design criteria. Design proposals will be produced in industry-standard formats suitable for sharing with wider stakeholders in the construction industry and will include detailed drawings and an outline specification.

For pass standard, learners are able to communicate adequately their housing design proposal to the audience. They will include some key points outlining the processes involved in the development of concepts. Key points in the development will be clear, with limited reference to the constraints of the brief and how the stages of the process inform each other. They will recognise the information required for each of the stages and the types of investigation required. Learners will be able to produce appropriate information and select an adequate method for information sharing with stakeholders. Learners will consider the criteria that inform a housing design proposal in order to develop basic concepts and detailed designs, but they may apply the constraints superficially. Drawings and the outline specification will show some detail but may not match the concept clearly.

Links to other units

This unit links to:

- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 7: Graphical Detail in Construction
- Unit 18: Building Information Modelling
- Unit 40: Offsite and Onsite Alternative Construction Methods
- Unit 41: Renewable Energy for Housing
- Unit 42: The Housing Industry.

Employer involvement

This unit would benefit from employer involvement, particularly where there is an opportunity to use and learn about real industry design and project management tools and software. This could include:

- workshops with housing design practitioners
- mentoring from local partners
- employers setting assignment briefs
- employers supporting the assessment of work.

Unit 40: Offsite and Onsite Alternative Construction Methods

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners will develop skills in selecting alternative construction methods to meet wider changes in the construction industry.

Unit introduction

New and alternative technologies, processes and materials are enabling new forms of construction that are more efficient, safer and more sustainable. There is pressure to modernise aspects of the industry, from working practices to inefficient business models and supply chains, which these new methods help to address.

In this unit, you will explore the alternative methods of offsite and onsite construction that are changing in the construction industry. You will consider how and why these changes are taking place, looking at the different types of driver that are internal and external to the construction industry. Your exploration will inform an investigation of opportunities for the use of alternative construction methods in relation to a construction project.

This unit will give you knowledge that complements other units in the qualification. For example, taking this unit along with *Unit 18: Building Information Modelling*, *Unit 39: Housing Design Project*, *Unit 41: Renewable Energy for Housing* and *Unit 42: The Housing Industry*, will give you a good understanding of modern home building and design. This unit also gives you a good foundation for studying construction-related subjects at a higher level, including degree-level programmes and the new Higher National Certificate and Diploma in Future Homes Design and Construction.

Learning aims

In this unit, you will:

A Examine the different forms of alternative construction available in industry

B Explore the drivers for alternative forms of construction

C Investigate the potential benefits of an alternative method of construction for a given project.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Examine the different forms of alternative construction available in industry	**A1** Offsite construction **A2** Onsite construction **A3** Renovation, adaptation and retrofit **A4** Advantages and disadvantages	A report on offsite and onsite alternative construction methods, and how they address drivers.
B Explore the drivers for alternative forms of construction	**B1** Construction-related drivers **B2** Non-construction drivers	
C Investigate the potential benefits of an alternative method of construction for a given project	**C1** Project parameters	A research portfolio on alternative methods of construction and their suitability for a given construction project.

Content

Learning aim A: Examine the different forms of alternative construction available in industry

A1 Offsite construction

- Non-volumetric pre-assembly:
  - pre-assembled units/elements
  - precast concrete sections
  - pre-assembled structural steelwork
  - Steel Framing Systems (SFS).
- Volumetric pre-assembly:
  - complete unit
  - modular units.
- Panelised offsite construction:
  - framed panels (timber, steel)
  - sandwich panel systems
  - concrete panels/sections.
- Automated:
  - 3D printing
  - robotics.

A2 Onsite construction

- Green oak.
- Container.
- Straw bale.
- Cob.
- Adobe.
- Rammed earth.
- Earthship.
- Earthbag.
- Cross-laminated timber (CLT).
- Onsite robotics.

A3 Renovation, adaptation and retrofit

- Type of change:
  - structural
  - cosmetic
  - service, e.g. electrical, heating, ventilation.
- Energy saving:
  - glazing upgrade
  - insulation
  - renewables integration.
- Cost-benefit analysis.

A4 Advantages and disadvantages

Learners will consider alternative types of construction in terms of:

- cost
- environmental impact
- speed and efficiency
- quality
- safety
- durability.

Learning aim B: Explore the drivers for alternative forms of construction

B1 Construction-related drivers

- Regulations.
- Quality control.
- Working conditions.
- New technologies and materials.
- Skills shortages.
- Materials shortages.
- Speed and efficiency of assembly.
- Cost.
- Health and safety.
- Economies of scale, e.g. labour, plant hire, material, purchasing.
- Automation.
- Delivery.

B2 Non-construction drivers

- Sustainability:
  - waste
  - impact on others
  - changes in cultural influence
  - carbon emissions
  - transport.
- Policy:
  - housing
  - economic
  - industrial
  - education.
- Population:
  - demographic
  - lifestyle
  - wealth.

Learning aim C: Investigate the potential benefits of an alternative method of construction for a given project

C1 Project parameters

- Stakeholder:
  - client/developer
  - user:
    - demographics
  - contractor.
- Stakeholder needs:
  - type of project
  - spatial needs
  - quality
  - maintenance
  - finance availability.
- Local context:
  - site access
  - material availability
  - material transport
  - impact:
    - environmental
    - community.
- Sustainability:
  - quantity of material
  - sustainability of material
  - waste.
- Legislation:
  - planning
  - building regulations
  - health and safety.
- Cost:
  - budget
  - material
  - construction
  - operational
  - maintenance over lifespan.
- Time for development.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Examine the different forms of alternative construction available in industry		**A.D1** Evaluate a selected alternative construction method for application in a given project type.
A.P1 Describe alternative onsite construction methods. **A.P2** Describe alternative offsite construction methods.	**A.M1** Compare alternative construction methods.	
Learning aim B: Explore the drivers for alternative forms of construction		**B.D2** Evaluate the way that alternative forms of construction respond to influences of policy, sustainability and population change.
B.P3 Define the construction-based drivers that influence moves toward alternative forms of construction methods. **B.P4** Explain the influence of policy, sustainability and population on construction.	**B.M2** Assess the relationship between construction- and non-construction drivers for alternative forms of construction.	
Learning aim C: Investigate the potential benefits of an alternative method of construction for a given project		**C.D3** Justify how the selection of an alternative method of construction meets the needs and constraints of the brief.
C.P5 Outline the drivers that influence a given construction project. **C.P6** Explain the potential benefits of alternative construction methods for a given project, based on project parameters.	**C.M3** Assess the ways in which a selected alternative method of construction addresses project parameters.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, B.P3, B.P4, A.M1, B.M2, A.D1, B.D2)

Learning aim: C (C.P5, C.P6, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit.

Essential information for assessment decisions

Learning aims A and B

For distinction standard, learners will consider how alternative onsite and offsite methods of construction respond to the influences of construction drivers, both generally for the industry and in relation to a given project type. They will also consider wider, non-construction drivers and carry out a detailed investigation of them, to include sustainability, policy and population changes. They will make clear judgements on the suitability of different alternative methods of construction in meeting the needs of the construction industry and wider social needs in a sustainable way.

For merit standard, learners will highlight key points that differentiate alternative construction methods, making relevant arguments. They will show clear understanding of the different opportunities available, how and why they are used and some of the benefits they provide, and clearly define their suitability for different types of projects. Learners will provide sound examples of how alternative forms of construction are being used in response to policy, sustainability and population change; some points will be obvious or partially developed.

For pass standard, learners will give a general outline of alternative onsite and offsite construction methods, covering basic processes and materials used. They will have some knowledge of their benefits, including their suitability for different construction projects. They will be able to provide a basic outline of the construction drivers and draw limited conclusions as to how these drivers have an impact on moves toward alternative methods of construction. Learners will give general examples of how policy, sustainability and population influence construction, using limited examples or illustrations to demonstrate their points.

Learning aim C

For distinction standard, learners will accurately consider all of the relevant project parameters and alternative types of construction available for the project. They will consider the options and select a method that meets the broad needs of the brief, including non-construction influences. Learners will communicate their choice of alternative methods of construction, justifying their choice based on clearly illustrated and valid supporting arguments.

For merit standard, learners will select an appropriate alternative method of construction based on an in-depth evaluation of its suitability for project parameters. They will show a sound understanding of the potential to use alternative methods of construction and will align the benefits with the constraints of the brief.

For pass standard, learners will select a range of relevant alternative methods of construction to consider for the project. They will outline how each method meets the different project parameters and will explore the potential benefits that each method provides.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 18: Building Information Modelling
- Unit 39: Housing Design Project.
- Unit 41: Renewable Energy for Housing
- Unit 42: The Housing Industry.

Employer involvement

This unit would benefit from employer involvement in the form of:

- workshops with housing design practitioners
- mentoring from local partners
- employers setting assignment briefs
- employers supporting the assessment of work.

Tutors would benefit from accessing industry resource and expert training materials on offsite technology, for example those available through the websites of external experts, such as Offsite Ready and MOBIE.

Unit 41: Renewable Energy for Housing

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners will develop plans for improving the sustainability of homes through renewable energy use.

Unit introduction

Housing is one of the largest users of energy. Developing and installing renewable energy systems is becoming increasingly feasible. The need for renewable energy systems is driven by regulation, demand for reduced energy costs and sustainability.

In this unit, you will explore energy forms, energy use and the available renewable energy solutions for housing. You will investigate opportunities for renewable energy systems and consider how they may meet the stakeholder needs. You will use the information you gather from these activities and combine them with analysis of environmental factors and energy requirements. You will then generate a plan for the installation of a renewable system in an existing domestic building.

This unit will give you underlying knowledge that you can use in other units in the qualification. For example, taking this unit along with *Unit 18: Building Information Modelling*, *Unit 39: Housing Design Project*, *Unit 40: Offsite and Alternative Production Methods in Construction* and *Unit 42: The Housing Industry*, will give you a good understanding of modern home building and design. This unit also gives you a good foundation for studying construction management and housing design related subjects at a higher level, including degree-level programmes and the new Higher National Certificate and Diploma in Future Homes Design and Construction.

Learning aims

In this unit, you will:

A Explore how renewable energy systems provide sustainable solutions for housing

B Investigate stakeholder needs, energy use and the efficiency of an existing domestic building

C Develop a plan for a renewable energy upgrade to an existing domestic building.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Explore how renewable energy systems provide sustainable solutions for housing	**A1** Types of energy and distribution **A2** Renewable energy **A3** Energy in housing **A4** Energy impact and sustainability	A report for a client that covers the energy forms available and opportunities where renewable systems can be used.
B Investigate stakeholder needs, energy use and the efficiency of an existing domestic building	**B1** Stakeholders **B2** Stakeholder needs **B3** Environmental factors **B4** Energy use and building efficiency	A plan for a given project scenario that includes the investigation of energy needs, suggests opportunities for energy efficiency, and plans for a renewable energy system.
C Develop a plan for a renewable energy upgrade to an existing domestic building	**C1** Utilities analysis **C2** Modification to building fabric **C3** System plan **C4** Cost planning	

Content

Learning aim A: Explore how renewable energy systems provide sustainable solutions for housing

A1 Types of energy and distribution

- Energy supply:
  - coal
  - petrochemical:
    - oil
    - LPG
    - butane
    - propane
    - natural gas
  - nuclear
  - hydro
  - solar
  - wind
  - geothermal
  - biomass.
- Distribution:
  - mains delivered
  - locally produced
  - locally stored
  - power storage:
    - battery technologies
    - grid 'buyback'.

A2 Renewable energy

- Solar:
  - photovoltaic
  - solar hot water.
- Wind:
  - horizontal and vertical turbines.
- Geothermal:
  - heat
  - electricity.
- Hydro:
  - turbine
  - wave
  - tidal.
- Biomass:
  - heat
  - anaerobic digestion.

A3 Energy in housing

- Managing energy use:
  - energy supply
  - energy monitoring
  - energy efficiency.

- How energy is used in housing:
  - heating
  - appliances
  - water heating and hot-water storage
  - cooking
  - lighting
  - cooling and ventilation.

A4 Energy impact and sustainability

- Impact, including:
  - climate change:
    - greenhouse effect
    - acid rain
  - carbon emissions
  - pollution
  - waste products.
- Sustainability:
  - environmental
  - social/cultural
  - economic.

Learning aim B: Investigate stakeholder needs, energy use and the efficiency of an existing domestic building

B1 Stakeholders

- Client:
  - individual
  - institutional
  - government/local authority.
- Developer.
- Contractor.
- User/occupier.

B2 Stakeholder needs

- Recognising stakeholder needs:
  - data gathering.
- Costs:
  - purchase costs
  - installation cost
  - operating cost
  - return on investment.
- Human comfort.
- Social need.
- Aesthetics.

B3 Environmental factors

- Natural environment:
  - trees:
    - shading impact
  - habitat.
- Natural resources:
  - wind
  - light availability and quality
  - available biomass.
- Buildings:
  - proximity
  - shading
  - access.
- Access.
- Existing energy supply.
- Regulations:
  - planning permissions
  - building regulations.

B4 Energy use and building efficiency

- Building efficiency:
  - insulation
  - draught proofing and sealing
  - heat loss:
    - roof construction
    - wall construction
    - window types
  - natural light.
- Energy use:
  - heating/hot-water systems:
    - boiler type
    - hot-water storage/supply
  - lighting:
    - luminaire types
  - ventilation and air conditioning:
    - air changes
    - cooling load.

Learning aim C: Develop a plan for a renewable energy upgrade to an existing domestic building

C1 Utilities analysis

- Loads and energy consumption:
  - size of system
  - energy fluctuation.

C2 Modification to building fabric

- Additional insulation.
- Windows:
  - frame material
  - multi-pane glazing.
- Draught proofing.
- Heating/hot-water system:
  - boiler upgrade/replacement
  - radiator upgrade/replacement.
- Lighting:
  - luminaire-type changes.

C3 System plan

- Type of renewable system.
- System integration:
  - safety systems
  - meters/monitoring
  - instrumentation
  - heat:
    - heat exchanges
    - heat pumps
  - power:
    - charge controller
    - power conditioning
    - energy storage
  - back-up requirements and redundancy.
- Maintenance plan.

C4 Cost planning

- Upfront:
  - equipment
  - delivery
  - installation.
- Maintenance/operating:
  - lifespan of system.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Explore how renewable energy systems provide sustainable solutions for housing		**A.D1** Evaluate the social, environmental and economic sustainability of a given renewable energy source for housing.
A.P1 Outline types of energy for housing. **A.P2** Explain how energy is used in housing. **A.P3** Describe the environmental impact of different forms of energy for housing.	**A.M1** Compare the use of renewable energy sources in housing in relation to their sustainability.	
Learning aim B: Investigate stakeholder needs, energy use and the efficiency of an existing domestic building		**B.D2** Evaluate the benefits of improving energy efficiency of an existing domestic building through changes to building fabric.
B.P4 Identify stakeholder needs for an existing domestic building. **B.P5** Measure energy use and building efficiency of an existing domestic building.	**B.M2** Assess the impact of environmental factors on building efficiency, energy use and stakeholder needs.	
Learning aim C: Develop a plan for a renewable energy upgrade to an existing domestic building		**C.D3** Create a plan based on a review of the opportunities for improved efficiency and reduced energy use through the relationship between integration of a renewable energy system and modification to building fabric.
C.P6 Select an appropriate renewable energy system for an existing domestic building. **C.P7** Plan the integration of a renewable energy system into an existing domestic building.	**C.M3** Plan the integration of a renewable energy system into an existing domestic building with a detailed demonstration of how it meets stakeholder needs.	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.P3, A.M1, A.D1)

Learning aims: B and C (B.P4, B.P5, C.P6, C.P7, B.M2, C.M3, B.D2, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will draw on varied sources of information to inform rational opinions of the strengths or weaknesses of a given renewable energy source. Learners will provide effective arguments in support of their opinions on the social, environmental and economic sustainability of a given renewable energy source for housing, and reach reasoned and valid judgements.

For merit standard, learners will identify the main factors relating to the use of renewable energy sources in housing, to explain the similarities, differences, advantages and disadvantages in relation to their sustainability and impact on the environment.

For pass standard, learners will give an overview of different types of energy, including renewable energy. They will show clear details and give evidence to support how energy is used in housing. Learners will show that they understand the origins, functions and objectives of how energy is used, and its suitability for purpose. They will give a clear, objective account, in their own words, of the relevant features of and information on the environmental impact of different forms of energy for housing.

Learning aims B and C

For distinction standard, learners will evaluate the benefits of improving energy efficiency and compare this with benefits of the installation of a renewable source. They will use this information to produce a comprehensive plan for the integration of a renewable energy system into an existing building. The plan will be well developed and contain full coverage of factors and information, including objectives, timescales and costs. The plan will consider maintenance requirements and explain how the renewable energy system fully meets stakeholder needs. This will include justification of the needs of stakeholders and how the plan will meet their needs, and how it will improve efficiency and reduce energy use through modification to building fabric.

For merit standard, learners will consider different aspects of the impact of environmental factors on building efficiency, energy use and stakeholder needs, how they interrelate and the extent to which they are important. They will provide a detailed plan for the integration of a renewable energy system into an existing building. The plan will contain many factors and information, including the objectives, timescales and costs but will be missing some elements. The plan will present evidence on how the identified stakeholders' needs are met.

For pass standard, learners will indicate the main features of stakeholder needs for an existing housing development by recognising them and being able to discern and understand facts. They will conduct basic research data analysis to determine energy use and building efficiency. Learners will choose a suitable renewable energy system for the existing building based on specific criteria, having first considered their effectiveness against other measures, such as insulation. They will provide a brief plan for the integration of a renewable energy system to the existing building. The plan will contain some factors and information, including the objectives and timescales, and which meets basic, but adequate identified stakeholders' needs, and gives only brief consideration to cost and maintenance requirements.

Links to other units

This unit links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 18: Building Information Modelling
- Unit 39: Housing Design Project
- Unit 40: Offsite and Alternative Production Methods in Construction
- Unit 42: The Housing Industry.

Employer involvement

This unit would benefit from employer involvement in the form of:

- workshops with housing design practitioners
- mentoring from local partners
- employers setting assignment briefs
- employers supporting the assessment of work.

Unit 42: The Housing Industry

Level: **3**

Unit type: **Internal**

Guided learning hours: **60**

Unit in brief

Learners will develop skills in assessing the drivers that influence the housing market in terms of development, delivery and procurement.

Unit introduction

The housing industry occupies a dynamic market space that is influenced by a wide range of drivers – from politics and economic factors to technology and sustainability. These, in turn, have an impact on the housing procurement and development process. Developers with an overview of these drivers and processes are able to exploit potential opportunities.

In this unit, you will explore the housing industry the development and delivery process, including supply chains, types of housing and models of delivery. You will then consider the housing procurement process and the wider influences that drive housing development, giving an insight into how this has an impact on a specific housing development.

The unit will give you underlying knowledge that can be used in other units in the qualification. For example, taking this unit along with *Unit 18: Building Information Modelling*, *Unit 39: Housing Design Project*, *Unit 40: Offsite and Alternative Production Methods in Construction* and *Unit 41: Renewable Energy for Housing*, will give you a good understanding of modern house building in context. This unit also gives you a good foundation for studying construction management and housing design related subjects at a higher level, including degree-level programmes and the new Higher National Certificate and Diploma in Future Homes Design and Construction.

Learning aims

In this unit, you will:

A Explore the development and delivery of housing

B Investigate the housing procurement process

C Review the drivers that influence the housing market in relation to a given housing development.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Explore the development and delivery of housing	**A1** Stakeholders **A2** Supply chain **A3** Type of housing **A4** Housing delivery models	A presentation or a formal report that explores development and delivery of housing in terms of stakeholders, the supply chain, housing types and procurement.
B Investigate the housing procurement process	**B1** Types of procurement **B2** Procurement process **B3** Housing legislation and legal processes	
C Review the drivers that influence the housing market in relation to a given housing development	**C1** Political influences **C2** Economic influences **C3** Social influences **C4** Construction influences **C5** Environmental and sustainability influences	A presentation or a formal report that evaluates the range of drivers that influence the housing market in general and a given housing development.

Content

Learning aim A: Explore the development and delivery of housing

A1 Stakeholders

- Developer:
  - single private
  - institutional:
    - charity
    - commercial
    - trust
    - cooperative
    - government
    - housing associations
  - other.
- Users:
  - owner/occupier:
    - single person
    - multiple occupancy
  - institutional:
    - care
    - supported living.

A2 Supply chain

- Material.
- Manufacturing.
- Logistics.

A3 Type of housing

- Single/family occupancy:
  - bungalow
  - cottage
  - detached/semi-detached/terrace
  - townhouse.
- Multi-occupancy:
  - condominium
  - apartment/flat.

A4 Housing delivery models

- Traditional build.
- Self-build.
- Manufactured/offsite.

Learning aim B: Investigate the housing procurement process

B1 Types of procurement

- Public.
- Private:
  - individual
  - developer.

B2 Procurement process

- Stakeholder needs.
- User needs.
- Procurement methods:
  - traditional contract
  - design-build contract
  - self-build/collaborative relationships.
- Procurement roles:
  - client
  - project manager
  - consultants, such as architect, engineer, cost consultant
  - contractor
  - sub-contractor.
- Occupancy:
  - forms of occupancy
    - private purchase
    - mortgage
    - rental
    - auction.
- Post-occupancy:
  - extension
  - adaptation.

B3 Housing legislation and legal processes

- Planning process.
- Building regulation
- Conveyancing.

Learning aim C: Review the drivers that influence the housing market in relation to a given housing development

C1 Political influences

- Taxation:
  - tax credits
  - deductions
  - stamp duty.
- Subsidies.
- Government housing targets.
- Legislation/regulation.

C2 Economic influences

- Supply and demand.
- Investment and return.
- Interest rates.

C3 Social influences

- Demographic changes.
- Social trends:
  - attitudes toward home ownership.
- Political uncertainty.
- Cost:
  - ownership vs cost of rent
  - maintenance/upkeep.

C4 Construction influences

- Technology.
- Lifestyle.
- Environmental.
- Scalability.
- Building Information Modelling.

C5 Environmental and sustainability influences

- Materials.
- Energy use.
- Carbon emissions.
- Waste management.
- Health and wellbeing.
- Sites:
  - green field
  - brown field
  - urban
  - change of use.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Explore the development and delivery of housing		
A.P1 Describe the stakeholders involved in the development of housing. **A.P2** Outline the delivery models for housing developments.	**A.M1** Assess the relationship between stakeholders and housing types.	**A.D1** Evaluate the ways in which the supply chain affects the housing development and delivery process.
Learning aim B: Investigate the housing procurement process		
B.P3 Explain the different types of procurement for housing. **B.P4** Describe the procurement process for housing.	**B.M2** Assess the influence of legislation and legal processes on housing procurement.	**B.D2** Compare the different stakeholder needs, user needs and procurement methods employed in the process of public and private housing procurement.
Learning aim C: Review the drivers that influence the housing market in relation to a given housing development		
C.P5 Explain the drivers that influence the housing market. **C.P6** Outline the way in which market drivers influence a given housing development.	**C.M3** Analyse the key housing market drivers that influence a given housing development.	**C.D3** Evaluate the way that changes in response to selected housing market drivers may reduce the influence of others on a given housing development.

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of two summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aims: A and B (A.P1, A.P2, B.P3, B.P4, A.M1, B.M2, A.D1, B.D2)

Learning aim: C (C.P5, C.P6, C.M3, C.D3)

Further information for teachers and assessors

Resource requirements

There are no specific additional resource requirements for this unit.

Essential information for assessment decisions

Learning aims A and B

For distinction standard, learners will provide a considered comparison of stakeholder and user needs in relation to procurement in both the public and private sectors. They will evaluate how and why housing procurement, development and delivery are impacted by different aspects of the supply chain and the effect this has on those working in the housing industry. The evaluation will be informed by an assessment of the relationship between the various stakeholders and different housing types, and the influence that planning and building regulations have on the procurement process for housing.

For merit standard, learners will provide a coherent assessment of the relationship between the various stakeholders involved in the development and delivery of housing, and the different housing types being developed and procured. They will competently consider the different stakeholders, how they interrelate and a broad range of common housing types. Their assessment will show a competent understanding of the influence that legislation and legal processes have on the procurement process, it will include some appraisal of why specific types of housing are being produced.

For pass standard, learners will be able to give an objective account, in their own words, of relevant features of and information on the different types of stakeholders, including developers and users. Learners will generally give clear details and give some evidence to support an outline of what is meant by traditional, self-build and manufactured/offsite housing delivery models. They will demonstrate knowledge of the difference between procurement in the public and private sectors, and explain the procurement process using general examples, giving detail on key stages of the process.

Learning aim C

For distinction standard, learners will be able to evaluate the way that changes in response to selected housing market drivers may reduce the influence of others for a given housing development, based on their analysis of the key market drivers. They will have detailed knowledge of the significant influences on the housing market and how they inform the response for a given housing development.

For merit standard, learners will demonstrate competent knowledge of the broad drivers of the housing market. They will provide a balanced assessment of how these drivers influence a specific housing development in general, both positively and negatively. They will be able to identify and communicate the key drivers that influence a specific development, using coherent and relevant examples.

For pass standard, learners will give general examples of how the housing market is influenced. The connections between the drivers and their influence may be clear but the examples given may be imbalanced. Learners will be able to identify and describe in some detail the specific drivers that influence a given housing development, giving basic examples.

Links to other units

This unit links to:

- Unit 3: Tendering and Estimating
- Unit 8: Building Regulations and Control in Construction
- Unit 18: Building Information Modelling
- Unit 22: Economics and Finance in Construction
- Unit 24: Planning Application Procedures in Construction
- Unit 25: Property Law
- Unit 39: Housing Design Project
- Unit 40: Offsite and Alternative Production Methods in Construction
- Unit 41: Renewable Energy for Housing.

Employer involvement

This unit would benefit from employer involvement in the form of:

- workshops/talks with commercial directors of housing contractors
- mentoring from local partners
- employers setting assignment briefs
- employers supporting the assessment of work.

4 Planning your programme

How do I choose the right BTEC National qualification for my learners?

BTEC Nationals come in a range of sizes, each with a specific purpose. You will need to assess learners very carefully to ensure that they start on the right size of qualification to fit into their 16–19 study programme, and that they take the right pathways or optional units that allow them to progress to the next stage.

If a learner is clear that they want to progress to the workplace they should be directed towards an occupationally-specific qualification, such as a BTEC National Diploma, from the outset.

Some learners may want to take a number of complementary qualifications or keep their progression options open. These learners may be suited to taking a BTEC National Certificate or Extended Certificate. Learners who then decide to continue with a fuller vocational programme can transfer to a BTEC National Diploma or Extended Diploma, for example for their second year.

Some learners are sure of the sector they want to work in and are aiming for progression into that sector via higher education. These learners should be directed to the two-year BTEC National Extended Diploma as the most suitable qualification.

As a centre, you may want to teach learners who are taking different qualifications together. You may also wish to transfer learners between programmes to meet changes in their progression needs. You should check the qualification structures and unit combinations carefully as there is no exact match among the different sizes. You may find that learners need to complete more than the minimum number of units when transferring.

When learners are recruited, you need to give them accurate information on the title and focus of the qualification for which they are studying.

Is there a learner entry requirement?

As a centre it is your responsibility to ensure that learners who are recruited have a reasonable expectation of success on the programme. There are no formal entry requirements but we expect learners to have qualifications at or equivalent to Level 2.

Learners are most likely to succeed if they have:

- five GCSEs at good grades and/or
- BTEC qualification(s) at Level 2
- achievement in English and mathematics through GCSE or Functional Skills.

Learners may demonstrate ability to succeed in various ways. For example, learners may have relevant work experience or specific aptitude shown through diagnostic tests or non-educational experience.

What is involved in becoming an approved centre?

All centres must be approved before they can offer these qualifications – so that they are ready to assess learners and so that we can provide the support that is needed. Further information is given in *Section 8*.

What level of sector knowledge is needed to teach these qualifications?

We do not set any requirements for teachers but expect that centres will assess their overall skills and knowledge of the teaching team to ensure that they are relevant and up to date. This will give learners a rich programme to prepare them for employment in the sector. As part of the requirements of the programme are to involve employers in delivery this should support centres in ensuring that they are following up-to-date practices when delivering the programme.

What resources are required to deliver these qualifications?

As part of your centre approval you will need to show that the necessary material resources and work spaces are available to deliver BTEC Nationals. For some units, specific resources are required. This is indicated in the units.

Which modes of delivery can be used for these qualifications?

You are free to deliver BTEC Nationals using any form of delivery that meets the needs of your learners. We recommend making use of a wide variety of modes, including direct instruction in classrooms or work environments, investigative and practical work, group and peer work, private study and e-learning.

What are the requirements for meaningful employer involvement?

Requirements

This BTEC National Extended Diploma in Construction and the Built Environment has been designed as a Tech Level qualification. As an approved centre you are required to ensure that during their study, every learner has access to meaningful activity involving employers. Involvement should be with employers from the construction and the built environment sector and should form a significant part of the delivery or assessment of the qualification. Each centre's approach to employer involvement will be monitored in two ways. It will be monitored at centre level in the first term each year as part of the annual quality management review process that addresses centre strategy for delivery, assessment and quality assurance, when we will ask you to show evidence of how employer involvement is provided for all learners. You will need to show evidence in order to gain reporting clearance for certification. It will be monitored also at programme level as part of the standards verification process to confirm that plans for employer involvement meet the requirements of the specification. These approaches are designed to ensure additional activities can be scheduled where necessary so learners are not disadvantaged (see *Section 8: Quality assurance*).

We know that the vast majority of programmes already have established links with employers. In order to give you maximum flexibility in creating and strengthening employer involvement, we have not specified a particular level of input from employers. However, meaningful employer involvement, as defined below, should contribute significantly to at least **three** units of which one must be a mandatory unit.

These are the mandatory units that specify where delivery and/or assessment will be linked to employers:

- Unit 4: Construction Technology
- Unit 6: Surveying in Construction
- Unit 9: Management of a Construction Project.

There are suggestions in many of the units about how employers could become involved in delivery and/or assessment. These suggestions are not exhaustive and there will be other possibilities at local level.

Employer involvement in these units is subject to verification as part of the standards verification process (see *Section 8*).

Definition

Activities that are eligible to be counted as meaningful engagement are:

- structured work experience or work placements that develop skills and knowledge relevant to the qualification
- projects or assessments set with input from industry practitioners
- masterclasses or guest lectures from industry practitioners
- 'expert witness' reports from practitioners that contribute to the assessment of a learner's work.

There may be other ways in which learners can benefit from contact with employers or prepare for employment, such as listening to careers talks or working in simulated environments. While they provide benefits to learners they do not count as meaningful engagement.

Support

It is important that you give learners opportunities that are high quality and directly relevant to their study. We will support you in this through guidance materials and by giving you examples of best practice.

What support is available?

We provide a wealth of support materials, including curriculum plans, delivery guides, authorised assignment briefs, additional papers for external assessments and examples of marked learner work.

You will be allocated a Standards Verifier early on in the planning stage to support you with planning your assessments. There will be extensive training programmes as well as support from our Subject Advisor team.

For further details see *Section 10*.

How will my learners become more employable through these qualifications?

All BTEC Nationals are mapped to relevant occupational standards (see *Appendix 1*).

In the mandatory content and the selected optional units that focus on technical preparation, learners will be acquiring the key knowledge and skills that employers need. Also, employability skills such as teamwork and entrepreneurialism, and completing realistic tasks, have been built into the design of the learning aims and content. This gives you the opportunity to use relevant contexts, scenarios and materials to enable learners to develop a portfolio of evidence that demonstrates the breadth of their skills and knowledge in a way that equips them for employment.

5 Assessment structure and external assessment

Introduction

BTEC Nationals are assessed using a combination of *internal assessments*, which are set and marked by teachers, and *external assessments* which are set and marked by Pearson:

- mandatory units have a combination of internal and external assessments
- all optional units are internally assessed.

We have taken great care to ensure that the assessment method chosen is appropriate to the content of the unit and in line with requirements from employers and higher education.

In developing an overall plan for delivery and assessment for the programme, you will need to consider the order in which you deliver units, whether delivery is over short or long periods and when assessment can take place. Some units are defined as synoptic units (see *Section 2*). Normally, a synoptic assessment is one that a learner would take later in a programme and in which they will be expected to apply learning from a range of units. Synoptic units may be internally or externally assessed. Where a unit is externally assessed you should refer to the sample assessment materials (SAMs) to identify where there is an expectation that learners draw on their wider learning. For internally-assessed units, you must plan the assignments so that learners can demonstrate learning from across their programme. A unit may be synoptic in one qualification and not another because of the relationship it has to the rest of the qualification.

We have addressed the need to ensure that the time allocated to final assessment of internal and external units is reasonable so that there is sufficient time for teaching and learning, formative assessment and development of transferable skills.

In administering internal and external assessment, the centre needs to be aware of the specific procedures and policies that apply, for example to registration, entries and results. An overview with signposting to relevant documents is given in *Section 7*.

Internal assessment

Our approach to internal assessment for these qualifications will be broadly familiar to experienced centres. It offers flexibility in how and when you assess learners, provided that you meet assessment and quality assurance requirements. You will need to take account of the requirements of the unit format, which we explain in *Section 3*, and the requirements for delivering assessment given in *Section 6*.

External assessment

A summary of the external assessment for this qualification is given in *Section 2*. You should check this information carefully, together with the unit specification and the sample assessment materials, so that you can timetable learning and assessment periods appropriately.

Learners must be prepared for external assessment by the time they undertake it. In preparing learners for assessment you will want to take account of required learning time, the relationship with other external assessments and opportunities for retaking. You should ensure that learners are not entered for unreasonable amounts of external assessment in one session. Learners may resit an external assessment to obtain a higher grade of near pass or above. If a learner has more than one attempt, then the best result will be used for qualification grading, up to the permitted maximum. It is unlikely that learners will need to or benefit from taking all assessments twice so you are advised to plan appropriately. Some assessments are synoptic and learners are likely to perform best if these assessments are taken towards the end of the programme.

Key features of external assessment in construction and the built environment

In construction and the built environment, after consultation with stakeholders, we have developed the following.

- Unit 1: Construction Principles – learners complete a written examination, demonstrating the skills needed to solve a variety of practical construction problems by applying science knowledge and carrying out mathematical and statistical techniques. Learners will apply mathematical principles and techniques to carry out calculations that determine how materials behave under the action of forces or loads when used as structural members, and draw conclusions regarding whether a material is fit for purpose.
- Unit 2: Construction Design – learners will complete an externally-marked task, demonstrating their understanding of the principles and practice involved in the design and construction of low- and medium-rise buildings and structures, and showing an understanding of how design is influenced by client requirements and external constraints.
- Unit 3: Tendering and Estimating – learners will complete an externally-marked task, demonstrating the skills necessary to carry out estimating procedures to produce an estimated project cost, and then consider external factors and risk to develop a firm tender offer.

Units

The externally-assessed units have a specific format which we explain in *Section 3*. The content of units will be sampled across external assessments over time through appropriate papers and tasks. The ways in which learners are assessed are shown through the assessment outcomes and grading descriptors. External assessments are marked and awarded using the grade descriptors. The grades available are Distinction (D), Merit (M), Pass (P) and Near Pass (N). The Near Pass (N) grade gives learners credit below a Pass, where they have demonstrated evidence of positive performance which is worth more than an unclassified result but not yet at the Pass standard.

Sample assessment materials

Each externally-assessed unit has a set of sample assessment materials (SAMs) that accompanies this specification. The SAMs are there to give you an example of what the external assessment will look like in terms of the feel and level of demand of the assessment. In the case of units containing synoptic assessment, the SAMs will also show where learners are expected to select and apply from across the programme.

The SAMs show the range of possible question types that may appear in the actual assessments and give you a good indication of how the assessments will be structured. While SAMs can be used for practice with learners, as with any assessment the content covered and specific details of the questions asked will change in each assessment.

A copy of each of these assessments can be downloaded from our website. An additional sample of each of the Pearson-set units will be available before the first sitting of the assessment to allow your learners further opportunities for practice.

6 Internal assessment

This section gives an overview of the key features of internal assessment and how you, as an approved centre, can offer it effectively. The full requirements and operational information are given in the *Pearson Quality Assurance Handbook*. All members of the assessment team need to refer to this document.

For BTEC Nationals it is important that you can meet the expectations of stakeholders and the needs of learners by providing a programme that is practical and applied. Centres can tailor programmes to meet local needs and use links with local employers and the wider vocational sector.

When internal assessment is operated effectively it is challenging, engaging, practical and up to date. It must also be fair to all learners and meet national standards.

Principles of internal assessment

Assessment through assignments

For internally-assessed units, the format of assessment is an assignment taken after the content of the unit, or part of the unit if several assignments are used, has been delivered. An assignment may take a variety of forms, including practical and written types. An assignment is a distinct activity completed independently by learners that is separate from teaching, practice, exploration and other activities that learners complete with direction from, and formative assessment by, teachers.

An assignment is issued to learners as an assignment brief with a defined start date, a completion date and clear requirements for the evidence that they need to provide. There may be specific observed practical components during the assignment period. Assignments can be divided into tasks and may require several forms of evidence. A valid assignment will enable a clear and formal assessment outcome based on the assessment criteria.

Assessment decisions through applying unit-based criteria

Assessment decisions for BTEC Nationals are based on the specific criteria given in each unit and set at each grade level. To ensure that standards are consistent in the qualification and across the suite as a whole, the criteria for each unit have been defined according to a framework. The way in which individual units are written provides a balance of assessment of understanding, practical skills and vocational attributes appropriate to the purpose of qualifications.

The assessment criteria for a unit are hierarchical and holistic. For example, if an M criterion requires the learner to show 'analysis' and the related P criterion requires the learner to 'explain', then to satisfy the M criterion a learner will need to cover both 'explain' and 'analyse'. The unit assessment grid shows the relationships among the criteria so that assessors can apply all the criteria to the learner's evidence at the same time. In *Appendix 2* we have set out a definition of terms that assessors need to understand.

Assessors must show how they have reached their decisions using the criteria in the assessment records. When a learner has completed all the assessment for a unit then the assessment team will give a grade for the unit. This is given simply according to the highest level for which the learner is judged to have met all the criteria. Therefore:

- to achieve a Distinction, a learner must have satisfied all the Distinction criteria (and therefore the Pass and Merit criteria); these define outstanding performance across the unit as a whole
- to achieve a Merit, a learner must have satisfied all the Merit criteria (and therefore the Pass criteria) through high performance in each learning aim
- to achieve a Pass, a learner must have satisfied all the Pass criteria for the learning aims, showing coverage of the unit content and therefore attainment at Level 3 of the national framework.

The award of a Pass is a defined level of performance and cannot be given solely on the basis of a learner completing assignments. Learners who do not satisfy the Pass criteria should be reported as Unclassified.

The assessment team

It is important that there is an effective team for internal assessment. There are three key roles involved in implementing assessment processes in your centre, each with different interrelated responsibilities, the roles are listed below. Full information is given in the *Pearson Quality Assurance Handbook*.

- The Lead Internal Verifier (the Lead IV) has overall responsibility for the programme, its assessment and internal verification to meet our requirements, record keeping and liaison with the Standards Verifier. The Lead IV registers with Pearson annually. The Lead IV acts as an assessor, supports the rest of the assessment team, makes sure that they have the information they need about our assessment requirements and organises training, making use of our guidance and support materials.
- Internal Verifiers (IVs) oversee all assessment activity in consultation with the Lead IV. They check that assignments and assessment decisions are valid and that they meet our requirements. IVs will be standardised by working with the Lead IV. Normally, IVs are also assessors but they do not verify their own assessments.
- Assessors set or use assignments to assess learners to national standards. Before taking any assessment decisions, assessors participate in standardisation activities led by the Lead IV. They work with the Lead IV and IVs to ensure that the assessment is planned and carried out in line with our requirements.

Effective organisation

Internal assessment needs to be well organised so that the progress of learners can be tracked and so that we can monitor that assessment is being carried out in line with national standards. We support you through, for example, providing training materials and sample documentation.

It is particularly important that you manage the overall assignment programme and deadlines to make sure that learners are able to complete assignments on time.

Learner preparation

To ensure that you provide effective assessment for your learners, you need to make sure that they understand their responsibilities for assessment and the centre's arrangements.

From induction onwards, you will want to ensure that learners are motivated to work consistently and independently to achieve the requirements of the qualifications. Learners need to understand how assignments are used, the importance of meeting assignment deadlines, and that all the work submitted for assessment must be their own.

You will need to give learners a guide that explains how assignments are used for assessment, how assignments relate to the teaching programme, and how learners should use and reference source materials, including what would constitute plagiarism. The guide should also set out your approach to operating assessment, such as how learners must submit work and request extensions.

Setting effective assignments

Setting the number and structure of assignments

In setting your assignments, you need to work with the structure of assignments shown in the *Essential information for assignments* section of a unit. This shows the structure of the learning aims and criteria that you must follow and the recommended number of assignments that you should use. For some units we provide authorised assignment briefs, for all the units we give you suggestions on how to create suitable assignments. You can find these materials along with this specification on our website. In designing your own assignment briefs you should bear in mind the following points.

- The number of assignments for a unit must not exceed the number shown in *Essential information for assignments*. However, you may choose to combine assignments, for example to create a single assignment for the whole unit.
- You may also choose to combine all or parts of different units into single assignments, provided that all units and all their associated learning aims are fully addressed in the programme overall. If you choose to take this approach, you need to make sure that learners are fully prepared so that they can provide all the required evidence for assessment and that you are able to track achievement in the records.
- A learning aim must always be assessed as a whole and must not be split into two or more tasks.
- The assignment must be targeted to the learning aims but the learning aims and their associated criteria are not tasks in themselves. Criteria are expressed in terms of the outcome shown in the evidence.
- You do not have to follow the order of the learning aims of a unit in setting assignments but later learning aims often require learners to apply the content of earlier learning aims and they may require learners to draw their learning together.
- Assignments must be structured to allow learners to demonstrate the full range of achievement at all grade levels. Learners need to be treated fairly by being given the opportunity to achieve a higher grade if they have the ability.
- As assignments provide a final assessment, they will draw on the specified range of teaching content for the learning aims. The specified content is compulsory. The evidence for assessment need not cover every aspect of the teaching content as learners will normally be given particular examples, case studies or contexts in their assignments. For example, if a learner is carrying out one practical performance, or an investigation of one organisation, then they will address all the relevant range of content that applies in that instance.

Providing an assignment brief

A good assignment brief is one that, through providing challenging and realistic tasks, motivates learners to provide appropriate evidence of what they have learned.

An assignment brief should have:

- a vocational scenario, this could be a simple situation or a full, detailed set of vocational requirements that motivates the learner to apply their learning through the assignment
- clear instructions to the learner about what they are required to do, normally set out through a series of tasks
- an audience or purpose for which the evidence is being provided
- an explanation of how the assignment relates to the unit(s) being assessed.

Forms of evidence

BTEC Nationals have always allowed for a variety of forms of evidence to be used, provided that they are suited to the type of learning aim being assessed. For many units, the practical demonstration of skills is necessary and for others, learners will need to carry out their own research and analysis. The units give you information on what would be suitable forms of evidence to provide learners with the opportunity to apply a range of employability or transferable skills. Centres may choose to use different suitable forms for evidence to those proposed. Overall, learners should be assessed using varied forms of evidence.

Full definitions of types of assessment are given in *Appendix 2*. These are some of the main types of assessment:

- written reports
- projects
- time-constrained practical assessments with observation records and supporting evidence
- recordings of performance
- sketchbooks, working logbooks, reflective journals
- presentations with assessor questioning.

The form(s) of evidence selected must:

- allow the learner to provide all the evidence required for the learning aim(s) and the associated assessment criteria at all grade levels
- allow the learner to produce evidence that is their own independent work
- allow a verifier to independently reassess the learner to check the assessor's decisions.

For example, when you are using performance evidence, you need to think about how supporting evidence can be captured through recordings, photographs or task sheets.

Centres need to take particular care that learners are enabled to produce independent work. For example, if learners are asked to use real examples, then best practice would be to encourage them to use their own or to give the group a number of examples that can be used in varied combinations.

Making valid assessment decisions

Authenticity of learner work

Once an assessment has begun, learners must not be given feedback on progress towards fulfilling the targeted criteria.

An assessor must assess only learner work that is authentic, i.e. learners' own independent work. Learners must authenticate the evidence that they provide for assessment through signing a declaration stating that it is their own work.

Assessors must ensure that evidence is authentic to a learner through setting valid assignments and supervising them during the assessment period. Assessors must take care not to provide direct input, instructions or specific feedback that may compromise authenticity.

Assessors must complete a declaration that:

- the evidence submitted for this assignment is the learner's own
- the learner has clearly referenced any sources used in the work
- they understand that false declaration is a form of malpractice.

Centres can use Pearson templates or their own templates to document authentication.

During assessment, an assessor may suspect that some or all of the evidence from a learner is not authentic. The assessor must then take appropriate action using the centre's policies for malpractice. Further information is given in *Section 7*.

Making assessment decisions using criteria

Assessors make judgements using the criteria. The evidence from a learner can be judged using all the relevant criteria at the same time. The assessor needs to make a judgement against each criterion that evidence is present and sufficiently comprehensive. For example, the inclusion of a concluding section may be insufficient to satisfy a criterion requiring 'evaluation'.

Assessors should use the following information and support in reaching assessment decisions:

- the *Essential information for assessment decisions* section in each unit gives examples and definitions related to terms used in the criteria
- the explanation of key terms in *Appendix 2*
- examples of assessed work provided by Pearson
- your Lead IV and assessment team's collective experience, supported by the standardisation materials we provide.

Pass and Merit criteria relate to individual learning aims. The Distinction criteria as a whole relate to outstanding performance across the unit. Therefore, criteria may relate to more than one learning aim (for example A.D1) or to several learning aims (for example DE.D3). Distinction criteria make sure that learners have shown that they can perform consistently at an outstanding level across the unit and/or that they are able to draw learning together across learning aims.

Dealing with late completion of assignments

Learners must have a clear understanding of the centre policy on completing assignments by the deadlines that you give them. Learners may be given authorised extensions for legitimate reasons, such as illness at the time of submission, in line with your centre policies.

For assessment to be fair, it is important that learners are all assessed in the same way and that some learners are not advantaged by having additional time or the opportunity to learn from others. Therefore, learners who do not complete assignments by your planned deadline or the authorised extension deadline may not have the opportunity to subsequently resubmit.

If you accept a late completion by a learner, then the assignment should be assessed normally when it is submitted using the relevant assessment criteria.

Issuing assessment decisions and feedback

Once the assessment team has completed the assessment process for an assignment, the outcome is a formal assessment decision. This is recorded formally and reported to learners.

The information given to the learner:

- must show the formal decision and how it has been reached, indicating how or where criteria have been met
- may show why attainment against criteria has not been demonstrated
- must not provide feedback on how to improve evidence
- must be validated by an IV before it is given to the learner.

Resubmission of improved evidence

An assignment provides the final assessment for the relevant learning aims and is normally a final assessment decision, except where the Lead IV approves one opportunity to resubmit improved evidence based on the completed assignment brief.

The Lead IV has the responsibility to make sure that resubmission is operated fairly. This means:

- checking that a learner can be reasonably expected to perform better through a second submission, for example that the learner has not performed as expected
- making sure that giving a further opportunity can be done in such a way that it does not give an unfair advantage over other learners, for example through the opportunity to take account of feedback given to other learners
- checking that the assessor considers that the learner will be able to provide improved evidence without further guidance and that the original evidence submitted remains valid.

Once an assessment decision has been given to the learner, the resubmission opportunity must have a deadline within 15 working days in the same academic year.

A resubmission opportunity must not be provided where learners:

- have not completed the assignment by the deadline without the centre's agreement
- have submitted work that is not authentic.

Retake of internal assessment

A learner who has not achieved the level of performance required to pass the relevant learning aims after resubmission of an assignment may be offered a single retake opportunity using a new assignment. The retake may only be achieved at a pass.

The Lead Internal Verifier must only authorise a retake of an assignment in exceptional circumstances where they believe it is necessary, appropriate and fair to do so. For further information on offering a retake opportunity, you should refer to the *BTEC Centre Guide to Assessment*. We provide information on writing assignments for retakes on our website (www.btec.co.uk/keydocuments).

Planning and record keeping

For internal processes to be effective, an assessment team needs to be well organised and keep effective records. The centre will also work closely with us so that we can quality assure that national standards are being satisfied. This process gives stakeholders confidence in the assessment approach.

The Lead IV must have an assessment plan, produced as a spreadsheet. When producing a plan, the assessment team may wish to consider:

- the time required for training and standardisation of the assessment team
- the time available to undertake teaching and carry out assessment, taking account of when learners may complete external assessments and when quality assurance will take place
- the completion dates for different assignments
- who is acting as IV for each assignment and the date by which the assignment needs to be verified
- setting an approach to sampling assessor decisions though internal verification that covers all assignments, assessors and a range of learners
- how to manage the assessment and verification of learners' work so that they can be given formal decisions promptly
- how resubmission opportunities can be scheduled.

The Lead IV will also maintain records of assessment undertaken. The key records are:

- verification of assignment briefs
- learner authentication declarations
- assessor decisions on assignments, with feedback given to learners
- verification of assessment decisions.

Examples of records and further information are given in the *Pearson Quality Assurance Handbook.*

7 Administrative arrangements

Introduction

This section focuses on the administrative requirements for delivering a BTEC qualification. It will be of value to Quality Nominees, Lead IVs, Programme Leaders and Examinations Officers.

Learner registration and entry

Shortly after learners start the programme of learning, you need to make sure that they are registered for the qualification and that appropriate arrangements are made for internal and external assessment. You need to refer to the *Information Manual* for information on making registrations for the qualification and entries for external assessments.

Learners can be formally assessed only for a qualification on which they are registered. If learners' intended qualifications change, for example if a learner decides to choose a different pathway specialism, then the centre must transfer the learner appropriately.

Access to assessment

Both internal and external assessments need to be administered carefully to ensure that all learners are treated fairly, and that results and certification are issued on time to allow learners to progress to chosen progression opportunities.

Our equality policy requires that all learners should have equal opportunity to access our qualifications and assessments, and that our qualifications are awarded in a way that is fair to every learner. We are committed to making sure that:

- learners with a protected characteristic are not, when they are undertaking one of our qualifications, disadvantaged in comparison to learners who do not share that characteristic
- all learners achieve the recognition they deserve for undertaking a qualification and that this achievement can be compared fairly to the achievement of their peers.

Further information on access arrangements can be found in the Joint Council for Qualifications (JCQ) document *Access Arrangements, Reasonable Adjustments and Special Consideration for General and Vocational Qualifications*.

Administrative arrangements for internal assessment

Records

You are required to retain records of assessment for each learner. Records should include assessments taken, decisions reached and any adjustments or appeals. Further information can be found in the *Information Manual.* We may ask to audit your records so they must be retained as specified.

Reasonable adjustments to assessment

A reasonable adjustment is one that is made before a learner takes an assessment to ensure that they have fair access to demonstrate the requirements of the assessments. You are able to make adjustments to internal assessments to take account of the needs of individual learners. In most cases this can be achieved through a defined time extension or by adjusting the format of evidence. We can advise you if you are uncertain as to whether an adjustment is fair and reasonable. You need to plan for time to make adjustments if necessary.

Further details on how to make adjustments for learners with protected characteristics are given on our website in the document *Supplementary guidance for reasonable adjustment and special consideration in vocational internally-assessed units.*

Special consideration

Special consideration is given after an assessment has taken place for learners who have been affected by adverse circumstances, such as illness. You must operate special consideration in line with our policy (see previous paragraph). You can provide special consideration related to the period of time given for evidence to be provided or for the format of the assessment if it is equally valid. You may not substitute alternative forms of evidence to that required in a unit, or omit the application of any assessment criteria to judge attainment. Pearson can consider applications for special consideration in line with the policy.

Appeals against assessment

Your centre must have a policy for dealing with appeals from learners. These appeals may relate to assessment decisions being incorrect or assessment not being conducted fairly. The first step in such a policy could be a consideration of the evidence by a Lead IV or other member of the programme team. The assessment plan should allow time for potential appeals after assessment decisions have been given to learners. If there is an appeal by a learner, you must document the appeal and its resolution. Learners have a final right of appeal to Pearson but only if the procedures that you have put in place have not been followed. Further details are given in the document *Enquiries and appeals about Pearson vocational qualifications and end point assessment policy*.

Administrative arrangements for external assessment

Entries and resits

For information on the timing of assessment and entries, please refer to the annual examinations timetable on our website.

Access arrangements requests

Access arrangements are agreed with Pearson before an assessment. They allow students with special educational needs, disabilities or temporary injuries to:

- access the assessment
- show what they know and can do without changing the demands of the assessment.

Access arrangements should always be processed at the time of registration. Learners will then know what type of arrangements are available in place for them.

Granting reasonable adjustments

For external assessment, a reasonable adjustment is one that we agree to make for an individual learner. A reasonable adjustment is defined for the individual learner and informed by the list of available access arrangements.

Whether an adjustment will be considered reasonable will depend on a number of factors, to include:

- the needs of the learner with the disability
- the effectiveness of the adjustment
- the cost of the adjustment; and
- the likely impact of the adjustment on the learner with the disability and other learners.

Adjustment may be judged unreasonable and not approved if it involves unreasonable costs, timeframes or affects the integrity of the assessment.

Special consideration requests

Special consideration is an adjustment made to a student’s mark or grade after an external assessment to reflect temporary injury, illness or other indisposition at the time of the assessment. An adjustment is made only if the impact on the learner is such that it is reasonably likely to have had a material effect on that learner being able to demonstrate attainment in the assessment.

Centres are required to notify us promptly of any learners who they believe have been adversely affected and request that we give special consideration. Further information can be found in the special requirements section on our website.

Conducting external assessments

Centres must make arrangements for the secure delivery of external assessments. External assessments for BTEC qualifications include examinations, set tasks and performance.

Each external assessment has a defined degree of control under which it must take place. Some external assessments may have more than one part and each part may have a different degree of control. We define degrees of control as follows.

High control

This is the completion of assessment in formal invigilated examination conditions.

Medium control

This is completion of assessment, usually over a longer period of time, which may include a period of controlled conditions. The controlled conditions may allow learners to access resources, prepared notes or the internet to help them complete the task.

Low control

These are activities completed without direct supervision. They may include research, preparation of materials and practice. The materials produced by learners under low control will not be directly assessed.

Further information on responsibilities for conducting external assessment is given in the document *Instructions for Conducting External Assessments*, available on our website.

Dealing with malpractice in assessment

Malpractice means acts that undermine the integrity and validity of assessment, the certification of qualifications, and/or that may damage the authority of those responsible for delivering the assessment and certification.

Pearson does not tolerate actions (or attempted actions) of malpractice by learners, centre staff or centres in connection with Pearson qualifications. Pearson may impose penalties and/or sanctions on learners, centre staff or centres where incidents (or attempted incidents) of malpractice have been proven.

Malpractice may arise or be suspected in relation to any unit or type of assessment within the qualification. For further details regarding malpractice and advice on preventing malpractice by learners, please see Pearson's *Centre guidance: Dealing with malpractice and maladministration in vocational qualifications*, available on our website.

The procedures we ask you to adopt vary between units that are internally-assessed and those that are externally assessed.

Internally-assessed units

Centres are required to take steps to prevent malpractice and to investigate instances of suspected malpractice. Learners must be given information that explains what malpractice is for internal assessment and how suspected incidents will be dealt with by the centre. The *Centre Guidance: Dealing with Malpractice* document gives full information on the actions we expect you to take.

Pearson may conduct investigations if we believe that a centre is failing to conduct internal assessment according to our policies. The above document gives further information, examples and details the penalties and sanctions that may be imposed.

In the interests of learners and centre staff, centres need to respond effectively and openly to all requests relating to an investigation into an incident of suspected malpractice.

Externally-assessed units

External assessment means all aspects of units that are designated as external in this specification, including preparation for tasks and performance. For these assessments centres must follow the JCQ procedures set out in the latest version of *JCQ Suspected Malpractice in Examinations and Assessments Policies and Procedures* (www.jcq.org.uk).

In the interests of learners and centre staff, centres need to respond effectively and openly to all requests relating to an investigation into an incident of suspected malpractice.

Learner malpractice

Heads of Centres are required to report incidents of any suspected learner malpractice that occur during Pearson external assessments. We ask that centres do so by completing a *JCQ Form M1* (available at www.jcq.org.uk/exams-office/malpractice) and emailing it and any accompanying documents (signed statements from the learner, invigilator, copies of evidence, etc.) to the Investigations Team at candidatemalpractice@pearson.com. The responsibility for determining appropriate sanctions or penalties to be imposed on learners lies with Pearson.

Learners must be informed at the earliest opportunity of the specific allegation and the centre's malpractice policy, including the right of appeal. Learners found guilty of malpractice may be disqualified from the qualification for which they have been entered with Pearson.

Teacher/centre malpractice

Heads of Centres are required to inform Pearson's Investigations Team of any incident of suspected malpractice by centre staff, before any investigation is undertaken. Heads of centres are requested to inform the Investigations Team by submitting a *JCQ Form M2(a)* (available at www.jcq.org.uk/exams-office/malpractice) with supporting documentation to pqsmalpractice@pearson.com. Where Pearson receives allegations of malpractice from other sources (for example Pearson staff or anonymous informants), the Investigations Team will conduct the investigation directly or may ask the head of centre to assist.

Incidents of maladministration (accidental errors in the delivery of Pearson qualifications that may affect the assessment of learners) should also be reported to the Investigations Team using the same method.

Heads of centres/Principals/Chief Executive Officers or their nominees are required to inform learners and centre staff suspected of malpractice of their responsibilities and rights; see Section 6.15 of the *JCQ Suspected Malpractice in Examinations and Assessments Policies and Procedures* document.

Pearson reserves the right in cases of suspected malpractice to withhold the issuing of results and/or certificates while an investigation is in progress. Depending on the outcome of the investigation results and/or certificates may be released or withheld.

You should be aware that Pearson may need to suspend certification when undertaking investigations, audits and quality assurances processes. You will be notified within a reasonable period of time if this occurs.

Sanctions and appeals

Where malpractice is proven we may impose sanctions or penalties.

Where learner malpractice is evidenced, penalties may be imposed such as:

- mark reduction for external assessments
- disqualification from the qualification
- being barred from registration for Pearson qualifications for a period of time.

If we are concerned about your centre's quality procedures we may impose sanctions such as:

- working with you to create an improvement action plan
- requiring staff members to receive further training
- placing temporary blocks on your certificates
- placing temporary blocks on registration of learners
- debarring staff members or the centre from delivering Pearson qualifications
- suspending or withdrawing centre approval status.

The centre will be notified if any of these apply.

Pearson has established procedures for centres that are considering appeals against penalties and sanctions arising from malpractice. Appeals against a decision made by Pearson will normally be accepted only from Heads of Centres (on behalf of learners and/or members of staff) and from individual members (in respect of a decision taken against them personally). Further information on appeals can be found in our *Enquiries and appeals about Pearson vocational qualifications and end point assessment policy*, which is on our website. In the initial stage of any aspect of malpractice, please notify the Investigations Team by email via pqsmalpractice@pearson.com who will inform you of the next steps.

Certification and results

Once a learner has completed all the required components for a qualification, even if final results for external assessments have not been issued, then the centre can claim certification for the learner, provided that quality assurance has been successfully completed. For the relevant procedures please refer to our *Information Manual*. You can use the information provided on qualification grading to check overall qualification grades.

Results issue

After the external assessment session, learner results will be issued to centres. The result will be in the form of a grade. You should be prepared to discuss performance with learners, making use of the information we provide and post-results services.

Post-assessment services

Once results for external assessments are issued, you may find that the learner has failed to achieve the qualification or to attain an anticipated grade. It is possible to transfer or reopen registration in some circumstances. The *Information Manual* gives further information.

Changes to qualification requests

Where a learner who has taken a qualification wants to resit an externally-assessed unit to improve their qualification grade, you firstly need to decline their overall qualification grade. You may decline the grade before the certificate is issued. For a learner receiving their results in August, you should decline the grade by the end of September if the learner intends to resit an external assessment.

Additional documents to support centre administration

As an approved centre you must ensure that all staff delivering, assessing and administering the qualifications have access to this documentation. These documents are reviewed annually and are reissued if updates are required.

- *Pearson Quality Assurance Handbook*: this sets out how we will carry out quality assurance of standards and how you need to work with us to achieve successful outcomes.
- *Information Manual*: this gives procedures for registering learners for qualifications, transferring registrations, entering for external assessments and claiming certificates.
- *Lead Examiners' Reports*: these are produced after each series for each external assessment and give feedback on the overall performance of learners in response to tasks or questions set.
- *Instructions for the Conduct of External Assessments (ICEA)*: this explains our requirements for the effective administration of external assessments, such as invigilation and submission of materials.
- *Regulatory policies*: our regulatory policies are integral to our approach and explain how we meet internal and regulatory requirements. We review the regulated policies annually to ensure that they remain fit for purpose. Policies related to this qualification include:
  - adjustments for candidates with disabilities and learning difficulties, access arrangements and reasonable adjustments for general and vocational qualifications
  - age of learners
  - centre guidance for dealing with malpractice
  - recognition of prior learning and process.

This list is not exhaustive and a full list of our regulatory policies can be found on our website.

8 Quality assurance

Centre and qualification approval

As part of the approval process, your centre must make sure that the resource requirements listed below are in place before offering the qualification.

- Centres must have appropriate physical resources (for example, equipment, IT, learning materials, teaching rooms) to support the delivery and assessment of the qualification.
- Staff involved in the assessment process must have relevant expertise and/or occupational experience.
- There must be systems in place to ensure continuing professional development for staff delivering the qualification.
- Centres must have in place appropriate health and safety policies relating to the use of equipment by learners.
- Centres must deliver the qualification in accordance with current equality legislation.
- Centres should refer to the teacher guidance section in individual units to check for any specific resources required.

Continuing quality assurance and standards verification

On an annual basis, we produce the *Pearson Quality Assurance Handbook.* It contains detailed guidance on the quality processes required to underpin planning for delivery, including appropriate employer involvement, and for robust assessment and internal verification.

The key principles of quality assurance are that:

- a centre delivering BTEC programmes must be an approved centre, and must have approval for the programmes or groups of programmes that it is delivering
- the centre agrees, as part of gaining approval, to abide by specific terms and conditions around the effective delivery and quality assurance of assessment; it must abide by these conditions throughout the period of delivery
- Pearson makes available to approved centres a range of materials and opportunities, through online standardisation, intended to exemplify the processes required for effective assessment, and examples of effective standards. Approved centres must use the materials and services to ensure that all staff delivering BTEC qualifications keep up to date with the guidance on assessment
- an approved centre must follow agreed protocols for standardisation of assessors and verifiers, for the planning, monitoring and recording of assessment processes, and for dealing with special circumstances, appeals and malpractice.

The approach of quality-assured assessment is through a partnership between an approved centre and Pearson. We will make sure that each centre follows best practice and employs appropriate technology to support quality-assurance processes, where practicable. We work to support centres and seek to make sure that our quality-assurance processes do not place undue bureaucratic processes on centres. We monitor and support centres in the effective operation of assessment and quality assurance.

The methods we use to do this for BTEC Level 3 include:

- making sure that all centres complete appropriate declarations at the time of approval
- undertaking approval visits to centres
- making sure that centres have effective teams of assessors and verifiers who are trained to undertake assessment
- undertaking an overarching review and assessment of a centre's strategy for ensuring sufficient and appropriate engagement with employers at the beginning of delivery of any BTEC programme(s)
- undertaking a review of the employer involvement planned at programme level to ensure its appropriateness at a time when additional activities can be scheduled where necessary
- assessment sampling and verification, through requested samples of assessments, completed assessed learner work and associated documentation

- an overarching review and assessment of a centre's strategy for delivering and quality assuring its BTEC programmes, for example making sure that synoptic units are placed appropriately in the order of delivery of the programme.

Centres that do not fully address and maintain rigorous approaches to delivering, assessing and quality assurance cannot seek certification for individual programmes or for all BTEC Level 3 programmes. An approved centre must make certification claims only when authorised by us and strictly in accordance with requirements for reporting.

Centres that do not comply with remedial action plans may have their approval to deliver qualifications removed.

9 Understanding the qualification grade

Awarding and reporting for the qualification

This section explains the rules that we apply in awarding a qualification and in providing an overall qualification grade for each learner. It shows how all the qualifications in this sector are graded.

The awarding and certification of these qualifications will comply with regulatory requirements.

Eligibility for an award

In order to be awarded a qualification, a learner must complete all units, achieve a Near Pass (N) or above in all external units and a pass or above in all mandatory units unless otherwise specified. Refer to the structure in *Section 2*.

To achieve any qualification grade, learners must:

- complete and **have an outcome** (D, M, P, N or U) for all units within a valid combination
- achieve the **required units at pass or above** shown in *Section 2*, and for the Diploma achieve a minimum of 600 GLH and Extended Diploma achieve a minimum 900 GLH at Pass or above (or N or above in external units)
- achieve the **minimum number of points** at a grade threshold.

It is the responsibility of a centre to ensure that a correct unit combination is adhered to. Learners who do not achieve the required minimum grade (N or P) in units shown in the structure will not achieve a qualification.

Learners who do not achieve sufficient points for a qualification or who do not achieve all the required units may be eligible to achieve a smaller qualification in the same suite provided they have completed and achieved the correct combination of units and met the appropriate qualification grade points threshold.

Calculation of the qualification grade

The final grade awarded for a qualification represents an aggregation of a learner's performance across the qualification. As the qualification grade is an aggregate of the total performance, there is some element of compensation in that a higher performance in some units may be balanced by a lower outcome in others.

In the event that a learner achieves more than the required number of optional units, the mandatory units along with the optional units with the highest grades will be used to calculate the overall result, subject to the eligibility requirements for that particular qualification title.

BTEC Nationals are Level 3 qualifications and are awarded at the grade ranges shown in the table below.

Qualification	Available grade range
Certificate, Extended Certificate, Foundation Diploma	P to D*
Diploma	PP to D*D*
Extended Diploma	PPP to D*D*D*

The *Calculation of qualification grade* table, shown further on in this section, shows the minimum thresholds for calculating these grades. The table will be kept under review over the lifetime of the qualification. The most up to date table will be issued on our website.

Pearson will monitor the qualification standard and reserves the right to make appropriate adjustments.

Learners who do not meet the minimum requirements for a qualification grade to be awarded will be recorded as Unclassified (U) and will not be certificated. They may receive a Notification of Performance for individual units. The *Information Manual* gives full information.

Points available for internal units

The table below shows the number of **points** available for internal units. For each internal unit, points are allocated depending on the grade awarded.

	Unit size	
	60 GLH	**90 GLH**
U	0	0
Pass	6	9
Merit	10	15
Distinction	16	24

Points available for external units

Raw marks from the external units will be awarded **points** based on performance in the assessment. The table below shows the **minimum number of points** available for each grade in the external units.

	Unit size	
	90 GLH	**120 GLH**
U	0	0
Near Pass	6	8
Pass	9	12
Merit	15	20
Distinction	24	32

Pearson will automatically calculate the points for each external unit once the external assessment has been marked and grade boundaries have been set. For more details about how we set grade boundaries in the external assessment please go to our website.

Claiming the qualification grade

Subject to eligibility, Pearson will automatically calculate the qualification grade for your learners when the internal unit grades are submitted and the qualification claim is made. Learners will be awarded qualification grades for achieving the sufficient number of points within the ranges shown in the relevant *Calculation of qualification grade* table for the cohort.

Calculation of qualification grade

Applicable for registration from 1 September 2016.

Extended Certificate		Foundation Diploma		Diploma		Extended Diploma	
360 GLH		540 GLH		720 GLH		1080 GLH	
Grade	**Points threshold**	**Grade**	**Points threshold**	**Grade**	**Points threshold**	**Grade**	**Points threshold**
U	0	U	0	U	0	U	0
P	36	P	54	PP	72	PPP	108
				MP	88	MPP	124
						MMP	140
M	52	M	78	MM	104	MMM	156
				DM	124	DMM	176
						DDM	196
D	74	D	108	DD	144	DDD	216
				D*D	162	D*DD	234
						D*D*D	252
D*	90	D*	138	D*D*	180	D*D*D*	270

The table is subject to review over the lifetime of the qualification. The most up-to-date version will be issued on our website.

Examples of grade calculations based on table applicable to registrations from September 2016

Example 1: Achievement of an Extended Diploma with a PPP grade

	GLH	Type (Int/Ext)	Grade	Unit points
Unit 1	120	Ext	Pass	12
Unit 2	120	Ext	Pass	12
Unit 3	120	Ext	Pass	12
Unit 4	60	Int	Merit	10
Unit 5	60	Int	Pass	6
Unit 6	60	Int	Pass	6
Unit 7	60	Int	Merit	10
Unit 8	60	Int	Pass	6
Unit 9	60	Int	Pass	6
Unit 10	60	Int	Merit	10
Unit 11	60	Int	Pass	6
Unit 12	60	Int	Pass	6
Unit 13	60	Int	Pass	6
Unit 14	60	Int	Pass	6
Unit 15	60	Int	Unclassified	0
Totals	**1080**		**PPP**	**114**

The learner has achieved N or higher in Units 1, 2, and 3 and P or higher in Units 4 and 5.

The learner has sufficient points for a PPP grade.

Example 2: Achievement of an Extended Diploma with a DDD grade

	GLH	Type (Int/Ext)	Grade	Unit points
Unit 1	120	Ext	Near Pass	8
Unit 2	120	Ext	Merit	20
Unit 3	120	Ext	Distinction	32
Unit 4	60	Int	Merit	10
Unit 5	60	Int	Distinction	16
Unit 6	60	Int	Distinction	16
Unit 7	60	Int	Merit	10
Unit 8	60	Int	Distinction	16
Unit 9	60	Int	Distinction	16
Unit 10	60	Int	Merit	10
Unit 11	60	Int	Distinction	16
Unit 12	60	Int	Distinction	16
Unit 13	60	Int	Merit	10
Unit 14	60	Int	Distinction	16
Unit 15	60	Int	Merit	10
Totals	**1080**		**DDD**	**222**

The learner has sufficient points for a DDD grade.

Example 3: An Unclassified result for an Extended Diploma

	GLH	Type (Int/Ext)	Grade	Unit points
Unit 1	120	Ext	Pass	12
Unit 2	120	Ext	Merit	20
Unit 3	120	Ext	Pass	12
Unit 4	60	Int	Merit	20
Unit 5	60	Int	Pass	6
Unit 6	60	Int	Merit	10
Unit 7	60	Int	Distinction	16
Unit 8	60	Int	Merit	10
Unit 9	60	Int	Unclassified	0
Unit 10	60	Int	Merit	10
Unit 11	60	Int	Unclassified	0
Unit 12	60	Int	Unclassified	0
Unit 13	60	Int	Unclassified	0
Unit 14	60	Int	Pass	6
Unit 15	60	Int	Pass	6
Totals	**1080**		**U**	**128**

The learner has 240 GLH at U.

The learner has sufficient points for an MPP and has achieved a Near Pass or above in Units 1, 2 and 3 and a Pass or above in Units 4 and 5 but has not met the minimum requirement for 900 GLH at Pass or above.

10 Resources and support

Our aim is to give you a wealth of resources and support to enable you to deliver BTEC National qualifications with confidence. On our website you will find a list of resources to support teaching and learning, and professional development.

Support for setting up your course and preparing to teach

Specification

This **specification** (for teaching from September 2017) includes details on the administration of qualifications and information on all the units for the qualification.

Delivery Guide

This free guide gives you important advice on how to choose the right course for your learners and how to ensure you are fully prepared to deliver the course. It explains the key features of BTEC Nationals (for example employer involvement and employability skills). It also covers guidance on assessment (internal and external) and quality assurance. The guide tells you where you can find further support and gives detailed unit-by-unit delivery guidance. It includes teaching tips and ideas, assessment preparation and suggestions for further resources.

Schemes of work

Free sample schemes of work are provided for each mandatory unit. These are available in Word™ format for ease of customisation.

Curriculum models

These show how the BTECs in the suite fit into a 16–19 study programme, depending on their size and purpose. The models also show where other parts of the programme, such as work experience, maths and English, tutorial time and wider study, fit alongside the programme.

Study skills activities

A range of case studies and activities is provided; they are designed to help learners develop the study skills they need to successfully complete their BTEC course. The case studies and activities are provided in Word™ format for easy customisation.

Support for teaching and learning

Pearson Learning Services provides a range of engaging resources to support BTEC Nationals, including:

- textbooks in e-book and print formats
- revision guides and revision workbooks in e-book and print formats
- teaching and assessment packs, including e-learning materials via the Active Learn Digital Service.

Teaching and learning resources are also available from a number of other publishers. Details of Pearson's own resources and of all endorsed resources can be found on our website.

Support for assessment

Sample assessment materials for externally-assessed units

Sample assessments are available for the Pearson-set units. One copy of each of these assessments can be downloaded from the website/available in print. For each suite an additional sample for one of the Pearson-set units is also available, allowing your learners further opportunities for practice.

Further sample assessments will be made available through our website on an ongoing basis.

Sample assessment materials for internally-assessed units

We do not prescribe the assessments for the internally-assessed units. Rather, we allow you to set your own, according to your learners' preferences and to link with your local employment profile.

We do provide a service in the form of Authorised Assignment Briefs, which are approved by Pearson Standards Verifiers. They are available via our website.

Sample marked learner work

To support you in understanding the expectation of the standard at each grade, examples of marked learner work at PM/MD grades are linked to the Authorised Assignment Briefs.

Training and support from Pearson

People to talk to

There are many people who are available to support you and provide advice and guidance on delivery of your BTEC Nationals. These include:

- Subject Advisors – available for all sectors. They understand all Pearson qualifications in their sector and so can answer sector-specific queries on planning, teaching, learning and assessment
- Standards Verifiers – they can support you with preparing your assignments, ensuring that your assessment plan is set up correctly, and support you in preparing learner work and providing quality assurance through sampling
- Curriculum Development Managers (CDMs) – they are regionally based and have a full overview of the BTEC qualifications and of the support and resources that Pearson provides. CDMs often run network events
- Customer Services – the 'Support for You' section of our website gives the different ways in which you can contact us for general queries. For specific queries, our service operators can direct you to the relevant person or department.

Training and professional development

Pearson provides a range of training and professional development events to support the introduction, delivery, assessment and administration of BTEC National qualifications. These sector-specific events, developed and delivered by specialists, are available both face to face and online.

'Getting Ready to Teach'

These events are designed to get teachers ready for delivery of the BTEC Nationals. They include an overview of the qualifications' structures, planning and preparation for internal and external assessment, and quality assurance.

Teaching and learning

Beyond the 'Getting Ready to Teach' professional development events, there are opportunities for teachers to attend sector- and role-specific events. These events are designed to connect practice to theory; they provide teacher support and networking opportunities with delivery, learning and assessment methodology.

Details of our training and professional development programme can be found on our website.

Appendix 1 Links to industry standards

BTEC Nationals have been developed in consultation with industry and appropriate sector bodies to ensure that the qualification content and approach to assessment aligns closely to the needs of employers. Where they exist, and are appropriate, National Occupational Standards (NOS) and professional body standards have been used to establish unit content.

In the construction and the built environment sector, the following approach has been used.

- The mandatory content has been mapped to NOS to reflect the essential skills and knowledge needed for entry to employment.

Appendix 2 Glossary of terms used for internally-assessed units

This is a summary of the key terms used to define the requirements in the units.

Term	Definition
Analyse	Learners present the outcome of methodical and detailed examination, either: • breaking down a theme, topic or situation in order to interpret and study the interrelationships between the parts and/or • of information or data to interpret and study key trends and interrelationships. Analysis can be through performance, practice, written or, less commonly, verbal presentation.
Assess	Learners present a careful consideration of varied factors or events that apply to a specific situation or, to identify those which are the most important or relevant and arrive at a conclusion.
Carry out	Learners demonstrate skills through practical activities, in line with certain requirements. Learners do this in order to complete an identified activity or to demonstrate personal achievement for an audience.
Compare	Learners identify the main factors relating to two or more items/situations or aspects of a subject that is extended to explain the similarities, differences, advantages and disadvantages. This is used to show depth of knowledge through selection and isolation of characteristics.
Demonstrate	Learners' work, performance or practice evidences the ability to carry out and apply knowledge, understanding and/or skills in a practical situation.
Develop	Learners acquire and apply skills and understanding through practical activities that involve the use of concepts, processes or techniques to expand or progress something.
Discuss	Learners consider different aspects of: • a theme or topic; • how they interrelate; and • the extent to which they are important. A conclusion is not required.

Term	Definition
Evaluate	Learners' work draws on varied information, themes or concepts to consider aspects such as: • strengths or weaknesses • advantages or disadvantages • alternative actions • relevance or significance. Learners' inquiries should lead to a supported judgement showing relationship to its context. This will often be in a conclusion. Evidence of explanations could be through visual explanations with annotations, as well as written work, presentation, performance or practice.
Examine	Learners select and apply knowledge to less familiar contexts.
Explain	Learners' work shows clear detail and gives reasons and/or evidence to support an opinion, view or argument. It could show how conclusions are drawn (arrived at). Learners show that they comprehend the origins, functions and objectives of a subject, and its suitability for purpose.
Explore	Learners apply their skills and/or knowledge in contexts involving practical research or investigation.
Investigate	Learners' application of knowledge is based on personal research and development.
Justify	Learners give reasons or evidence to: • support an opinion • prove something right or reasonable.
Perform	Learners demonstrate a range of skills required to complete a given activity.
Review	Learners make a formal assessment of work produced. The assessment allows learners to appraise existing information or prior events, and reconsider information with the intention of making changes, if necessary.
Understand	Learners demonstrate knowledge related to defined situations.
Undertake	Learners demonstrate skills through practical activities, often referring to given processes or techniques.

This is a key summary of the types of evidence used for BTEC Nationals.

Type of evidence	Definition and purpose
Case study	A specific example to which all learners must select and apply knowledge. Used to show application to a realistic context where direct experience cannot be gained.
Individual project	A self-directed, large-scale activity requiring planning, research, exploration, outcome and review. Used to show self-management, project management and/or deep learning, including synopticity.
Practical task (artefact/outcome)	Learners carry out a defined or self-defined task to produce an outcome.
Presentation	To show presentation skills, including communication. To direct to a given audience and goal. To extract and summarise information.
Written task/report	Individual completion of a task in a work-related format, e.g. a report, marketing communication, set of instructions.

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BTEC Level 3 Nationals
in
Construction and the Built Environment

Extended Certificate in Construction and the Built Environment

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