Pearson BTEC Nationals in Construction and the Built Environment

Delivery Guide

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

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

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

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

First teaching September 2017

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All information in this specification is correct at time of publication.

Welcome to your BTEC National delivery guide

This delivery guide is a companion to your BTEC Level 3 National specifications, Authorised Assignment Briefs (AABs) and Sample Assessment Materials (SAMs). It contains ideas for teaching and learning, including practical activities, realistic scenarios, ways of involving employers in delivery, ways of managing independent learning and how to approach assessments. The aim of this guide is to show how the specification content might work in practice and to inspire you to start thinking about different ways to deliver your course.

The guidance has been put together by tutors who have been close to the development of the qualifications and so understand the challenges of finding new and engaging ways to deliver a BTEC programme in the context of the new qualifications from 2017.

Guidance around what you will need to consider as you plan the delivery of the qualification(s) has been provided. You will find information around the structure of your course, how you may wish to build the course for your learners, suggestions for how you could make contact with employers and information around the other support and resources available to you.

Unit-by-unit guidance has been provided, which includes suggestions on how to approach the learning aims and unit content, as well as ideas for interesting and varied activities. You will also find coverage of assessments, including useful advice about external assessment, as well as tips and ideas around how to plan for and deliver your assignments.

You will also find a list of carefully selected resources for each unit. The lists include suggestions for books, websites and videos that you can either direct your learners to use or that you can use as a way to complement your delivery.

We hope you will find this guidance relevant and useful.

Enjoy your course!

What's new

The BTEC Level 3 Nationals 2017 are the result of more than three years' consultation with employers, higher education institutions (HEIs), and many thousands of tutors and managers in colleges and schools. Our aim has been to ensure that the BTEC Level 3 Nationals continue to allow a recognised and well-respected route into employment or higher education by meeting the needs of these key stakeholders and that learners continue to enjoy a stimulating course of study and develop the skills and attributes that will enable them to progress.

As a result of this consultation and on the advice of employers, higher education institutions and most importantly of those of you who teach BTEC, some key changes have been made to the BTEC Level 3 Nationals. These are described throughout this delivery guide and include the following.

- **Updated content and a larger proportion of mandatory content** – both employers and universities said they wanted a greater consistency in coverage of the subject for BTEC learners. Employers wanted to see systematic coverage of core knowledge and skills for their sector, and for the Nationals to reflect up-to-date industry practice.
- **The reintroduction of external assessment** – employers were keen to see an element of rigour and consistency across the country in terms of assessment, while higher education institutions wanted learners to be better prepared for meeting deadlines and preparing for formal exams, where appropriate. Both were keen to see learners applying their knowledge and skills to new contexts through synoptic projects and assessments.

- **A focus on employability skills** – the BTEC approach to learning, through projects, practical assignments, group work and through simulating the world of work, has always supported the development of employability skills, e.g. self-management. In the new Nationals, the balance of cognitive and skills work has been carefully calibrated to ensure that learners get a range of different opportunities across their course.
- **Broader assessment in internal units** – the assessment criteria for each unit are carefully structured to set a clear level of demand. Distinction criteria encourage and require depth of study, including demonstration of the application of knowledge and understanding as well as a synoptic element for the learning aim or unit.
- **Alignment with DfE criteria for performance measures for 16–19 year olds in England** – all new BTECs are designed as either Applied General qualifications or Tech Levels to fulfil criteria for inclusion in 2018 performance tables and funding for 16–19 year olds and 19+ learners.

To support transition to the BTEC Level 3 Nationals 2017, we are providing a support programme with exemplar and practice materials, and training is available. Please see the *Support and resources* section for details of the support and the link to sign up to training, which will be available from 2017 and throughout the lifetime of the qualification.

Notes:

The specification tells you what **must** be taught and what **must** be assessed. This delivery guide provides suggestions and ideas on how you could do this.

The suggestions given in this delivery guide link with the Authorised Assignment Briefs provided by Pearson, but they are not compulsory. They are designed to get you started and to spark your imagination.

Contents

OVERVIEW

Delivery Guides as support

In the specification, the 'Unit content' tells you what must be taught and the 'Assessment criteria' what must be assessed. The 'Essential information for assessment decisions' explains what the assessment criteria mean.

This delivery guide provides suggestions and ideas on how to plan and deliver the qualification, and includes a summary of recent changes.

Unit-by-unit guidance has been provided that includes suggestions on how to approach the learning aims and unit content. Teaching, learning and formative assessment activities are also suggested. You will also find delivery plans to help you timetable your course and ensure your learners are well prepared for internal and external assessments

Links to carefully selected resources are provided for each unit. The lists include suggestions for books, websites and videos that will help you plan and deliver your course. Alternatively, you may wish to direct your learners to these resources.

Use the delivery guides as model templates or an interpretation on which you can base your own plan. Every delivery guide presents each unit as an exemplar, highlighting construction links to motivate tutors and learners.

Significant changes for those teaching to the new 2017 specification

Changes across the BTEC National suite as a whole are listed above. For Construction specifically, some key changes include:

- External Assessment including 'Construction Principles' (key science and maths concepts), Construction Design, and Tendering & Estimating units (depending on size of qualification)
- New content to reflect workplace practice and latest knowledge such as in Building Information Modelling, Design, Surveying, Civil Engineering for infrastructure, Quantity Surveying, Quality Control and understanding employer Commercial and Contractual requirements
- Embedding 'Sustainability' into the qualification as a key theme rather than offering a stand-alone unit in the subject
- Removal of surveying as a stand-alone qualification and inclusion in all qualifications as either mandatory or optional content
- A common core followed by a narrower choice of optional units for each 'pathway' qualification, to comply with DfE tech level criteria and to ensure a specific job-focused purpose to each
- Greater opportunities for employer involvement throughout the qualification, with specific requirements to involve employers in certain units
- Removal of underused and unpopular units following consultation with providers.

Structure

The level 3 Nationals in Construction and the Built Environment are a suite of qualifications that focus on different progression routes, allowing learners to choose the one best suited to their aspirations. Pearson has developed the content of the new BTEC Nationals in collaboration with employers and representatives from higher education and relevant professional bodies. This ensures that content is up to date and that it includes the knowledge, understanding, skills and attributes required in the sector.

Whereas the previous Nationals were internally assessed only, these new Nationals have three types of assessment: Internal, External and Synoptic. There is also more emphasis on developing and utilising links with employers. This would require a review of how the units are delivered and assessed and provides a unique opportunity to create project-based assessments which map across more than one unit and which involve employers in developing realistic briefs and case studies.

These qualifications are aimed at supporting post-16 learners interested in pursuing specialist pathways within construction-related industries. Learners will be provided with technical skills and the required knowledge to enable them to follow their desired career goals. This may be through directly into employment, or onto suitable higher education courses. As mentioned earlier, the employers must have significant involvement in these programmes.

In the Construction and the Built Environment sector, these are:

- Pearson BTEC Level 3 National Extended Certificate in Construction and the Built Environment (340 GLH)
- Pearson BTEC Level 3 National Foundation Diploma in Construction and the Built Environment (560 GLH)
- Pearson BTEC Level 3 National Diploma in Construction and the Built Environment (720 GLH)
- Pearson BTEC Level 3 National Extended Diploma in Construction and the Built Environment (1080 GLH).

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 published programme specification provides an overview of various qualification sizes, clearly highlighting both mandatory (M) and optional (O) units. Some units are mandatory across all qualification sizes, while some units are mandatory only for larger size of the qualification. While choosing the optional units, consideration should be given to the opportunities for coordinated delivery across units as well as to the efficient use of resources.

Certain units of the qualification suite, such as mandatory *Unit 1: Construction Principles*, provide underpinning knowledge of mathematics, technology, materials and construction science, which learners then apply to solve construction problems. Such units must precede specialist units to ensure learners are well prepared for the applied part of their learning and should be taught over a longer period of time – something at times referred to as a long and skinny delivery model.

Other units, such as *Unit 10: Building Surveying in Construction*, develop skills in a specific vocational area. You could consider delivering such units over a shorter period of time – a short and fat delivery model.

The key to successful delivery is the ability to engage learners. Providing a practical construction context to the delivery should be your focus. This could be through site visits to reinforce learning in class or developing sessions to explore field-based exercises. Making use of images, animations and a wide range of

web-based resources will be of great benefit in the classroom, and suggestions to such resources have been included alongside each unit of this guide. You should also, where possible, invite in guest speakers to engage with learners who will be interested and inspired to hear first-hand about the current practices from local professionals.

The content for a unit, or across units, can be delivered in parallel or linear sequence as appropriate. Whatever route you take, adopting a holistic project-based approach in combining the delivery of content as well as assessment will work well. You could use industry projects; for example, *Unit 4: Construction Technology* and *Unit 5: Health and Safety in Construction* could be delivered and assessed using this approach, wherein construction of various elements could be integrated with relevant health and safety regulations and codes.

Depending upon the size of qualification, the choices available to you for optional units vary. Choosing optional units is an important decision. Staff expertise and the availability of physical resources to support delivery and assessment will be a priority concern, as will meeting the aspirations of your learners. You may also wish to consider the local job market and the anticipated future needs when making these decisions.

The mandatory units could be either externally or internally assessed. You should prepare your learners for external assessment throughout delivery, especially where they must sit an examination. Such a preparation involves frequent quizzes, class tests, mock examinations, supported by explanations of keywords used in assessments and general examination techniques.

The mandatory synoptic units require learners to apply learning from across the qualification to the completion of defined vocational tasks. This should be planned to be completed at the end of the programme or when learners have gained adequate knowledge and understanding by studying other relevant units of the programme.

Making the right choice for your learners

You should support your learners in making the right choice that aligns with their future aspirations, whether aiming for starting a degree or a specific job role in the industry.

For example, the **Extended Diploma** is largest size of qualification within the suite:

- It is equivalent in size to 3 A levels and allows the learner to develop a substantial common core of knowledge.
- Learners have the choice to study topics in depth across full range of optional units.
- Learners will develop the broader skills highly valued by higher education institutions, such as critical thinking.
- A range of written and verbal communication skills required in the construction sector will be covered.

Hence, such a qualification would suit a learner if they are studying full time over a period of two years and want to pursue a career in construction. This could be proceeding directly to employment as a technician as this qualification is intended to meet the requirements to registration as a technician. Alternatively, this qualification will allow learners to progress to higher education.

For each qualification, no prior study of the sector is needed, but the learner should normally have a range of achievement at level 2, in GCSEs or equivalent qualifications, including English, mathematics and science.

The smaller size qualifications, such as the **Foundation Diploma**, cater for learners who wish to learn about construction alongside other areas of study, such as an A level, and as a support in their progression to higher education.

Making contact with employers

The employers in the construction industry range from small design consultancies to large national and international construction companies. Which of these business models would benefit your learners will depend upon the size of the qualification as well as the optional units that you have chosen.

If your centre has well established construction programmes, you could start by contacting employers who are already on your customers' database. If this is not the case, developing a list of local companies using internet-based searches is a good start. You could also develop a list of relevant staff within, for example, the local council, Highway Agency and Environment Agency. You should also look to build links to professional bodies, such as Chartered Institute of Building (CIOB), Chartered Institute of Building Services Engineers (CIBSE) and Institution of Civil Engineers (ICE).

Making contact through email or phone is a good start, but before making contact, be clear on the unit content which you could ask them to relate to. You should also be flexible with the timing of any site visits or guest speakers. While talking to the employers, it is always worthwhile to articulate the mutual benefits of developing a positive relationship between the centre and the employers. For example, one of the benefits they are likely to get from this relationship could be offering work placements, which will provide them opportunities for low-risk employee recruitment while contributing towards the local and national skills agenda.

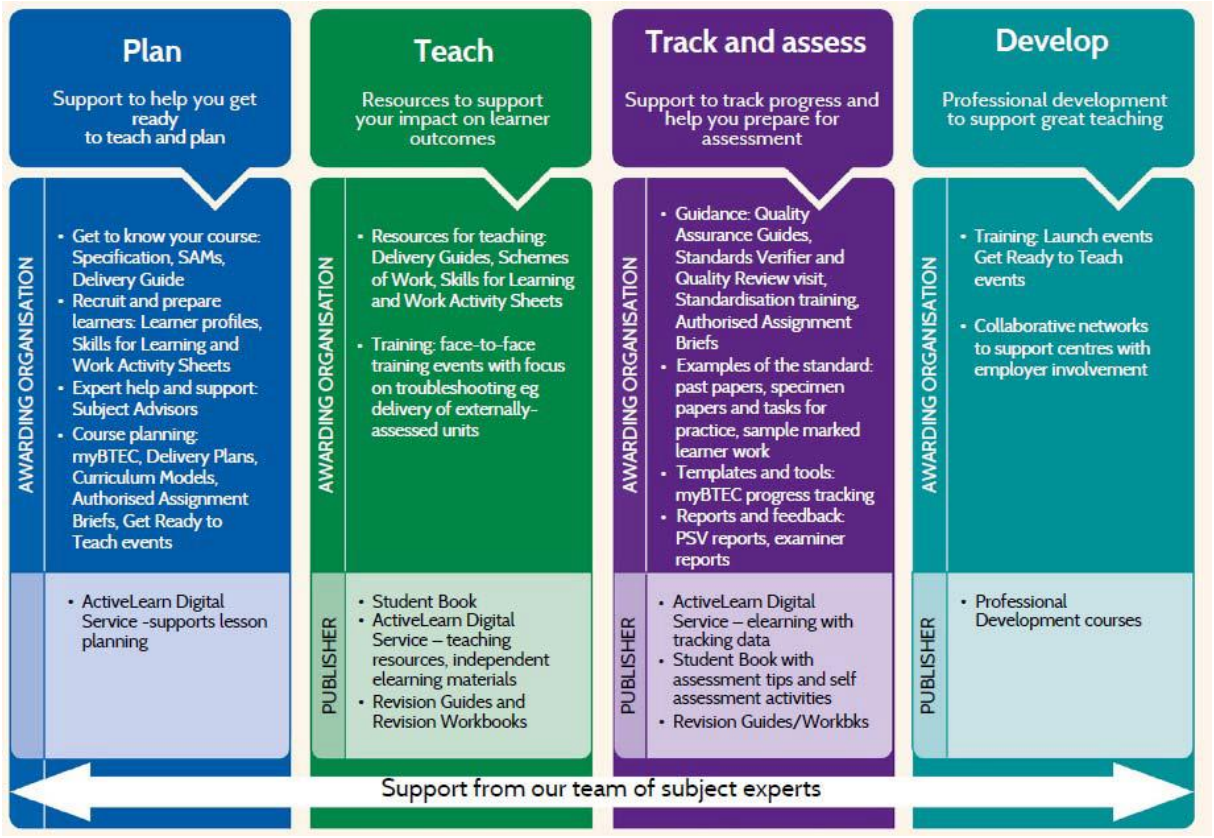
SUPPORT AND RESOURCES

There are a wealth of resources available to ensure that you feel confident delivering your BTEC National qualification throughout your entire course.

All the 'Awarding Organisation' resources can be found on the Pearson Qualifications website here: https://qualifications.pearson.com/en/home.html

As well as the free resources supporting the qualification, provided by Pearson as an Awarding Organisation, Pearson Learning Services ('Publisher' in the tables below) provides a range of engaging resources to support BTEC Level 3 Nationals, including:

- Student books 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 ActiveLearn Digital Service.



In addition to the 'publisher' resources listed above, publishers other than Pearson may produce textbooks that are endorsed for BTEC. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

There are also a number of people who are available for you to speak to:

- **Standards Verifiers** – they are subject specialists who can support you with ensuring that your assessment plan is fit for purpose and whose role is to confirm that you are assessing your learners to national standards as outlined in the specification by 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.

Subject Advice
TeachingConstruction@pearson.com
020 7010 2168

Training for the new BTEC Level 3 Nationals can be found on the Pearson website here: http://qualifications.pearson.com/en/support/training-from-pearson-uk.html

Unit 1: Construction Principles

Delivery guidance

Approaching the unit

This mandatory unit will provide learners the underlying knowledge they will need to solve problems related to the design, construction and refurbishment of buildings and infrastructure.

There is opportunity within the delivery of the unit for a range of scenario based problem-solving activities to be carried out, along with investigations into construction materials and site visits that will allow learners to gain a deeper understanding of how to solve practical construction problems.

This unit could be delivered in a specialist context such as construction and the built environment, building services or civil engineering; however, care must be taken to ensure learners are prepared for the external assessment that is set by Pearson and that the full breadth of the unit content is covered.

Delivery of the unit is likely to use a range of different methods, including a large proportion of tutor presentation, along with individual, paired and group work when carrying out research activities, learner-centred activities and problem-solving activities. There should be an opportunity for learners to put theory into practice when investigating human comfort parameters. The focus should be on equipping learners with the skills they need to be able to apply the mathematical and construction principles studied in order to solve problems related to the design, construction and refurbishment of buildings and infrastructure.

You can involve local employers in the delivery of this unit if there are local opportunities to do so, for example, through site visits.

Delivering the topics

Topic A could be delivered through a range of learner-led investigations into materials; this could involve the use of site visits, independent research or presentations from visiting speakers. Learners will benefit from the use of visits where they can see materials *in situ* and be able to apply their knowledge of the materials, their properties and manufacturing processes to develop a deeper understanding of why each type of material is used for a specific construction project. Where this is not possible, it would be appropriate to use videos or case studies in order to support learning.

Once learners are familiar with the materials that are used in construction projects, you could then introduce factors that impact on the service life of buildings, such as degradation methods, the effects of temperature changes and how loadings affect structural members. This could involve the use of practical investigations into failure modes, supported by the use of video resources. You could approach topic A holistically, considering groups of materials individually across each of the topics.

Topic B could then be introduced by the consideration of the underpinning mathematical techniques, including algebra and trigonometry, which will form

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Issue 1 – April © Pearson 2017

the basis for solving construction problems that are set in with appropriate scenarios. Learners could be given a range of activities that build in complexity in order to practise these skills and become familiar with the techniques that they will need to apply.

Where possible, learners should be given the opportunity to collect and analyse data in order to carry out statistical analysis; this could be linked with other construction-related problems such as a traffic census, occupancy rates, sound levels or temperatures. Concepts such as structural analysis could be introduced through the use of simulations, with learners investigating the relationships between loadings and forces and relating the results of simulations to theoretical calculations.

Where topics from topic B are associated with underpinning knowledge from topic C, it would be appropriate to consider the theory and related calculations together.

This leads onto topic C, which itself could be introduced through either site visits or class discussions. Learners need to be given a range of different scenarios that they can relate to in order to understand how the human comfort requirements related to temperature, acoustics and lighting differ for different user groups. This could include the use of case studies, or primary investigations into the needs of specific user groups. Learners could then be given construction-related problems and case studies for which they need to develop solutions to issues such as noise pollution, unsuitable lighting or excessive levels of condensation within a building. They will need to develop the skills to be able to apply the most appropriate mathematical modelling techniques in order to both generate and justify their solutions. Throughout each of the topics, there are opportunities for learners to collaborate on research and investigations.

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Assessment guidance

This unit is assessed through a 1 hour 30 minute written examination that will be set and marked by Pearson. The examination will include short and longer written questions, along with calculations and synoptic questions that draw together understanding from all three topics to consider problems related to the provision of human comfort in buildings.

In order to prepare for the external assessment, it is important that learners have opportunity not only to complete individual questions and problems related to individual topics, but also to gain experience of completing these under controlled conditions. Centres should make use of the Sample Assessment Materials, and in future past papers, when they are preparing learners for assessment. It is important that learners have the ability to interpret given climatic information, and be able to apply their findings to justify material selections for given problems. Learners will also need to understand the meaning of the various command words used in questions, and the typical format that responses to each of these questions should take.

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Issue 1 – April © Pearson 2017

Getting started

This provides you with a starting place for one way of delivering the unit. Activities are provided in preparation for the external assessment.

Unit 1: Construction Principles

Introduction

In the delivery of this unit, there are opportunities for you to develop links with a range of local organisations including construction companies, materials suppliers and to an extent landowners and local authorities. These organisations may be able to provide information about construction sites that can be used as starting points for scenarios, or give learners first-hand experiences of materials either being manufactured or used in projects. Centres may consider it appropriate to deliver aspects of topic B alongside topics from topic C where theory can be applied to the completion of various calculations such as temperature coefficients. Centres may wish to adopt a holistic approach to the delivery of topic C as the factors that influence thermal comfort, acoustics and lighting are rarely isolated and build upon the knowledge and understanding of materials and their properties covered in topic A.

Topic A – Construction materials

- There is opportunity to deliver the topic holistically as the links between properties, materials, their uses and degradation could be approached in a number of ways, for instance, considering one material type from manufacturing through to failure methods.
- Introduce topic A1 with a discussion about the properties that materials need to have when they are being used in construction projects. Discuss how materials are selected specifically for their properties, and how this relates to the design and construction of buildings. There are opportunities for site visits, material investigations within centres or visits from outside speakers to explain the influence of the choice of materials on the life of a building. This could then be followed by learners, in pairs or small groups, investigating a range of properties and qualities of materials. The investigations could be divided among the group, with learners researching one specific property and then feeding back to the wider group in the form of presentations. Handout notes could be provided as a part of the presentation that could then be used by others as references. Learner understanding could be assessed through the use of focussed tasks that require learners to identify the properties of materials that will be used in a specific location or scenario.
- Topics A2 and A3 could be delivered holistically, with the manufacturing and processing of construction materials being considered at the same time as the properties and uses of materials. There are opportunities for collaborative learning, either paired or small groups, when learners investigate and research how materials are processed. If possible, learners could be given first-hand experience of how some materials are processed, or video of manufacturing activities could be used. Learners could then be given scenarios where they need to select materials based on given information, and justify their choices based on the properties of the materials. Learners should be encouraged to consider a range of factors when deciding upon their material choices, including the manufacturing processes, the embedded energy of the material and also issues related to the sustainability of materials. You could consider the life cycle of construction materials from raw

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Issue 1 – April © Pearson 2017

materials through to disposal, discussing how this impacts on the sustainability of materials and their embedded energy. There are opportunities to link topic A3 with topic A4 by considering the processing of construction materials and the links with degradation methods. Finally, for A3 learners should be encouraged to consider how manufacturing is increasingly being integrated into the construction building project. A good example of this could be offsite construction using modular building for homes and factories. The construction site and technician roles of the future may be as much in a factory, manufacturing prefabricated modules, as on a traditional building site. This would also allow further holistic teaching with A1/A2 when covering material properties, such as cross-laminated timber as used in prefabricated panels, in offsite construction.

- You could introduce topic A4 by reflecting on the reasons why materials are chosen for specific applications, developing this further by then introducing learners to a range of sources and causes of degradation of construction materials. There is again opportunity for paired or small group investigations into causes of degradation, which can be supported with appropriate use of video, or visits to inspect material degradation and examples of material failure *in situ*. Learners could carry out research investigations into which types of treatments are most effective at preventing material degradation through the use of simulations and practical experiments. The topic could be concluded with discussions and investigations into the ways in which materials fail, and the impact of such material failures.
- You could introduce topic A5 through discussions about the effects of temperature changes on materials. This could be enhanced through the use of demonstrations or video resources that relate to changes of state of materials, expansion and contraction, and evaporation. Learners could carry out investigations into how these changes can impact on the properties of materials and how material choices can be influenced by how they react to changes in temperature.
- To conclude topic A, topic A6 could be introduced through a consideration of the different types of structural members that are used in construction projects. You could use demonstrations, video or simulations to demonstrate to learners how these structural members react when they are under loading. Learners could carry out paired or grouped investigations into how structures react to loading, and then investigate the specific modes of failure for each type of material. As with earlier topics, if groups are of sufficient number, this could be achieved by allocating materials to groups and then the groups feed back to the wider class their findings. Learners should consider the effects of different types of loading on different materials, such as tension forces on both steel and concrete, or compressive forces on timber and reinforced concrete.

Topic B – Solving practical construction problems

- Topic B1 could be introduced by discussing learners' prior experience of using algebraic methods to solve problems with them, along with their understanding of linear equations and simultaneous equations. This could be either through discussion or through simple assessments. You could then develop learners' ability to apply algebraic concepts by introducing them to factorisation of linear and quadratic equations for which learners should be taught how to apply the quadratic equation to find roots of an equation. You should give an appropriate construction context for problems. Learners should also be taught the necessary skills to rearrange formulae, and the methods of substituting values into formulae to arrive at a solution.
- You could then introduce trigonometry, and the range of trigonometric functions that can be used to solve realistic 2D and 3D construction problems, such as determining the area of a site where it is not possible to make direct

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Issue 1 – April © Pearson 2017

measurements. Moving on from trigonometry, you could begin by explaining the importance of circular measurements to learners, introducing radians as the unit of circular measurement, explaining the advantages of using radians especially with regard to finding arc lengths and areas of sectors. This could then be further developed with considerations of the properties of points, lines, angles and circles before introducing Pythagoras' theorem to learners. For each, learners could carry out tasks that apply the theory to construction problems, perhaps in conjunction with local organisations. Examples could include problems related to irregular shaped sites, building plans and elements such as structural steelwork and timbers.

- Next, you could introduce learners to the method of plotting graphs from linear equations prior to giving learners a range of equations that they should plot for themselves. Learners should be able to apply a range of techniques to interpret information from graphs, including the ability to interpolate and extrapolate values from the given information. Once learners are competent in the production and interpretation of graphs, you could review methods of determining surface areas of solids and related volumes before giving learners further opportunity to work individually on solving problems related to areas and volumes.
- You could give learners either practical data collection exercises, or desk studies, to develop their skills in the interpretation and application of statistical information. These should give learners sufficient opportunity to gain an understanding of a wide range of types of data, and the methods used to present them. You could provide contextualised problems related to construction projects in areas where the climate will be a significant determining factor for the materials used in the project. Learners should be given opportunity to practise interpreting a range of types of climatic information, e.g. identifying trends in weather conditions or the extremes that would need to be considered when selecting materials.
- There could be an opportunity for collaborative working in order to solve problems related to concurrent and non-concurrent coplanar forces. Learners should have opportunity to investigate the relationship between force, mass and acceleration due to gravity, before introducing different types of force including tension, compression and shear. This can then be expanded to consider stress and strain; following investigation of these concepts, learners should be introduced to both the modulus of elasticity and how to derive this for these from values of stresses and strains. There are further opportunities for learners to work individually to solve problems before demonstrating shear force and bending moment to learners. This could be through practical demonstrations or virtually.
- You could use practical demonstrations in order to show learners the conditions for static equilibrium, prior to explaining how these conditions can be arrived at. Learners could then be given further opportunity for collaborative working to investigate systems. You should expand upon the application of moments and conditions for equilibrium by introducing learners to simply supported beams. You should initially introduce learners to the methods of resolving forces with point loadings, before introducing uniformly distributed loads.
- Finally, you could introduce learners to how mathematical techniques are applied to construction problems related to human comfort, discussing briefly how mathematical techniques are used to determine material requirements and other factors that relate to human comfort.

Topic C – Human comfort

- Introduce the topic by considering the three factors that contribute to human comfort levels: thermal, acoustic and lighting. Explain to learners that there is an interaction between each of the requirements and that often the optimal solution is a compromise between the most effective solution for each individual comfort

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Issue 1 – April © Pearson 2017

requirement.

- You could then introduce topic C1 by discussing the scientific principles related to heat before learners investigate heat transfer methods in small groups. This knowledge could then be built upon to consider how temperature can be measured. Learners could again work in small groups to produce presentations to demonstrate how measuring instruments are used and how they function.
- Learners could then be provided with investigations into the different factors that will impact on thermal requirements for buildings, including personal and regulatory considerations. Once an understanding of the thermal requirements has been gained, learners could investigate the modes by which heat is lost from buildings, methods of reducing such heat losses and the calculations that need to be carried out to find the magnitude of losses.
- To conclude topic C1, you could then consider condensation and heat losses. This could be approached through the use of small group investigations or paired research activities. Once the causes of heat losses are determined, you could introduce methods of determining heat losses through the use of calculations, linking back to topic B1. Learners could be given a range of scenarios and situations for which they need to carry out some investigations and then apply calculations appropriately. Similar activities could be taken for condensation, with learners completing tasks related to dew-point temperature profiles and structural temperature profiles.
- You could then introduce topic C2 by discussing the scientific principles related to sound before learners investigate how sound impacts on human comfort. This could then be developed to consider the differences between sound and noise, perhaps using audio clips for learners to consider whether something is 'sound' or 'noise'. Learners could then research and investigate the different factors that will impact on acoustic requirements for buildings, including personal and regulatory considerations. This could then be developed to consider the differing acoustic comfort requirements for different types of building and use, with learners being given scenarios to investigate.
- Learners could then be introduced to methods of providing sound insulation and absorption, with calculations being demonstrated. Learners could then apply this knowledge to given situations where they would carry out calculations and suggest appropriate noise control measures. Learners could then consider the methods that can be used to provide sound insulation in more depth, relating the methods to situations and typical applications.
- Topic C3 could then be introduced by considering the scientific principles related to lighting, with learners investigating the principles that impact on appropriate lighting levels. This could include the standard units of measurement for lighting, and the personal and regulatory considerations that should be accounted for when determining suitability of lighting levels. You could then demonstrate how to perform calculations related to lighting requirements. Learners should also be introduced to the principles related to daylight factors and how these influence lighting decisions.
- Finally, learners could be given a research task to complete in pairs to investigate different forms of lighting that could be used, considering how the lighting functions, its typical uses and reasons why it would be used in given situations. Learners could then be given scenarios for which they need to select and justify an appropriate form of lighting.

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Issue 1 – April © Pearson 2017

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

As a core mandatory unit, this unit links with most of the other units in the qualification, including:

- Unit 2: Construction Design
- Unit 3: Tendering and Estimating
- 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 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
- Unit 15: Further Mathematics for Construction
- Unit 16: Work Experience in the Construction Sector
- Unit 17: Projects in Construction
- Unit 18: Building Information Modelling
- Unit 19: Quantity Surveying
- Unit 20: Quality Control Management in Construction
- Unit 21: Building Services Science
- Unit 22: Economics and Finance in Construction
- Unit 23: Construction in Civil Engineering
- Unit 24: Planning Application Procedures in Construction
- Unit 25: Property Law
- Unit 26: Conversion, Adaptation and Maintenance of Buildings

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Ahmed A and Sturges J, *Materials Science in Construction: An Introduction,* Routledge, 2014 ISBN 9781135138417 – includes sections related to material properties, modes of failure, embedded energy, sustainability, along with

considerations of modern structural materials including glass, engineered timbers and concretes.

Domone P and Illston J, *Construction Materials: Their Nature and Behaviour (*Fourth Edition*)*, CRC Press, 2010 ISBN 9780203927571 – covers a wide range of construction materials that are assessed in this unit, including production, sustainability, recycling and reuse. Considers how materials are used in construction projects, including reasons for selection.

McMullan R, *Environmental Science in Building* (7th Edition), Palgrave Macmillan, 2012 ISBN 9780230390355 – covers a wide range of principles and theories related to building services science.

Virdi S, Baker R and Kaur Virdi N, *Construction Mathematics,* Routledge, 2014 ISBN 9781135055226 – includes theory and examples of topics covered throughout topic B, including algebra, trigonometry, statistics and geometry.

Journals

Building Services & Environmental Engineering (Datateam Publishing Ltd)

CIBSE Journal (CIBSE)

Heating and Ventilating Review (Faversham House Group Ltd)

Videos

Beam failure (https://www.youtube.com/watch?v=6ycbDCnoO8M beam test)

Buckling failure (https://www.youtube.com/watch?v=jNwvub87l8o)

Cement manufacturing (https://www.youtube.com/watch?v=jIom24zXsJk)

Changes of state of matter (https://www.youtube.com/watch?v=ndw9XYA4iF0)

Concrete (https://www.youtube.com/watch?v=woaUs5XnjUo)

Glass production (https://www.youtube.com/watch?v=4j6MB6yDKDE)

How bricks are manufactured (short video of automated manufacturing processes) – similar videos are available for most of the materials listed in the unit content (https://www.youtube.com/watch?v=tfKt49dK29o)

How drywall is made (https://www.youtube.com/watch?v=tmbk8Pfau0I)

Lateral torsional buckling (https://www.youtube.com/watch?v=bcIrDoL6WSA)

Load bearing walls in homes (https://www.youtube.com/watch?v=a9UOwDjBZH0)

Noise pollution (https://www.youtube.com/watch?v=-VaaTn_g1_k)

Smart glass (https://www.youtube.com/watch?v=aXo2Gp2PVlE)

Sustainable building materials (1 of 4 videos in a series) (https://www.youtube.com/watch?v=RocreN7_sqs)

Sustainable construction with timber (https://www.youtube.com/watch?v=v3AIYTB5v-w)

Types of roofing material (https://www.youtube.com/watch?v=DXx35rudxRo)

UPVC manufacturing (https://www.youtube.com/watch?v=koBfCTz-IZo)

Webinar on Pre-fabricated materials, properties, application and fabrication off site (cross-laminated timber): (https://www.youtube.com/watch?v=Q1VZwVTnPn0)

Modular Construction (https://www.youtube.com/watch?v=2e0QnAUtmko)

Websites

www.bsee.co.uk – Building Services & Environmental Engineer

www.cibse.org – Chartered Institution of Building Services Engineers

www.heatingandventilating.net – Heating and Ventilation

http://www.hse.gov.uk/temperature/thermal/index.htm – Health and Safety Executive – information about thermal comfort. Relevant to workplaces; however, the factors considered are also applicable to domestic situations.

https://skyciv.com/free-truss-calculator/ – online structural analysis simulation software

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Unit 2: Construction Design

Delivery guidance

Approaching the unit

This mandatory unit is intended to give learners the skills that they will need to meet design challenges and plan effective construction methods to meet client's requirements.

There is opportunity within the delivery of this unit for a range of design activities to be carried out, along with practical investigations of existing building projects. Site visits and the involvement of local employers in delivery of this unit are highly recommended.

Delivery of this unit is likely to use a range of different methods, including tutor presentations, individual and group work along with paired investigations. The focus should be on equipping learners with the skills they need to be able to develop their design concepts coherently, identifying design constraints at an early stage, and using their knowledge of construction methods and planning to give the client cost-effective and viable solutions.

Learners should be able to confidently address a range of challenges, including those related to sustainability issues within the design and construction stages. They should be encouraged to draw on their experience of construction from other units in the qualification and the wider engineering world to present suitable design solutions.

Delivering the topics

Topic A gives the foundation for this unit, introducing learners first to the stages and tasks involved in the design process, and then investigating the factors that influence the design process, including client requirements, budget and regulatory constraints.

To begin analysis of the process, you could introduce learners to the RIBA Plan of Work 2013 and focus on each of the design stages 0 to 4. This could be introduced by considering a recent construction project in the local area and discussing with learners the possible reasons that led to its development. You could use a construction project that learners are familiar with – such as Wembley Stadium or the Olympic Stadium – or something less familiar, such as new university halls of residence. This analysis could provoke discussion that you can then build upon by directing learners to carry out their own independent study into client requirements for projects.

You could then carry this forward by discussing how client requirements often lead to identifying the range of constraints that may apply, such as site and planning constraints. Again, the same projects could be considered, with learners investigating the constraints that existed and how these constraints influenced the final design.

You could also consider more holistic challenges such as identifying constraints associated with statutory, social and environmental issues for different building projects, along with considering constraints that place limitations on the design solution. These topics are likely to be delivered using a range of methods, including paired and group research tasks.

Having considered a range of constraints that will need to be considered while designing a building, you will then need to help learners gain the skills that they

will require to be able to communicate their solutions. They should consider the different forms of communication used within a construction project and the benefits of good communication and the hazards of poor communication.

In topic B, you should make sure that learners have a good understanding of how to interpret client requirements in order to produce an initial project brief. This could be achieved by giving learners a range of case studies that feature a client's requirements, from which learners would then develop a suitable design. Learners could carry out independent research to further their understanding of economic constraints on building designs.

This could then be complemented by further paired or group activities where learners investigate the planning and statutory constraints associated with given projects or case studies. Finally, you could introduce learners to the various analytical skills that they will need to employ when producing their own designs and initial project briefs, including spatial requirements, desired project outcomes, site information and budget requirements.

You should develop the visual presentation skills that learners will be expected to employ, such as 2D and 3D sketching, rendering, use of technical drawings. These skills could then be employed by tasking learners with a number of design challenges. These challenges would require learners to develop a range of initial ideas and could be linked to work with an industry partner who may give learners suitable projects to address.

Topic C deals with construction methods and techniques and will link closely with *Unit 4: Construction Technology*. Learners could work in groups to investigate the different forms of construction available. This is an opportunity to work with an industrial partner to look at case studies and identify the advantages and disadvantages of each method. Learners could be given a range of scenarios and asked to select an appropriate technique and justify its selection.

Learners will be introduced to site investigations and the information that can be gained from these. Case studies presenting the different forms of substructure could be introduced and discussed as group to develop learners' understanding of when and why certain substructures are used. This would be an excellent opportunity to work with an industry partner who may have a range of projects requiring different foundations.

Following this, the group can be challenged to research the function and types of primary and secondary elements. This research could be supplemented by looking at existing projects and identifying and justifying the selection of the different types of element in each example. These examples could be the same case studies as investigated in topic A. Working in small groups, learners could develop the initial design considering suitable construction methods, justifying the selection of the form of construction and the materials used for each element of the superstructure.

Finally, the learners should be introduced to the range of sustainability methods and techniques that can be incorporated in a building project. They should research the modern techniques for improving the energy efficiency of a building and reducing the carbon footprint of the building. Learners can research modern buildings that have been assessed under the BREEAM system and identify the sustainable techniques that have been adopted.

You could work in partnership with a local design or construction organisation to give learners the opportunity to present and discuss their design solutions.

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Assessment guidance

Due to the nature of this unit, with the extended external assessment relating to a pre-release case study, it is important that learners are fully prepared with the skills they need to be able to interpret a client's vision, identify the design constraints, produce an initial project brief and then plan the most suitable construction method.

This is most likely to be achieved with a range of practical design tasks where learners could address aspects of the content prior to carrying out a practice task, probably based on the Sample Assessment Materials. It is important that learners have a good understanding of the materials and processes involved with the design and construction of buildings. You should ensure that they also are proficient in presenting design ideas and have the skills to be able to produce manual annotated 2D and 3D sketches and also use CAD software to produce a virtual model of the design solution.

Getting started

This provides you with a starting place for one way of delivering the unit. Activities are provided in preparation for the external assessment.

Unit 2: Construction Design

Introduction

You could approach this unit in a number of ways. However, it is likely that once the underpinning knowledge and understanding that is covered through topics A, B and C has been addressed, a more holistic approach could be employed, which would give learners a similar experience that they will encounter in their external assessment.

Where possible, make the most of opportunities to develop links with local construction and design companies who may be able to provide suitable design challenges or scenarios that could be used by learners to develop their design skills.

Topic A – The construction design process

- Topic A could be introduced by discussing the possible stages involved in a construction project. Use the stages of the Royal Institute of British Architects (RIBA) Plan of Work 2013 to identify the work involved with the design of low- and medium-rise domestic, commercial and industrial buildings. Focus on the stages from 0 to 4.
- There are many factors that will influence the design process of a proposed new building project. Learners would benefit from initial tutor presentation on the regulations, followed by small group or paired activities to develop research skills.
- As a group, discuss the client requirements of projects, such as a new shopping centre, hotel, office block or housing development. Ask learners, in pairs, to research information on different projects and create a spider diagram of all the different requirements. Allow the learners to compare and contrast their ideas to ensure they have covered all the possible requirements. This would allow learners to develop their interpersonal skills.
- There may be a number of possible sites for a planned construction project. As a group, investigate site constraints that may impact on the design.
- Research the range of planning and statutory constraints that impact on the design of the building. Ask the learners, in small groups, to investigate a number of different planning and statutory constraints and present their findings to the wider group, thereby developing the transferable skills they may need in future employment.
- There are a number of other constraints that will impact on the design of the building, such as environmental, social and economic constraints. A group discussion on the range of constraints within each topic should help the learners understand the possible factors that may influence the design process.
- Ask the learners to think about who would be involved in the design of a construction project. Make a list of persons who would be involved in the process, and who would use or otherwise be impacted by the construction. Learners could then recommend appropriate forms of communication for the different stakeholders.
- Learners should investigate modern techniques and practices, in particular the use of modular build offsite (e.g. Laing O'Rourke's offsite construction facility, http://www.laingorourke.com/what-we-do/modular-manufacturing.aspx). They should look at house builders that are using modular build and cross-laminated timber technology to improve efficiency and productivity. Another example is the new Legal and General offsite construction facility, which shows the increasing control that the client can have over the process (http://www.legalandgeneralgroup.com/investors/news_releases/releases2015.asp

?newsid=2785).

- As a group, discuss the advantages of good communications in the design team and the possible consequences of poor communication.

Topic B – Project information and building design production

- The focus of topic B is for learners to be able to examine client's requirements for a project. Take into consideration external factors such as planning, statutory, environmental, social and economic constraints and create an initial project brief.
- This section offers you the opportunity to develop links with an industry partner who could identify possible projects that your learners could investigate.
- From their investigation of the client's requirements and consideration of the constraints, learners could produce initial project briefs. There is scope for collaborative working between learners in the first instances, with learners developing their skills to be able to work independently prior to beginning their external assessments.
- Introduce the section by giving learners a relatively simple explanation of the possible information that should be included in an initial project brief such as spatial requirements, desired project outcomes, site information and budget requirements.
- They could then work through this, in either groups or pairs, to come up with specific design factors needed for the client's project identified earlier.
- Following on from this, learners should consider the planning and statutory constraints that relate to the design brief. Discuss as a group, and then allow learners to work in pairs to investigate the relevant planning and statutory, constraints. Learners could then modify their own initial project brief, in light of the constraints that they have identified.
- Learners can then look at a further range of constraints, which can have an impact on the design. This will allow learners to consider the unique environmental constraints of the project. In small groups, the learners can study the social impact a project may have on an area.
- A determining factor for any project will be the financial constraints. Learners can research the possible costs of building the project and how to present a project budget.
- It is vital that the learners can not only communicate their initial project briefs in writing, but they should also be able to produce a range of sketches, 2D and 3D CAD drawings, to enable the client to interpret their ideas. Tutor demonstrations to present technical draftsmanship skills and software functionality will be required alongside a number of progressive activities to stretch the learners' ability in visual representation. Link with *Unit 7: Graphical Detailing in Construction* to produce hand sketches and CAD to produce 2D plans, sections and elevations and 3D models.
- 'Project Information' can come from CAD produced schematics, but also from the outputs of Building Information Modelling (BIM) software and tools. This can provide efficiencies in the design process. Link with *Unit 18: Building Information Modelling.*
- To bring together learning for this section, you could offer learners the opportunity to complete a number of revision activities where they could consider the design factors and constraints and develop an initial project brief. Learners will need to produce a brief that fulfils the requirements of the project and clearly represents the client's vision.

Topic C – Construction methods and techniques

- The focus of topic C is for learners to be able to examine client's requirements for a project. Take into consideration external factors such as planning, statutory,

environmental, social and economic constraints and outline a solution.

This section also offers you the opportunity to develop links with an industry partner who could identify possible projects that your learners could investigate. The learners could work in pairs to recommend and justify solutions that meet the client's vision and work within the constraints. These recommendations could be presented to the industry partner who could critique the solutions.

- You could initially introduce the learners to the functional requirements of primary and secondary elements. This could then be expanded in covering the range of construction methods and techniques available through group discussion. In pairs, the learners could investigate and produce sketches for a number of different construction methods. These investigations and sketches could then be presented to the rest of the class for discussion on the possible uses, advantages and disadvantages of each method.
- For the next section – substructure construction – there is a direct link with *Unit 4: Construction Technology.* Links with an industry partner could be used for activities such as site visits or guest speakers.
- Learners should understand the purpose of site investigations and the factors that influence foundation design. In small groups, the different forms of foundation design could be investigated and the type of building and factors that may influence the choice. Learners could research the types of foundations used for a range of local and national building projects and justify why this foundation method was selected.
- For the next section – superstructure construction – again, there is a direct link with *Unit 4: Construction Technology*. Links with an industry partner could be used for activities such as site visits or guest speakers.
- Learners will need to understand the function of the primary and secondary elements used to construct the superstructure and external envelope of a range of different buildings.
- In small groups, the different elements of superstructure could be investigated. This investigation should be expanded to look at types of building constructed and the factors that may influence the choice. Learners could research the form and type of construction used for a range of local and national building projects and justify why this method was selected.
- The advantages and disadvantages of modern construction techniques should be researched, such as offsite and modular construction. Investigate the growing importance of manufacturing in the design process.
- The final section – sustainability – gives learners the opportunity to investigate sustainable methods and techniques that are a crucial part of any modern construction project. This is an opportunity to link with industrial partners and to research new technologies.
- Learners can review the work covered in *Unit 4: Construction Technology* when discussing how new materials/methods (modular building, cross-laminated timber) designs can lead to lower costs and more sustainable projects.
- Learners should be introduced to the benefits of passive solar gain and passive stack ventilation. In small groups, learners should investigate the methods used to reduce the use of water within buildings and to reduce waste. Learners could select a construction material and research its embodied energy and potential for recycling.
- To gain knowledge of a range of alternative energy sources available, learners should collaborate as a group to discuss the advantages and disadvantages of each method and research projects that have used each of the different methods.
- Learners should be made aware of other ways of improving the sustainability and energy efficiency of a building, such as insulation methods, sustainable urban drainage systems and sustainable landscape design.

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- Finally, you could discuss with learners the concept of assessing the sustainability of a building by providing an understanding of BREEAM, and the purpose and benefits of this assessment method. This could be extended using case studies identified from the BREEAM website to identify the sustainable techniques used in each building.
- In the external assessment, learners must be able to recommend and justify the possible size, form and type of construction to meet the client's needs for a proposed project. Give learners practice assessments at the end of this topic and provide feedback to help them develop their skills before the final assessment.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit has links to:

- Unit 1: Construction Principles
- Unit 4: Construction Technology
- Unit 7: Graphical Detailing in Construction
- Unit 8: Building Regulations and Control in Construction
- Unit 10: Building Surveying in Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 14: Provision of Primary Services in Construction
- Unit 18: Building Information Modelling
- Unit 24: Planning Application Procedures in Construction
- Unit 25: Property Law
- Unit 26: Conversion, Adaptation and Maintenance of Buildings

Resources

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Textbooks

Anderson J, Shiers D and Steele K, *The Green Guide to Specification* (Fourth Edition), IHS BRE Press, 2009 ISBN 9781848060715 – provides good information on sustainability and environmental issues

Chudley R, Greeno R, Hurst M and Topliss S, *Construction Technology* (5th Edition), Pearson, 2011 ISBN 9780435046828 – provides information on construction techniques and sustainability

Cooke R, *Building in the 21st Century*, Wiley-Blackwell, 2007 ISBN 9781405156554 – this book provides information on modern building techniques with particular interest in sustainability and environmental issues.

Illingworth JR, *Construction Methods and Planning* (Second Edition), Routledge, 2000 ISBN 9780419249801 – this book takes a practical approach and features examples and illustrations taken from real situations and sites.

Websites

http://www.breeam.com/ – British Research Establishment Environmental Assessment Method

https://www.gov.uk – Building Regulations approval, Guidance on Party Walls, Disability Discrimination Acts 1995 and 2005, Equality Act 2010, Landlord and Tenant Act 1985 and restrictive covenants

https://www.gov.uk/government/publications/national-planning-policy-framework--2 – National Planning Policy Framework 2012

http://www.hse.gov.uk/construction/cdm/2015/index.htm – Health and Safety Executive, CDM Regulations 2015

https://www.planningportal.co.uk/ – information on the 'planning process' and 'building control'

https://www.ribaplanofwork.com/ – Royal Institute of British Architects Plan of Work 2013

https://qualifications.pearson.com/en/qualifications/btec-nationals/construction-and-the-built-environment-2017.coursematerials.html#filterQuery=category:Pearson-UK:Category%2FSpecification-and-sample-assessments – Sample Assessment Materials

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Unit 3: Tendering and Estimating

Delivery guidance

Approaching the unit

This is an externally assessed, mandatory unit for the Extended Diploma in which learners will examine the means and processes involved when tendering and estimating to obtain work as a main contractor. Learners will gain understanding of the essential requirements for main contractors in order to assess commercial risks associated with a project bid.

This unit is best delivered holistically using practical estimating exercises that will prepare learners for the supervised final assessment task. Ahead of the assessment, learners will need to demonstrate their understanding of:

- the elements that make up an estimate
- the build-up of the final price within a tender
- the mathematics involved in calculating values for work items
- how to build up prices from the analysis of method statements and outputs to produce final costs.

The use of a guest speaker who works within an estimating department of a main contractor would provide an ideal opportunity to situate this unit in a real scenario. Guest speakers would need to be prepared so they are aware of the unit's content and the focus of assessment.

Delivering the topics

You may wish to introduce this unit with an initial top-level view of the complete process involved in producing project estimates and commercial risk assessments, through to the submission of the tender bid. This may help prepare learners ahead of the in-depth analysis into each stage, setting the context and providing a useful point of reference throughout delivery.

Topic A

The tendering process is outlined in topic A, and you will need to break the overview down further here into a detailed sequence for learners. The sequence needs to start with the receipt of tender documentation and covers the subsequent actions that you would take as an estimator. You could engage learners and initiate class discussion through posing a number of questions that would need to be answered, such as:

- What decisions do you, the estimator, have to make?
- What bearing does the type of contract have on the tender?
- What supply chain contractors are required?
- What is the risk?
- Is there any commercial intelligence available?

These questions could be based around an estimating case study that you have prepared and set the scene for learners. This case study could be used throughout topic A, prompting questions that cover the unit content A1 to A6.

Throughout topic A, you are looking to develop the learners' knowledge and understanding of the tendering process, the requirements for the compilation of an estimate and the techniques used in building up the costs for a tender.

Delivery of the content is likely to rely heavily on scenario and case studies. For example, you may choose to task learners to act in the role of main contractor and identify errors in tender documentation – such as missing drawings, or specification inconsistencies. In such activities, you may wish to take the lead. This could be around the exploration of the tendering considerations and strategies and producing flow charts with learners on the key decision criteria they should be aware of.

Topic B

Topic B covers the next point in the sequence – estimating processes and procedures where a tender price is compiled. This is all about assembling components of rates, which include labour, plant, materials and subcontractors. If possible, obtaining an estimate from a main contractor would provide an ideal vehicle to demonstrate to learners the compilation of a tender bid for a project. A site visit is an essential part of estimating for a project, and this should be incorporated into your delivery of topic B. However, if this is not possible, Google mapping software can also be used in delivery.

Mathematical manipulation and analysis are the key skills to estimating costs that learners must develop. Start with simple exercises and build up learners' confidence in compiling rates. You will then need to open this up so learners see the big picture and what a complete tender can look like. This should include preliminaries, the main measured work section, provisional and prime costs sums, dayworks and summary. The New Rules of Measurement (NRM) provides a useful resource when explaining this to learners. Topic B4 covers the analysis of an estimate. This is the final build up that pulls all the totals together and a spreadsheet approach would be useful for this message.

Topic C

In topic C, you will cover the commercial decisions that influence tender submission. This could be delivered by a role-playing exercise where a tender adjudication meeting is held, ideally based on the same case study behind the estimating exercise. In their project teams, learners contribute to the final decision on what margin to apply to the tender. You would represent the Managing Director of the company who will make the final decision regarding the tender adjudication process. In this role, you could keep throwing in variables to be considered as part of the process. Topics to be introduced within the meeting would be risk, commercial intelligence from the last role play, what adjustments to make and the final commercial decision.

Learners need to be able to read information, digest it and then calculate unit rates and estimates for various aspects of the tasks within the external examination. Therefore, exam technique is a valuable skill, and one in which learners need to build confidence. Use mock tasks to support this development, applying and time constraints so learners understand how to plan effectively.

Assessment guidance

This is an externally assessed unit comprising a written exam based upon a given estimating scenario. Sample Assessment Materials will be provided on the Pearson website (see link in Resources), which you can use as a revision guide, and you will need to schedule sufficient time for revision ahead of the assessment period.

The sample papers are an excellent method of revising and can be worked through in a workshop session. As the final assessment is subject to timing constraints, you should prepare learners for this pressure and break the mock paper down into time slots and practice answers with learners. Taking a bite sized approach will allow them to focus on small pieces of assessment and build their confidence ahead of the final exam.

If you are not attempting the external assessment within the first year, you may request a copy of the examination paper as a revision resource. You could also read the Chief Examiner's reports, which contain a great deal of information in support of what went well in the exam and what did not. Finally, you should examine the banding or grading within the external exam to inform you where the majority of the marks are held and how to plan an exam strategy.

Getting started

This provides you with a starting place for one way of delivering the unit. Activities are provided in preparation for the external assessment.

Unit 3: Tendering and Estimating

Introduction

You could instigate discussion of this unit's main themes by presenting a photograph of a well-known, striking building and propose a question to learners: How do I order this building?

Learners could then debate and discuss how they could achieve this, while you collate ideas on a whiteboard to provide notes from the session.

You could then introduce the tendering process and the procedure for obtaining a price for the iconic building that you have illustrated, drawing out relevant points from the previous discussion. This debate can then be extended into the estimating process and what involves – always referring back to the iconic image.

To conclude the session, finally diversify out into the sub-contract works that would be required, e.g. facade glazing, air conditioning and so on.

Topic A – Commercial risk

- In this topic, you will examine the risk associated with the tendering of a project and its award to a main contractor. For learners to adopt the necessary strategic mind-set, you should frequently employ questions such as: What is the risk in doing the work – low, medium or high? How shall we price accordingly? How will I find a contractor to do the work?
- To introduce action on receipt of the tender documentation, learners could be placed into the context of a main contractor while you play the client. The main contractor receives a mock tender from the client and must action its receipt. You will need to place within the mock tender some errors in the information that learners should identify within the tender documentation. This could be missing drawings, specifications or pages.
- A further activity could be as follows:
  - Divide the cohort up into small 'main contracting teams'. Explain that they will be given a brief on a project that they have to decide if they will tender for it.
  - Issue the project brief to all teams and allow sufficient time for it to be read and digested. You can then start the debate, asking, 'Will you tender for this work?'
  - After a certain time period, cohorts are then given an envelope with some constrains pertinent to their company (each team's constraints should be different).
  - You should then take a poll on their decision to tender and each group can present their rationale to the class points regarding whether they would tender or not.
  - A collective summary of the session should be captured, recording all the points raised by the activity.
- Tendering considerations and strategies can be best delivered with learners compiling a flow chart (A4 format) with the content mapped from topic A2 in a vertical chart, with yes/no options. This would cover all the content aspects in a simple document, from the decision to accept or decline, right through to the tender adjudication.
- Moving on to contractual arrangements, you will need to source sample contracts guides that can then be used to demonstrate how they may influence a final tender price. Discussions with any guest speaker from a main contractor would also

provide valuable insight into how a contract affects an estimate.

- For learners to examine the supply chain, you would need to provide a set of drawings and a specification or a bill of quantities. Working in pairs, learners could then break down a simple document into the elements that will need to be 'sent out' for quotations, identifying the materials and plan elements that will need to be priced from suppliers. As an extension to this exercise, learners can be asked to research what a nominated supplier and subcontractor is, and how this is integrated into a client's tender.
- Following this, you need to look at the commercial risk associated with a tender. A detailed scenario needs to be prepared that covers a number of different factors. This could include, e.g. an inner-city project, on a very tight spaced site. The area would be subject to high crime rates, with one-way traffic routes, no available storage, time-limited access and delivery arrangements, as well as neighbours who have objected to the development. Learners could then make informed decisions on how they would price for risk and what measures may need to be provided within the tender. Obtaining a location map of such an area would provide a visual engagement for debate and tutor-led discussion, with targeted questions to learners on how they propose certain obstacles are overcome.
- To cover the factors surrounding commercial intelligence, you could benefit from dividing the group into small 'contracting teams'. Give each team some information about the other team's business strategy and position. Then, ask each team to make an informed decision on a 'mark-up' to a tender. Open up the tenders submitted for analysis and debate how they made that decision.

Topic B – Estimating

- When a decision to tender has been made, then the estimating process begins. This is the compilation of all the resources required in terms of their financial value. The delivery of this topic should be based around the pricing of a project using given information, including covering letters with qualifications on tenders for analysis and debate. Work for this topic could be undertaken in small groups.
- Topic B2 covers a site visit. This is an essential part of estimating for a project. Google mapping software could also be used for this purpose if resources for a site visit are not available or cannot be organised. A site visit will enable the estimator opportunity for assessment of the elements that cannot be seen on drawings. These elements must be considered in compiling rates – traffic congestions, obstructions, delivery time constraints and so on. Adjustments to process can then be made to reflect the additional time that these incur.
- Before learners start to assemble a tender for the mock project, some exercises that involve the calculation of labour, plant and materials will need to be provided along with output tables to enable an all-in rate to be calculated.
- You will need to prepare resources such as specification, drawings, list of subcontractors, supplier quotations, plant rates and some output tables. This does not need to be complicated and can be a simple project that contains all these elements. This will enable learners to gain an understanding of how the whole estimate is compiled into a final sum. Explanations on provisional and prime costs sums will need to be achieved and included within the estimate.
- The pricing of preliminary items needs to be illustrated for learners. You could direct learners to the first section of the NRM, which covers all the items that would be measured under preliminaries. In a tutor-led discussion, you could then debate about the unit content lists and how you would obtain prices for each item.
- Topic B4 covers the analysis of an estimate. This is the final build up that pulls all the totals together. A spreadsheet approach would be useful for this message. Some measured quantities will be needed for the project so the all-in rates can then be financially quantified against the all-in rates that learners have produced.

Topic C – Commercial decisions

- This topic covers the commercial decisions that would be made by the main contractor when the final price has been estimated and is ready for submission. This analysis would take place at the tender adjudication meeting, and you may find a role-playing approach to delivery of this content the most enlightening for learners. This would be a direct extension of the content in topic B, where the estimate that learners compiled can now be used for the final commercial decision.
  - Firstly, assemble teams and give each an estimate.
  - Give a collective guide on the commercial constraints and some intelligence that each of the tenderers must take into account for the final mark-ups on their tender. This could be, e.g. an appraisal of how busy each of the contractors is and what their specialisms are, or the capacity of your organisation to take on additional work, or the current economic climate and any government incentives that could be woven into a bid (such as apprenticeship grants).
  - Allow time for the information to be digested and debate to take place on each teams' mark-up. You might like to prompt each team as you work among them, giving advice and guidance against their bid.
  - Ask teams to submit their bid. This needs to be done in a sealed plain envelope, and you should explain why this is done. Discuss the malpractices that could occur in bidding and why an honest approach is needed.
  - Before opening bids, ask learners to present their discussions as to how they arrived at the final tender sum and what commercial decisions they had to take. This presentation needs to be in front of their peers. This is to develop speaker skills within a group, and you should explain to learners that they may often have to do this as part of the tender process.
  - Conclude with a collective summary of the session and record all the points raised by the activity.

  As the tutor, you will need to prepare for each team the constraints and commercial considerations that you are going to give them. This needs to differ for each team, so healthy debate ensures as a result. All of the bids will be different, which reflects the real-life situation when contracting.

  Revision workshops and mock exam sessions are essential for this externally examined unit. You will need to download and make use of the Sample Assessment Materials that are published on the Pearson website. Several sessions will be needed, so that learners can build up confidence in reading and absorbing the information before carrying out the calculations.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- Unit 13: Measurement Techniques in Construction
- Unit 19: Quantity Surveying
- Unit 22: Economics and Finance in Construction
- Unit 24: Planning Application Procedures in Construction
- Unit 26: Conversion, Adaption and Maintenance of Buildings

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Institution of Civil Engineers, *CESMM4: Civil Engineering Standard Method of Measurement*, ICE Publishing, 2012 ISBN 9780727757517 – The standard method of measurement for civil engineering works

Topliss S, *BTEC Nationals in Construction*, Pearson, 2017 ISBN 9781292184043 – A textbook that has been written to reflect each unit's content in detail

Websites

http://www.jctltd.co.uk/ – The Joints Contract Tribunal website

http://www.rics.org/Global/Cost_analysis_and_benchmarking_global_1st_edition_PGguidance_2013.pdf – A professional-level introductory guide to cost analysis and benchmarking guidance

https://www.rics.org/uk/knowledge/professional-guidance/guidance-notes/new-rules-of-measurement-order-of-cost-estimating-and-elemental-cost-planning/ – Link to download the New Rules of Measurement 1, 2 and 3

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 4: Construction Technology

Delivery guidance

Approaching the unit

Your focus during delivery of this unit will be on forms and methods used in the construction of low-rise buildings along with associated external works. This unit is mandatory for all qualification sizes, and throughout the delivery, you should (where possible) relate the content of this unit to the relevant units across the qualification, which will help to motivate learners.

You should utilise site visits in the delivery of this unit, as this will enable learners to develop their understanding of the key elements, processes and materials being used. The number and frequency of such site visits would vary according to your delivery schedule and availability of site(s).

Tutor-led delivery of the topics can be enhanced by the use of illustrations, images, animations and video clips to explain construction forms and processes, as well as external works, including drainage, roads and footpaths. Such resources are often freely available online, and you may find your construction learners engage well with these resources over other delivery approaches.

This unit allows plenty of opportunities to forge links with local businesses. You could invite guest speakers – either from your local council, building firms, utility companies or design consultancies. Learners will be interested and inspired to hear first-hand about the current practices from local professionals.

Learning aim A is about construction forms of low-rise buildings. It introduces framed, traditional and modular forms typically used for low-rise buildings. The focus is to develop an understanding of their suitability for a given project scenario.

Throughout delivery, engage your learners with knowledge quiz, paired/group activities, class discussions and presentations as these provide opportunities for peer learning in addition to motivating the learners.

You may wish to introduce various construction forms using animations, DVDs, pictures, illustrations or web-based videos – some suggested resources have been provided. With the basic principles understood, you can then follow up with more in-depth group activities and class discussions, such as learners supplying the rationale behind the specific construction forms that have been used in a given scenario.

Further activities to explore could include an interactive Lego game on modular construction, or independent research and small group presentations on various forms of low-rise construction.

Learning aim B is about foundation design and construction including site investigations, design principles and foundation types and combines research and practical tasks – such as investigating the subsoil conditions of a site with a detailed desk study and walkover survey. You would require access to project drawings, especially related to component details, as well as site investigation data to be used as learning resources. You could contact the construction companies who are always willing to help.

Invite a guest speaker who could be a geotechnical design engineer, structural engineer or technical staff working at the local council. The guest speaker should be able to share with learners some examples of design principles currently in practice.

Learners will need to consolidate their knowledge on the many considerations of foundation design and construction and the use of case studies can present an interesting problem-solving challenge for learners. For example, you could task learners to explore the impact of building regulations on foundation design for a number of given scenarios.

A well planned site visit will provide a useful means of delivery for learning aim C, which is about the construction of superstructure. You should ensure that the appropriate safeguards are in place during the site visit. Coordinate with the site staff before the visit so that all parties are aware of the learning opportunities during the visit. Reinforce this learning in class using project drawings, especially related to component details.

Learning aim D is about the external works associated with construction projects. You could use the same site visit to deliver part of this learning aim related to roads and footpaths. A guest speaker – a services engineer or professional from a utility company – could give learners an informed presentation, drawing on their experience and the interesting challenges faced.

To provide access to additional case studies about sustainable drainage systems, you could either approach companies for this information, or download examples from the web using the suggested web links. In addition to the above, you could use class discussions and group research activities to deliver this learning aim.

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Issue 1 – June © Pearson 2017

Assessment model

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** Sustainable urban drainage systems **D2** Foul and surface water drainage **D3** Utility services **D4** Roads and footpaths	A report for a given project scenario that covers the design and construction of the external works, including the incorporation of sustainable drainage systems

Assessment guidance

This is an internally assessed unit, with a maximum number of three summative assignments: Assignment 1 covering learning aim A, Assignment 2 covering learning aims B and C and Assignment 3 covering learning aim D.

The assignment briefs should be set within the context of a construction project, such as a housing development. For Assignment 1, you should provide adequate details about the client requirements so that learners could carry out suitable evaluation. For Assignment 2, you should include – in addition to the above – site investigation and component details. Ensure that client requirements include external works details for Assignment 3.

Submitted assessment evidence could be in the form of a project report and a presentation. You could also ask learners to include sketches, illustrations and a list of information sources used.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 4: Construction Technology

Introduction

Introduce learners to the unit using animations, DVDs, pictures, illustrations or web-based videos relating to various construction forms. Engage your learners during delivery through knowledge quiz, paired/group activities, class discussions and presentations as well as through site visits and guest speakers.

Well organised site visits – where learners can see both substructure and superstructure as well as external works – are invaluable to the delivery of this unit. They will need to be timetabled carefully to ensure learners have sufficient knowledge across the learning aims to fully benefit from the experience. They could also be done in conjunction with other unit site visits requirements.

You would need to coordinate with the site staff to ascertain:

1 Health and safety requirements
2 Type of project
3 Construction stage
4 Extent to which site staff could engage (project presentation, access to drawings, site investigation data, design data).

Learners could prepare checklists before the visit so that they can record details of elements, components and processes.

If finding appropriate sites proves difficult, you could instead use project examples through DVDs or other project data.

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

- You could introduce this topic with a tutor presentation, showing images/illustrations demonstrating various forms of low-rise construction. This would allow you to then engage learners in class discussion, asking them about the advantages of using a certain construction form.
- The use of DVD/web-based video resources could enhance a presentation on framed, traditional and modular construction forms. You could then task learners to work in pairs to summarise the advantages of using various types of construction forms. Points could then be fed back to the class for group discussion.
- Knowledge quiz as a paired activity: use this as a learning check, share the answers and ask learners to do self-assessment of their work. Explain any questions learners have.
- Working in small groups, task learners to justify the selection of construction forms suitable for modular, traditional and framed construction. The groups could present their reasoning to the class.
- Based on the result of group activity, initiate a class discussion about the suitability of construction forms and associated materials. Draw upon the key points and explain any questions learners have.
- Discuss with class how such evaluation could be presented in a report to the client.

Learning aim B – Examine foundation design and construction

- Introduce learners to the importance of data and information, which is to be used for foundation design, explaining concepts such as bearing capacity and subsoil classification. To help learners understand its significance, you could look at

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Issue 1 – June © Pearson 2017

various case studies of construction projects that have suffered due to errors or inaccuracies in the application of such data.

- In a tutor presentation, using video resources as appropriate, provide learners an overview of various site investigation methods. Introduce the techniques to improve the bearing capacity of the ground and various foundation types.
- Following this, learners could work independently looking at examples of investigation data to allow them to develop their understanding of the information and its use. To consolidate their learning, they could summarise findings in a brief report of the possible advantages and disadvantages of various investigation methods.
- In a paired practical activity, learners could carry out site investigation, first in a desk study followed by a walkover survey, and identify any evidence of soil shrinkage, ground heave, differential settlement and effects of tree growth and tree removal. Ask learners to share their results with the class, and in a tutor-led discussion summarise findings and highlight any variations.
- Working in pairs or in small groups, learners could investigate and then present various methods of subsoil improvement.
- For an individual activity, give learners foundation sketches and ask them to re-draw one of these and examine its characteristics and the various elements of a foundation.
- Following this, bring learners together in groups (such that each member has a similar foundation type). Ask learners to discuss among their group members details of foundation, materials used, potential advantages and disadvantages, and factors affecting choice of each foundation type. In a tutor-led discussion, ask groups to share their findings and draw upon the key points raised.
- You will need to introduce learners to Building Regulations, Part A. In a tutor-led activity, you could run through the relevant sections of this document with learners before setting them a number of worksheet-based activities to check parameters such as width and thickness of foundations and overlaps.
- You could invite geotechnical design engineers, structural engineers or technical staff working at the local council to share with learners some examples of design principles currently in practice. Prior to the visit by the guest speaker, prepare learners to ask questions to ensure they maximise this opportunity.

Learning aim C – Examine superstructure design and construction

- The second assignment will cover both learning aims B and C, so you may wish to restate the expectations for this report with your learners.
- This learning aim would benefit from a site visit for learners to examine both substructure and superstructure. If a visit is not possible, targeted use of online resources and video clips can enhance tutor-led presentations and classroom-based activities.
- To establish learners' prior knowledge, you could lead discussion on common types of construction methods and materials used. This could take the form of interactive brainstorming activity with the learners working together to compile lists and categories (using flipcharts, or sticky notes for example).
- Engage learners in a class discussion about details, finishes and performance requirements of external and internal walls and partitions, floors and roofs including pre-fabricated construction. You could compare the traditional versus new technologies, e.g. new building envelope technologies/cladding that may provide advantages in terms of cost and energy efficiency performance and/or use of pre-fabricated panels, as you have specified for learning aim A with other modern methods. You should draw on key points and summarise.
- Working in small groups, you could task learners to investigate a particular ground or intermediate floor type. Providing them the detailed drawings, learners could

then further research and prepare presentations for the class on construction methods and techniques, materials used, support, detailing, finishes, performance requirements, advantages and disadvantages.

- In a similar format, you could allocate small groups of learners a particular roof type to investigate and present back to class. Presentations should be made accessible to the whole class via the VLE or a group server.
- In a final consolidation exercise, the class could collaborate to evaluate the construction of a new low-rise building, which has been constructed with new technologies such as building envelope technologies/cladding and how much cost saving it has realised (both in construction and ongoing energy costs). Allocate each group a specific area covered in this learning aim. Ask all groups to use the site visit data as well as their own research to present their findings. You would lead a whole group discussion sharing their findings, draw on key points and summarise.
- There is an opportunity to holistically deliver this content with *Unit 2: Construction Design*, when discussing sustainability in the design/manufacturing process and the associated technologies.

Learning aim D – Examine external works associated with construction projects

- A site visit to examine external works would ideally be incorporated earlier in the unit. Learners should prepare checklists for the visit to record details of the external works.
- A tutor presentation could introduce learners to the differences between separate and combined drainage systems, along with the associated advantages and disadvantages of each system. You could then move onto group work and discussion activities around detailed layout and component drawings for these systems.
- You could invite a guest speaker who is either services engineer or from a utility company background, to present to class. The guest speaker should cover some real-world examples of utility services in terms of their layout, depth, colour coding of ducts, positioning, and building entry of water, gas, electricity and telecommunications. Prior to the visit by the guest speaker, prepare learners to ask questions to ensure they maximise this opportunity.
- Moving on, you could split the class into groups and allocate each group a research topic related to roads and paths. Ask all groups to consider construction methods and techniques, materials used, edge details, performance requirements, specifications and finishes. Ask all groups to use the site visit data as well as their own research to present their findings.
- The groups could share their findings with their peers and you could facilitate collation of summary and key points and summarise.
- A tutor presentation, incorporating suggested resources and online videos, could help to emphasise the significance of sustainable urban drainage systems, both in environmental terms and cost implications. Discuss the various methods used for both temporary storage and that allow water to percolate, encouraging learners to identify their characteristics, advantages and disadvantages.
- Following this introduction, you could assign each small group a specific sustainable urban drainage system to research, considering methods, use, characteristics, advantages and disadvantages of using such systems. Following feedback of findings from the groups, you could then lead a class discussion to summarise key points and collate information for class reference.
- Allow time in the teaching of this learning aim for discussion with learners on the related assignment.

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Issue 1 – June © Pearson 2017

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- 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 Construction

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Chudley R and Greeno R, *Building Construction Handbook* (11th Edition), Routledge, 2016 ISBN 9781138907096 – this handbook has been used by construction learners over number of years. It covers construction forms, processes and external works in a concise manner.

Chudley R, Greeno R, Hurst M and Topliss S, *Construction Technology* (5th Edition), Pearson, 2011 ISBN 9780435046828 – this book provides excellent illustrative content and some useful descriptions that are very relevant to the unit.

Pitman P, *External Works, Roads and Drainage: A Practical Guide: A Practitioner's Guide,* Taylor and Francis, 2001 ISBN 9780419257608 – this book provides a practical and hands-on learning to understand external works.

Smith R and Timberlake J, *Prefab Architecture: A Guide to Modular Design and Construction,* John Wiley & Sons, 2011 ISBN 9780470275610 – a very good resource to learn not only about modular buildings, but also about pre-fabricated ones.

Journals

Construction Manager (The Chartered Institute of Building) – this journal contains updates on construction projects, methods and materials – see also http://www.constructionmanagermagazine.com/

Journal of Green Building (College Publishing) – the journal addresses sustainability, new materials and modern methods of construction – see also http://www.journalofgreenbuilding.com/

Videos

This video has details of timber frame construction (https://www.youtube.com/watch?v=65T20dQpOT8)

This video has details of load bearing and frame structures (https://www.youtube.com/watch?v=UzOg83hc95Q)

This is a good resource to understand portal frame construction

(https://www.youtube.com/watch?v=g6sSbazsyLw)

This video explains the construction of a building and is a good resource for explaining construction processes
(www.youtube.com/watch?v=NYCOwue0bMQ&feature=related)

These videos explain the modular construction techniques
(https://www.youtube.com/watch?v=QdovakVUkaw)
(https://www.youtube.com/watch?v=cDeoN9COb4Y)

A video resource explaining site investigation techniques
(https://www.youtube.com/watch?v=MtkfI5G_jbY)

A video resource for vibro replacement
(https://www.youtube.com/watch?v=bh7TieIxrWE)

This is good resource for raft foundations
(https://www.youtube.com/watch?v=Ztq2cPstbo0)

These are resources to understand pile foundations and their installation
(https://www.youtube.com/watch?v=C1byOuqC684)
(https://www.youtube.com/watch?v=6OAHO9zgeXM)

A resource to help understand internal wall construction
(https://www.youtube.com/watch?v=uZHcWUU-FbQ)

Websites

http://www.buildoffsite.com/ – the website is owned by Buildoffsite, an important and respected organisation promoting all types of offsite construction, including modular and prefab. The website contains wealth of information and industry updates.

www.the-self-build-guide.co.uk/house-construction-methods.html – the website owned by the-self-build-guide.co.uk, explains traditional and modern construction processes in a structured way.

http://www.yorkon.co.uk/?gclid=CNyIztnNltECFe4Q0wodyWUMFw – this Yorkon website is an excellent resource for modular construction.

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Unit 5: Health and Safety in Construction

Delivery guidance

Approaching the unit

This is a mandatory unit across all qualifications in the suite and covers the vital part that health and safety play on a construction site. The necessary use of temporary structures on construction sites requires that the many associated hazards are assessed and the risk evaluated in accordance with the governing legislation.

A hands-on engaging delivery of this subject is essential to get the safety message over to learners. The use of actual health and safety case studies and reports would provide an initial starting point for discussion and debate. Learning through errors made in health and safety highlights the serious nature of health and safety provisions on construction sites. Newspaper reports and construction publications provide access to such stories and features.

Throughout delivery of this unit you will find the Health and Safety Executive (HSE) is a valuable resource that you can access for free with many publications, features and safety information. This has been highlighted in the Resources section for this unit.

Delivering the learning aims

Learning aim A

Learning aim A covers the main health and safety legislation in the UK and introduces learners to the primary act of parliament – the Health and Safety at Work Act 1974 (HSWA1974). Interactive delivery, such as role-play activities, paired work or small group activities, would give learners a positive way to engage with the legislation.

Topic A2 covers the Construction Design and Management Regulations 2015 (CDM). These are a set of complex regulations. Access to guest speakers would promote and inspire learners to meaningful debate on the regulations, so they consider what is notifiable and how to comply to avoid sanctions and prosecution.

The Management of Health and Safety at Work Regulations 1999 (MHSW) are generic and apply to all industries, so you will need to focus on the construction-specific aspects outlined in the specification. This content could be explored in small group work, with each group taking on one of the five sections listed, to prepare and deliver a presentation of their findings to the class. These presentations could prove a useful resource to learners and could be made available on a shared server.

The Working at Height Regulations 2005 (WAH) could be delivered using a case study for which learners would have to provide a full risk assessment, detailing the control measures that are required to reduce the risk of working at height to an acceptable level. You could ask your centres' health and safety manager to provide feedback on the learner proposals and whether they offer practical and reasonable solutions to mitigate risk.

Regulations on the Control of Substances Hazardous to Health (COSHH) can be delivered in small group activities, each group analysing a product typically found in construction work. Learners could research the manufacturer's website to find the safety data sheet for their given product and consider the implications for PPE, operative training or specific instructions from the manufacturer, for a

COSHH risk assessment (obviously, you will need to issue warnings that their product must not be opened or tampered with for this exercise).

Topic A6 covers training and education, which you could approach with tutor-led discussion, scene setting an operative on a construction site and asking a basic question, such as 'How can I prove competency of this person'. This should draw out the qualifications and training aspects of such discussion. To promote some independent research, you could task learners to investigate the 'CSCS' card and the general 'Safety Passport' and ask them how to become qualified on each. This would draw out several issues once they start their research. Collate these issues on the whiteboard and ask them to find solutions to meet compliance.

Learning aim B

Learning aim B covers safe systems of work (SSW) for construction operations, initially looking at the preparation that is required to start up a construction project. An ideal method of delivery for this would be to arrange for a site or contracts manager to talk to learners. This would provide valuable information on the setting up of a site, the documentation that is required and who is to be notified.

You can then move onto the construction phase health and safety planning. A brief detailing work within a specific location would provide an ideal delivery vehicle for learners to design an SSW. You could also task learners to formulate a site induction for a main contractors site, presenting their work in a slide presentation (or a similar format). The use of hazard checklists and video resources for risk analysis will also provide useful material for learners to test their understanding.

Topic B3 covers the health and safety file (a requirement of CDM Regulations 2015) that is handed over to the client at the end of the contract. Demonstration of existing files is useful and gives learners good understanding of what is contained within such a file.

Learning aim C

The first section of learning aim C covers accident-reporting procedures. A formal definition of the classification of accidents could be obtained by learners researching the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). Delivery could then follow with an activity for learners to classify types of accidents you have listed for them. Your centres' health and safety officer could provide a talk on accident reporting to highlight the importance of procedures being followed in the event of an accident. Examples of accident forms, of correct reporting procedures in accordance with RIDDOR, and how the HSE are informed would also prove beneficial.

Topics C2 and C3 cover the reviewing of health and safety systems. Use of accident statistics, example risk assessments, review of control methods and product safety data can all help develop learners' ability to analyse information in order to seek improvements to existing safety systems. Delivery on the benefits of undertaking reviews could be achieved by providing learners with a case study on how injuries have been reduced and what benefits this produced for the organisation.

Assessment model (in internally assessed units)

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

Assessment guidance

You could break down the assessments into two or three sections. The first would cover the theoretical elements of the legislation and regulations covered in learning aim A. The second and third assignments would cover risk assessments followed by a review of safety systems; these areas could be combined or captured in separate reports.

There is no requirement for any special resources for the assessment material, apart from access to the internet to research and obtain resources. Local environments or local construction activities visited can be used for scene setting for the hazard and risk assessments. You could provide health and safety case studies, of which there are many published examples available. Start with the HSE website, which has a lot of information and links.

Learners could undertake presentations as part of the assessment evidence for the first assignment to demonstrate their interpersonal skills, knowledge and behaviours (as targeted in topic C4). The safety survey and evaluative report would follow standard formats for evidencing the assessment criteria. Remember that the assessment method recommended is in a report format, and the findings from this review will need to be written into such a document as recommendations that have been drawn from the review of the risk assessment held in an appendix.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 5: Health and Safety in Construction

Introduction

This unit covers three key areas – legislation, SSW and closing the safety cycle through review of all systems.

Legislation tends to be 'heavy' in its use of technical language; therefore, guides should be sought to help that dissolve language down to level 3, where by learners can understand how the law is applied. There are many summaries for legislation that are published (some examples are listed in the Resources).

The HSE is your bible in regard to health and safety guidance, and they publish many resources that can be used to engage and motivate the understanding of health and safety within a construction context.

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

- You could introduce this unit with a tutor presentation and refer to the PDF of the original HSWA1974 to demonstrate that this primary piece of legislation has not been altered, but is the basis on which all the regulations have followed.
- To get learners further engaged with the HSWA, you could set up a role-play group exercise. You could divide the cohort into employees, employers, self-employed, designers and manufacturers and, in the context of a scenario project, ask each group to discuss their duties under HSWA considering every aspect of the project, from design, manufacturers of equipment, operations on-site as employees, the self-employed and the main contractor as an employer. Groups could then present their findings to give the whole class an overview of the legal position regarding safety consideration for all operatives on a construction site. Alternatively, learners could produce an explanation leaflet for employees starting on a site that outlines the responsibilities under the HSWA for both them and their employers.
- Non-compliance with the HSWA and the associated penalties is best delivered through research on the litigation section on the HSE website. Learners can review cases here that have been prosecuted along with the fines and sentences levied.
- The Construction Design and Management (CDM) Regulations 2015 is a very technical piece of legislation. You should direct learners to the HSE website, which contains publications on the duties of all the parties to a contract. These are very useful resources and contain summary explanations of the regulations. There is also an Approved Code of Practice (ACOP) that accompanies the CDM Regulations, explaining how to apply the regulations to a construction project using a language that an uninformed person would understand.
- The CDM Regulations are best delivered by a guest speaker, such as a designer, CDM coordinator or planner, who can present learners with details of how to comply with the regulations. The contracts manager from a main contractor could provide the on-site application side of the regulations to be contrasted with the design aspects. Also, the estates office of your centre may have the resources to facilitate this, especially if you have had a large construction project on the site.
- The Management of Health and Safety Regulations could be delivered using an independent learner task. To develop learners' understanding of the provisions under the MHSW Regulations, ask them to consider what the following mean in terms of construction:

- risk assessment
- arrangements
- cooperation
- coordination
- capabilities
- training.

Learners should research and provide definitions of each of these in terms of the regulations, with examples cited against each that are specifically construction related.

- All the legislation covered in this section can be evidenced by learners within a presentation. This should contain a couple of slides on each regulation and include details on the roles and responsibilities for all parties associated with a construction contract. Further slides can detail other regulation requirements.
- The Working at Height Regulations could be introduced with a review of construction accident statistics related to working at height. Delivery could then take the form of a scenario-based activity based upon work to be undertaken at height on a construction site (this could be as simple as giving learners a photograph of an aspect on site to be conducted at height). Task learners to recommend a method of undertaking the work and how they will reduce the risk. Learners should also identify the employee and employers' duties associated with the construction activity and produce a method statement that details all personnel's responsibilities, the precautions to be taken and the PPE required (you will need to make sure that every aspect of the content under topic A4 can be covered within the provided photograph or source material, e.g. provision of a working platform).
- The COSHH regulations can be covered by giving learners a chemical product commonly used on a construction project. You can then ask them to evaluate it in terms of the precautions that need to be taken, employer's duties, health surveillance and so on. This evaluation could be produced in the form of a risk assessment that covers the control measures for the product.
- An alternative to the risk assessment activity could be the production of a safety guidance leaflet that could be used by operatives prior to using a chemical product. Working a review into this for topic C3 could be, e.g. a change in the product used as part of the installation process and a revision that is then required to the COSHH risk assessment.
- Training and education could be delivered through a task that investigates 'How can you become a competent person on site?'. Learners could then research the following areas:
  - qualifications
  - training – off site
  - training – on site.
- Both the CSCS and Safety Passport websites contain details of what their schemes entail and how to obtain this qualification through training. You could task learners, working in small groups to apply for a different classification of CSCS card, e.g. an operative and a Contracts Manager. In a class discussion, learners could then compare the requirements and see what the differences are.

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

- The SSW covered in this learning aim includes site preparation, CDM applications and safety documentation. A main contractors' health and safety representative, or a site manager, would be an ideal guest speaker to assist the delivery of SSW. You would need to brief them to concentrate on the systems to be in place before work

commences, such as the preparation to be completed prior to F10 submission – as outlined in topic B1.

- A number of additional delivery methods for this aspect could be employed as follows:
  - requesting a copy of a site induction video from a main contractor. This could then be played to the cohort and examined for compliance with health and safety legislation in a tutor-led discussion.
  - learners to download the F10 HSE forms and work in pairs to complete an F10, with the project information supplied by you acting as the client or main contractor.
  - learners to review the environmental agency's guidance on site waste management; a link has been provided under Resources.
  - reviewing the formal safety notices that are posted on a local site's gates and access points through photographs.
- Topic B2 covers the construction phase health and safety plan. This is a mandatory requirement under the CDM Regulations and has to be in place before work commences. The content under topic B2 in the unit specification lists the main items that are included within this safety plan. If you can obtain a copy, then run through the contents page so that learners get an understanding of what aspects have to be included.
- The following methods can be used for the different aspects of the content to provide engaging delivery and assessment:
  - In a tutor-led activity, you could present photographs of construction sites taken from the internet and displayed on the whiteboard, to draw out the different methods of identifying hazards that could be used besides direct observation. Non-visible methods could be drawn out from this discussion, e.g. use of checklists, toolbox talks and so on.
  - Arrange a site visit either at a local construction site, or at your centre to an area where construction activities will take place (e.g. replacing a manhole top on a main access road). Task learners to write a risk assessment and method statement for the operation.
  - Provide a video of a construction activity and instruct learners to produce written method statements and risk assessments for this activity.
  - Learners are to consider fire and evacuation procedures. Ask them how a construction site would implement a fire evacuation procedure. What alarms would be required?
  - Obtain a copy of a toolbox talk from the HSE website, and ask learners to evaluate its effectiveness in getting the message over.
  - Review an example site meeting agenda and to demonstrate how health and safety is recorded.
- Learners could research waste generated by construction projects, and its potential harm to site operatives. They could also consider the effective methods of waste management and recycling options for a given scenario.
- Moving on to cover the health and safety file, you may find the best method of delivering this is to obtain an example of the contents index. Learners can then expand upon the inclusions that must be provided within the file, detailing what should be included within each section. Alternatively, you could borrow a health and safety file from an existing project. These tend to be substantive, but it would give learners an idea of how a project's HSF is put together. Learners should also have access to a completed risk assessment and method statement for a real project, to show them what they will look like in reality. They could use this to suggest control measures to implement and hold a discussion on how to improve this in future.
- 'As-built' drawings form part of the CDM health and safety file so the term 'as-built'

needs to be explained to learners. This should include an explanation of the recorded drawn information that is amended each time a variation occurs to the original design drawings.

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

The first topic covers the classification of accidents, which is undertaken using the RIDDOR reporting system. Direct learners to the website, and ask them to investigate what classifications of accidents should be recorded against. Get them to complete a table with a classification type and an example for each one (e.g. the classification 'near miss' and 'falling material from a scaffold that did not injure any site operatives'). This simple table then covers all four of the major classifications that are formally used for reporting procedures.

- The following activities would provide learners an ideal vehicle to understand the use of health and safety data and how to spot trends along with making recommendations to reduce accident rates:
  - providing a set of accident statistics (sourced or created by you) and asking learners to review in terms of any training needs that the statistics highlight
  - providing some mock safety data – this could be in the form of the number of accidents to hands and feet on a site during a year – and have learners make recommendations to reduce this frequency.
  - analysis of your centres' accident data from the health and safety department, for learners to evaluate trends and make recommendations.
- Topic C3 is about how to implement changes to safety systems and processes. In a tutor-led discussion, you could initially question learners as to why a process or procedure might need to change.
- Learners could then take some of the risk assessments that they had undertaken within learning aim B and apply some variables to the processes examined. Learners could then review these risk assessments in light of the changes.
- Give learners a risk assessment for an activity undertaken in normal working hours, and then ask them to revise it, as the work will now be undertaken at night. Outcomes could be shared in a class discussion.
- Change a company strategy and ask them to review a policy document. This could be the policy on smoking on a construction site, which is now off site!
- Learners could conduct a comparison of a manufacturer's new product against an older one. They should assess in terms of the safety data sheets for both products, identify changes and what aspects can be carried into further control measures.

  For further analysis of control measures, provide a reasonably practical measure for an activity, and then ask learners to make it safer within a cost budget.

  Delivery of topic C4, to develop learners' professional skills, knowledge and behaviours, can be ongoing throughout this unit as learners carry out group activities. Also, presentation skills can be refined when used to produce the evidence against each assessment criteria. Witness statements and or observation records would prove useful here to record 'behaviours'.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This standalone unit has links to other units in terms of understanding how construction technology is installed and the temporary systems that are required to be safe during the installation.

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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

HSE, *Health and Safety in Construction HSG150*, HSE, 2006 ISBN 9780717661822 – Download a free copy at http://www.hse.gov.uk/pubns/books/hsg150.htm

HSE, *Managing Health and Safety in Construction*, HSE, 2015 ISBN 9780717666263 – Download a free copy at http://www.hse.gov.uk/pubns/books/l153.htm

Hughes P and Ferrett E, *Introduction to Health and Safety in Construction*, Routledge, 2015 ISBN9780415824361

Topliss S, Hurst M, Cummings S and Donyavi S, *BTEC Nationals Construction Student Book + Activebook*, Pearson, 2017 ISBN 9781292184043 – The core book that accompanies the BTEC Nationals in Construction

Videos

A time lapse of a complete build that can be stopped and started (https://www.youtube.com/watch?v=chLRrSru55Q)

Construction-related activity (https://www.youtube.com/watch?v=oHrbEv9ZNR4Safety induction video)

Construction Site Health and Safety – 5-minute video (https://www.youtube.com/watch?v=vkohCmK3mrA)

Turning concern into action – statistics of construction-related injuries, personal accounts of accidents and long-term effects of injuries (http://www.hse.gov.uk/construction/resources/turning-concern-into-action.htm)

Working at height video (https://www.youtube.com/watch?v=Kwh8wGWLMrs)

YouTube channel to support CSCS Health & Safety Test for Operatives (https://www.youtube.com/channel/UCxaJmuoc47SkFB1kn6_BDOw)

Websites

http://www.hse.gov.uk/ – The Health and Safety Executive's website, which publishes lots of free publications and resources and statistics, including:

- Resources
  - A step by step guide to COSHH assessment (http://www.hse.gov.uk/pubns/priced/hsg97.pdf)
  - A useful HSE site. Useful for topic B on developing SSW (http://www.hse.gov.uk/pUbns/priced/hsg150.pdf)
  - Free guidance summary on the CDM Regulations published by the HSE (http://www.hse.gov.uk/pubns/books/l153.htm)
  - http://www.hse.gov.uk/construction/resources/index.htm
  - Managing for health and safety (http://www.hse.gov.uk/pubns/priced/hsg65.pdf)
  - Working at height (http://www.hse.gov.uk/pubns/indg401.pdf)
- Toolbox talks and safety inductions
  - http://www.hse.gov.uk/construction/induction.pdf
  - http://www.hse.gov.uk/construction/resources/toolboxtalks.htm
- Incident reporting
  - https://www.hse.gov.uk/forms/incident/index.htm
  - http://www.hse.gov.uk/riddor/report.htm
- Health and safety statistics
  - http://www.hse.gov.uk/statistics/
  - http://www.hse.gov.uk/statistics/pdf/fatalinjuries.pdf

https://www.cscs.uk.com/card-finder/ – Applying for CSCS card

http://www.citb.co.uk/cards-testing/construction-skills-certificate-scheme-cscs/ – Construction Skills Certification Scheme (CSCS)

https://data.gov.uk/dataset/construction-notifications-form-10-f10-database – F10 database

http://www.citb.co.uk/cards-testing/health-safety-environment-test/ – Health and safety test from Construction Industry Training Board (CITB)

https://www.gov.uk/topic/environmental-management/waste – Including landfill aspects of waste management, and recycling of waste

http://www.safetysignsupplies.co.uk/search/signs-by-business/building-sites-trades/ – The range of safety signs that can be displayed on construction entrances

http://www.legislation.gov.uk/ukpga/1974/37/contents – The UK Government website for legislation; this is the HSWA 1974.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 6: Surveying in Construction

Delivery guidance

Approaching the unit

This unit gives learners a great opportunity to get out of the lecture room and into the field to undertake practical surveying tasks, before then developing their skills in the production of accurate survey drawings. Through the high percentage of fieldwork and drawing in this unit, learners will be engaged by the practical application of the theoretical elements that they must master.

Interactive demonstrations that allow learners to get hands on with surveying equipment will offer the best means of delivery. Learners will also need plenty opportunity to use the equipment in practice tasks, which will build up their understanding of the booking of information and how to record this correctly.

Accuracy is a skill that learners will develop as they learn to read and interpret measurements. Calculations will need to be presented and demonstrated in class, accompanied by set tasks for learners to test and reinforce their learning with tutor support. Such exercises should always apply to the survey, so learners understand what they are doing in a site engineering and design context.

You will need to source a site or location that will provide areas that can be used for linear, levelling and angular surveys. Sloping topography is ideal for such situations, as it adds to the degree of complexity required at this level. You must ensure the location chosen should be free from any hazards or risks associated with undertaking practical surveying activities.

You will find group work essential for the practical fieldwork, due to the nature of the surveys that are to be undertaken. Learners will therefore need to annotate their initials against any measurements that they take within group work and evidence of learning can be reinforced by witness or observation records.

Access to a range of surveying equipment – tape measures, ranging poles, automatic levels and theodolites, for example – needs to be considered regarding access, calibration and currency.

Delivering the learning aims

Learning aim A

Learning aim A covers the theoretical knowledge that learners will require before undertaking any practical fieldwork exercises. This can best be delivered through your demonstration of the techniques that underpin linear, levelling and angular measurement. Working through these topics in order will allow learners to progressively learn how to correctly read a tape measure, then use a level, and finally a theodolite, which may be a less familiar item to them.

Many different delivery methods could be used for this. For example, you could begin with a practice linear survey using three lines to form a triangle. You would then explain by demonstration the recording along one line and task learners to then practice the measurement and recording along the other two lines. Learners would benefit from working in small groups during this activity, which would allow opportunity for your feedback and correction, if required.

Learners should be encouraged to research instructional videos online – of which there are many. You could also arrange a site engineer to come as a guest speaker, to explain current industry practices. Learners would value this insight, and it may also enable further employer engagement and support, such as

providing opportunities for site visits for learners to observe site engineering activities.

Learning aim B

Learning aim B is the main practical element for the unit. This is delivered using an appropriate plot of land that will contain enough topography for linear, levelling and traverse surveys. You need to select this so all three areas can be accommodated without having to transport equipment too far and without any risks.

The first practical is a linear survey. The linear survey needs to pick up sufficient detail, such as, trees, bushes, footpaths, kerb edges, buildings and other structures. Placing the survey stations is the key to achieving this so each survey line picks up sufficient detail. There are no systematic checks required upon equipment as standard tape measures are used. These could be checked and maintained by learners to remove dirt so they can be easily read.

Learners will then need to carry out a levelling survey in an area that has a suitable range of topography for them to produce a set of cross-sections. Learners will be booking levels in the correct position in order to calculate reduced levels accurately, so the development of maths skills and interpretation of processes is essential here. The ability to read a staff accurately is also essential. Finally, learners will move on to practice the use of a theodolite and develop the skills required to read angles. The prerequisite to this is learners understanding of the use of degrees, minutes and seconds in the measurement of horizontal angles. You will need to show learners how to use this function on a scientific calculator and explain the issue around 360 degrees, which is also zero. Setup on site of a suitable traverse network of at least five stations will be required here.

Learning aim C

The final learning aim covers the production of the drawings resulting from the fieldwork surveys. This has links with *Unit 7: Graphical Detailing and Drawing*. The use of conventions employed in survey drawings can be illustrated by providing examples for learners to view and use for their drawing production. Online videos may also provide additional examples and instruction for those learners that require it. You will need to guide learners on the appropriate scales to use, dependent upon the size of the practical exercises undertaken. You will also need to decide on the size of media to use (A3 or A2) and which would be most suitable for the large sections and the drawing of contours. The use of computer-aided design (CAD) software can also be considered for the production of some of the drawing elements for those learners who have sufficient prior experience in its use and application to surveying.

Assessment model (in internally assessed units)

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 undertaken 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 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	

Assessment guidance

The assessment needs to be split into two parts. The first would cover learning aim A and the theoretical knowledge that learners require to undertake the practical tasks. The format for this assessment for learning could be formal report that explains the techniques, equipment and processes to record linear, levelling and angular surveys. Extensions can be added to explain how errors occur within each survey and the evaluation needs to outline the advantages and disadvantages of each method, process and technology used for each survey. A table within the report would be an ideal vehicle to achieve this.

The practical assessment will cover the learning aims B and C assessment criterion. Observation records should be used to evidence performance on equipment checks and adjustments. A survey book could be provided to record all three surveys within one document, witnessed by you.

The production of drawings will require graphical detailing resources for the three surveys, which will need to be drawn on paper with standards in accordance with BS1192 – for example, a border, scale and title block.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 6: Surveying in Construction

Introduction

This is a very 'hands-on' unit, and from the outset, you should get learners to hold, handle and experiment with the surveying equipment. This can be done effectively by:

- demonstration by the tutor
- practice sessions by learners and feedback from tutor
- assessment sessions.

Following this sequence will develop learners' independent skills and prepare them to undertake a variety of surveys used in construction.

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

- This learning aim is focused on introducing learners to the theoretical principles fundamental to the surveys to be studied. It is recommended that you approach the theory in the three distinct areas, taught in succession: linear, levelling and angular knowledge. Throughout delivery, you will find the use of textbook resources a good way for learners to absorb this knowledge, findings from which can then be shared in group discussion.
- An interactive, hands-on approach with the instruments will be of great value for learners as you demonstrate the setup and correct operation of equipment. Opportunities to engage equipment suppliers could be explored for demonstrations of the current range of surveying equipment.
- You will also need to ensure learners are aware of what constitutes an 'acceptable error' in the use of the equipment. Learners can conduct independent research activities to investigate this and you may wish to direct them to a number of civil engineering websites that provide detailed explanations of the errors that occur in surveys. Your feedback and analysis of the practice surveys that learners undertake can reinforce this.
- To introduce linear measurement, you could begin with horizontal distances and the practice of 'chainage' and the use of perpendicular offsets. Tutor demonstration of slope and horizontal lengths, along with a simple 3-sided triangle survey, would provide a good starting point for learners. They can then progress to conduct their own linear survey, working in small groups.
- Once learners have learned how to record a linear survey, they can then independently undertake the assessment survey and fully record this for drawing production.
- Moving on to levelling, you could begin by recommending suitable videos from a video-sharing website on setting up an automatic level and taking readings against a staff. Following viewing, learners could then practice the techniques witnessed. A class discussion following this would help consolidate learning.
- Learners will need access to automatic levels so they can learn how to set one up on a tripod and level it using the foot screws. (You will also need to provide a levelling booking sheet for this activity). You then need to work through the booking using HOC or Rise and Fall methods. This might take at least three sessions for learners to reach to a point where they confidently understand how levels are taken and recorded.
- Learners should now be ready to cover angular measurement using a theodolite. You

will of course need to then explain degrees, minutes and seconds within a lecture, as these are the units that the instrument is calibrated within.

- The first major task is to get learners to set up over a known point. Start with a coin on a level non-slip surface and demonstrate how to get the optical plumb of the theodolite over the centre of the coin.
- The next stage is to move outside and use a 50 × 50 peg with a round head nail in the top, to act as a 'station point'. Once they have mastered this, move onto three stations forming a triangle. The sum of the three internal angles is 180 degrees, so learners need to be shown how to measure an angle using face left and right. Demonstrate this for one angle then get them to survey the other two and collate readings.
- Learners should also be introduced to modern technology and practices in surveying, and would benefit from a discussion on how technology may change working practice, or could be of benefit (e.g. through improved accuracy or reduced cost). For example, digital theodolites, digital imagery, use of drones, aerial photography in topographic surveying, using GNSS systems.

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

- The surveying principles now understood, learners can progress to the practical application of this knowledge. Typical areas that could be surveyed safely could include:
  - parkland with sufficient details
  - land available at your centre
  - a building plot.
- For the linear survey, learners will need to set up trilateration for an area using survey stations, such as, pegs, ranging poles or survey arrows. You will also need to provide clipboards and plain A4 paper (with tramlines down the centre) for the recording of the linear survey. Other resources required would be a couple of 30 m reel tape measures and a 5 m steel tape measure.
- As an initial task, get all learners to sketch the position of the stations and tape the three sides of the triangle so they can plot these lines for the drawing. In addition, encourage learners to use their smartphone cameras to record each survey line so that they have a photograph to refer back to when they are drawing the survey as part of learning aim C content delivery.
- Accurate surveying requires appropriate selection of equipment and learners will need to demonstrate this understanding. This could be accomplished by providing learners a range of equipment to select from. They could then write out their justification as to why they have selected the particular piece chosen. Evaluation could be directed through tutor feedback at the end of the linear survey, where discussions are held on what went well, what did not and how learners would improve next time.
- You can then move on to the levelling survey. The required outcome of this practical task is for learners to produce plans of land and section detail drawings. There is therefore no requirement to produce a contoured plan, only some cross-sections and spot height drawings for the assessment in learning aim C. The spot heights could be linked to the linear survey drawing and annotated upon this to combine the assessment, which would be more efficient.
- The sections will require an area of topography that has a slope that can be surveyed using horizontal distances and vertical levels. For example:
  - A slope cross-section, 30 m long with a 3 m rise in height
  - A cross-section of an access road to detail camber, kerbs and footpaths
  - An access ramp to a building
  - A long section across a slope.

- This could be achieved by a site visit for half a day to an area that has a range of topography that could be used to produce a set of cross-sections. Equipment needed would be just one automatic level per cross-section, which can be set up at the top of the section. If a 5 m staff is used and the slop drop does not extend past this, then no movement of the level is required.
- You will need to establish at your location a benchmark point that all learners can reference to. This could be a temporary benchmark (TBM) or an ordnance survey benchmark (OSBM). This needs clearly highlighting as the point of reference for all survey work and a reduced level applied to this 'known' point.
- Lastly, the angular survey needs to be carried out. Practice is required for learners to set up a theodolite over a station marker so that they can accomplish this with some speed and accuracy. The variation in theodolites – from string plumb lines, optical plummets and laser plummets – must also be considered. You may wish to hire in the latest technology available to assist with this practical task.
- The angular survey should be set up in the form of a traverse network encompassing angles and distances that can be plotted onto media, e.g.:
  - a building and surrounding boundaries
  - a plot of land and boundaries
  - a carpark and boundaries
  - a park with sufficient details to survey.
- The traverse needs to contain at least five stations so the angles and coordinates can be corrected using a Bowditch method. You will need to provide coordinates for one of the points.
- A standard template for recording dimensions can be used. Learners will need to capture face left and face right angles and average these.
- The topics B4 and B5 require that mathematical techniques are applied to the following levelling booking methods:
  - Height of collimation checks
  - Rise and fall method checks
  - Bowditch correction method.
- All of the above will need preparation of exemplar calculations that can be worked through with learners so that they gain the knowledge to apply these to their practical measurements.

Learning aim C – Develop drawings from completed fieldwork surveys

- This final learning aim covers the production of drawings from each of the surveys. Manual drawing techniques should be used that have been learned from *Unit 7: Graphical Detailing in Construction*. The drawings need to be of a size that enables sufficient detail to be produced. A3 drawing paper should be suitable for the plotting of the linear survey to scale. Note that unit 7 is not going to be taken (i.e. if you are delivering the Foundation Diploma where it is not mandatory); additional time will have to be spent introducing and practicing graphical detailing for this learning aim. Where learners are taking both units, this presents an opportunity for holistic delivery.
- A useful preparation for this activity could be a tracing plot of the three stations to be provided to learners. This would make it easier for learners to start the plot, rather than having to use a compass with an extension bar to scribe the stations from a base line.
- Learners should be encouraged to reference north and to orientate their drawing accordingly. This will link the survey with the planning permission requirements for location and block plan drawings.
- The cross-sections of the levelling topography need to be drawn to a suitable scale so the cross-section is clearly defined and of a suitable size. Vertical and horizontal

scales can be exaggerated for this purpose. Learners should plot at least two cross-sections on the one drawing, to demonstrate competent assessment skills.

- All of the drawings produced will need to conform to drawing standard BS1192. Drawings will need a title block completing for each, which details the drawing type, learner name, scale and reference.
- Presentation skills can be delivered by providing exemplars of survey plots so learners can understand the standards required for a pass or merit in the assessment criteria.
- The evaluation of the final drawing could be assessed using an interview technique that is recorded where a professional discussion with the learner is undertaken. Questions could draw out the following:
  - The quality of their work and how it could be improved
  - What areas did not work well
  - How errors occurred
  - How could they minimise these
  - What techniques could be improved
  - What are the advantages of a technique
  - What are the disadvantages of a technique?

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

The following units have links to the surveying unit in skills that can be used for the development of evidence in undertaking and producing survey drawings.

- Unit 7: Graphical Detailing
- Unit 11: Site Engineering for Construction
- Unit 15: Further Mathematics for Construction
- NVQ3: Construction Contracting Operations

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Bannister A and Raymond S, *Surveying*, Prentice Hall, 1998 ISBN 9780582302495 – A well-known textbook that covers all aspects of surveying

BSI, *Code of Practice, BS1192: 2007+A2:2016,* British Standards Institute, 2008 ISBN 9780580928178 – This is the official British Standard Code of Practice dealing with collaborative production of architectural, engineering and construction information covering signs, conventions, naming and so on. You could register using the following link to get a free copy of **BS1192:2007** code of practice http://shop.bsigroup.com/forms/PASs/BS-1192-2007/.

Huth M, *Understanding Construction Drawings with Drawings* (6th Edition), Delmar Cengage Learning, 2013 ISBN 9781285061023 – This book has examples of both domestic and commercial projects and deals with the subject in a hands-on manner.

Irvine W, *Surveying for Construction* (Fifth Edition), McGraw Hill Education, 2005 ISBN 9780077111144 – A well-known textbook that covers all aspects of surveying

Kubba S, *Blueprint Reading: Construction Drawings for the Building Trade*, McGraw-Hill Education, 2008 ISBN 9780071549868 – This book has examples of a range of drawings used in construction and will be useful to understand the information contained within and the conventions used.

Videos

This Australian surveying organisation produced detailed videos demonstrating basic surveying methods (https://www.youtube.com/user/OTENBuildingCourses)

Websites

http://www.civilprojectsonline.com/ – This is a forum website that contains detailed site surveying issues.

http://www.rics.org/Global/Downloads/Guidelines_for_the_use_of_GNSS_in_surveying_and_mapping_2nd_edition_PGguidance_2010.pdf – Information on the use of modern technologies in surveying (e.g. Global Navigation Satellite Systems)

http://www.rics.org/Global/Measured_surveys_of_land_buildings_and_utilities_3rd_edition_PGguidance_2014.pdf – RICS introduction to the standards and practices of surveying, including land surveying

http://www.rics.org/uk/ – The Professional Body for Surveyors in the UK, including free educational guides and agreed standards of operation

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 7: Graphical Detailing in Construction

Delivery guidance

Throughout delivery of this unit, you will be focused on developing the knowledge and skills of learners to enable them to produce graphical information using manual and computer-aided design (CAD) methods.

Learners will be able to assess the appropriate media and materials for the intended visual outcome. They will also learn the importance of clear visual, written and verbal communication to convey the information and detailed instruction required for successful construction projects.

You would need access to computers with a suitable CAD software installed, along with an area suitably equipped to produce graphical information using manual methods. It is advisable to plan more time in the CAD room/drawing office than in the classroom, as this unit requires learners to develop practical skills to produce graphical information

High-quality drawings following conventions of BS1192:2007 – for example, of a typical two-storey building – will be a valuable learning resource and may be available from local architecture or construction firms. You should also plan visits to an architectural practice and invite guest speakers from architectural or structural engineering backgrounds. This would help your learners to appreciate the importance of learning in this unit and will contribute towards their motivation.

This is a mandatory unit for learners taking the Diploma and Extended Diploma, and optional for those on the Foundation Diploma qualification. Throughout the delivery, you should relate the content and skills focus to a number of units on these qualifications – such as the mandatory *Unit 2: Construction Design* and *Unit 4: Construction Technology* – as this will help to motivate learners. There will be further links applicable for learners taking optional units, such as *Unit 11: Site Engineering for Construction*.

Approaching the unit

The focus of the unit is developing practical skills to produce graphical information, covering various types of drawings as well as freehand sketches. Before you start developing these skills, you should introduce learners to the resources they would require for this unit, including materials and equipment. Providing learners with industry standard set of drawings will help them to understand the layout and conventions used.

You will need to provide constructive and developmental feedback on learner work on an ongoing basis, and you should expect that the learners' progress on the attainment of skills would vary. This would necessitate arranging of additional support or drop-in sessions for such learners.

To further support learners in developing their CAD skills, you could store all resources on a shared drive or server where learners can access these at any time. This would also help learners who require more time in developing their skills.

Delivering the learning aims

Learning aim A

In learning aim A, learners will develop their understanding of the resources required to produce construction drawings using both manual and CAD methods.

You could introduce the materials and equipment required to produce drawings manually, and give your learners a set of drawings to appreciate the requirements. You will need to do some practical demonstrations of how equipment could be used.

When introducing learners to the CAD environment, you should again approach with practical demonstration followed by individual support as required. The demonstration could be supported with a number of web-based video resources, and you could provide links to such resources through the shared folder. These resource links are liable to change over time, so you will need to ensure that you keep the list updated and relevant.

Learning aim B

Moving on to learning aim B, learners will be tasked with developing construction drawings for a given brief. Offer your learners enough opportunities to practise drawing standard conventions in accordance with BS1192:2007, but also ensure learners are able to work independently once they are undertaking their assessment tasks. Ask learners to reflect upon, and evaluate, their experience of producing graphical information using manual and CAD methods.

Make a continuous reference to the assessment criteria when learners are working on the class-based exercises, especially relating the quality of output to BS1192:2007, so they appreciate the importance of following standard conventions, and always keep the focus on the exact requirements of the assessment and put effort where it is needed, instead of into something of little value in terms of assessment of the unit.

Learning aim C

Learning aim C is about production of two-dimensional and three-dimensional freehand construction sketches. Use a suitable video resource to develop freehand sketching skills. You could do a practical demonstration of, for example, how the interior of a room could be drawn from a square or a rectangle. Give learners examples of suitably annotated freehand sketches. Allow enough time for learners to practise before starting an assessment activity. You should also refer to the assessment criteria as appropriate, especially to the importance of annotations and the use of a suitable sketching technique.

Assessment model

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.

Assessment guidance

A maximum number of two summative assignments is recommended for this unit, with assignment 1 covering both learning aims A and B.

You should provide adequate details within the brief – such as line plans and concept design – so that learners can produce the drawings to the required standard and carry out suitable evaluation.

Moving on to learning aim C and assignment 2, you could use the same project brief, but adding clear instructions about the techniques and annotations required for the freehand sketches.

For each assignment, you could ask learners to submit assessment evidence in the form of an evaluation report or presentation, along with a portfolio of drawings and freehand sketches.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 7: Graphical Detailing in Construction

Introduction

Introduce the unit by giving your learners a set of drawings relating to the construction of a two-storey building, produced in accordance with BS1192:2007. To emphasise the significance of this unit, you could show your learners how information is extracted from these drawings by the various parties involved – from client, through to planning authorities, the site manager and engineers. By doing so, you can highlight the importance of this information being interpreted correctly, e.g. how a setting out engineer will use these plans or how these plans would help a planner to set up the site and produce a project plan.

Your aim throughout should be to develop learners' appreciation of the materials and equipment required to produce these drawings, with good understanding of the standard conventions used.

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

- In a tutor-led practical demonstration, show learners the variety of media and equipment used to produce manual drawings. Use web-based video resources and animations to supplement learning.
- For an initial individual practical activity, you could give learners a sheet of commonly used symbols and conventions extracted from BS1192:2007 and ask them to redraw these. Support learners in setting up, layout and use of equipment.
- You could then give learners a set of drawings for a typical two-storey building, including site plans, building plans and elevations, sections, component details, structural drawings, as well as preliminary sketches. Ask learners to interpret and share their findings with their peers in a class discussion, providing tutor support and clarifications where necessary. This activity will develop learners' skills further in understanding symbols and conventions used in drawings.
- Hold a group activity where your learners investigate materials and equipment required to produce manual drawings. You could relate this to the previous activity and use the same set of drawings to understand the production requirements: e.g. the requirements to produce a preliminary sketch as compared with component drawings.
- You will need to give a practical tutor demonstration of a range of CAD techniques, starting with basic drawing and editing commands, manipulation of views, importance of file management and saving files in appropriate formats. As you progress through the functionality, introduce learners to using the basic commands as they familiarise themselves with the software and techniques. Support learners in developing templates and create a shared folder where learners can save their work.
- Over several practical sessions, you can set learners a number of tasks to work through for them to produce different elements of a build, concluding the tasks with a virtual building model for learners to demonstrate their skills.
- Facilitate a tutor-led discussion on CAD and traditional drafting techniques, for learners to consider the need to evaluate resources and design skills learned to date in terms of costs and efficiency.
- Facilitate a tutor-led discussion on how BIM software, tools and techniques

integrate with CAD drawings, how it may assist with modelling changes to building plans/drawings and outputting new drawings from given parameter changes.

- You may wish to then issue the initial assignment for learners to reflect upon before progressing to the practical, skills development focus of learning aim B.

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

- The focus of this learning aim will be for learners to refine their practical skills in producing construction drawings. Practice is key, so you will need to support learners by providing sufficient, suitable practice tasks, such as drawing plans and elevations, for them to work on independently.
- Given the scope of this unit, learners need to focus on the skills applicable to the assessment criteria, and this should be reiterated to them as necessary.
- Allow adequate time for learners to practise the art of drawing manually or using CAD and monitor their progress by supporting them in their practice tasks. Ensure that the focus of the practice tasks is to develop skills to produce drawings following BS 1192:2007 standards and that learners understand the importance of these standards to quality output.
- Ensure that learners are supported throughout their practice sessions and are given constructive and developmental formative feedback on their work. You will also need to encourage learners to self-assess their own progress in manual and CAD drawing, and take responsibility to attend the additional support or drop in sessions on areas that they struggle with.
- To inspire your learners, invite a guest speaker from an architectural consultancy firm who would be able to emphasise the importance of learning CAD as an essential skill for employability.
- With the practical skills now developed, you should lead a discussion with the group, asking learners to reflect upon their experience of producing drawings and to evaluate both manual and CAD methods in terms of their resource requirements, efficiency and cost.
- From the outset, you will need to schedule in sufficient class time and access to resources to accommodate the first assignment.

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

- To introduce this learning aim, you could give learners some high-quality sketches that have appropriate notations. To engage learners on usefulness of various annotations shown, you could question how such information would be used and by whom. For example, an annotation about the condition of a building element will be of use for a building surveyor.
- In a class discussion, get learners to consider the professionalism expected when construction sketches are required. As well as the quality and accuracy of drawings and annotations, emphasise the importance of meeting deadlines. Ask learners to consider the consequences for the wider project team if deadlines are missed, or inaccurate drawings are used, and how the construction team members could take incorrect decisions.
- Lead a group activity where learners are given sketches with no annotations or incorrect annotations. Learners could then carry out a group discussion as to how this misinformation could impact upon various construction processes. You can facilitate this discussion by drawing on key points and summarising the findings.
- Throughout the practical sessions, you will need to demonstrate to learners the various techniques used for freehand sketching, making use of online tutorials where appropriate.

- Learners will need access to a number of practice tasks to develop the skills to produce freehand sketches representing, e.g. the interior and exterior of a building. Allow adequate time for learners to practise sketching techniques clearly showing vanishing points, and ensure that learners develop skills to use annotations to communicate details of materials, finishes, condition or any other relevant information in sketches.
- You will provide ongoing support to learners throughout the practice sessions, but you may also need to schedule in additional support or drop in sessions to help learner master the technical skills.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

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
- Unit 18: Building Information Modelling

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

BSI, *Code of Practice, BS1192: 2007+A2:2016*, British Standards Institute, 2008 ISBN 9780580928178 – This is the official British Standard Code of Practice dealing with collaborative production of architectural, engineering and construction information covering signs, conventions, naming and so on. You could register using the following link to get a free copy of BS1192:2007 code of practice: http://shop.bsigroup.com/forms/PASs/BS-1192-2007/.

Huth M, *Understanding Construction Drawings with Drawings* (6th Edition), Delmar Cengage Learning, 2013 ISBN 9781285061023 – This book has examples of both domestic and commercial projects and deals with the subject in a hands-on manner.

Kubba S, *Blueprint Reading: Construction Drawings for the Building Trade*, McGraw-Hill Education, 2008 ISBN 9780071549868 – This book has examples of a range of drawings used in construction and will be useful to understand the information contained within and the conventions used.

Journals

AT Magazine – this journal is published by Chartered Institute of Architectural Technologists (CIAT) and contains updates on regulations and technical issues.

Construction Manager – this journal is published by the Chartered Institute of Building and contains updates on construction projects, methods and materials.

Videos

AutoCAD – Tutorial for Beginners (https://www.youtube.com/watch?v=-JbXqesOUyM)

This video explains how to draw a floor plan (https://www.youtube.com/watch?v=b_bEps3hJLI)

This video explains how to draw an architectural wall section (https://www.youtube.com/watch?v=MKc7yYurPis)

Websites

http://www.architecturaldigest.com/ – Architectural Digest is a monthly international design magazine. A wide variety of innovative homes and products are available on the website to inspire learners.

https://www.architecture.com/Explore/Home.aspx – Royal Institute of British Architects – a professional association including some educational resource and standards relevant to the drawing, modelling and design phases of construction.

http://www.exhibitions.co.uk/find-an-event/building-construction-and-architecture/building-construction-and-architecture?calendar%5Bvalue%5D%5Bdate%5D= – This web link contains a list of various exhibitions and trade shows which will be of help across the qualification.

http://www.londonfestivalofarchitecture.org/ – This website is supported by the Mayor of London and is about the yearly festival in London that follows a specific theme.

http://projects.bre.co.uk/site_communications/pdf/communication-guidance.pdf – This webpage is from the Building Research Establishment (BRE) under the title 'Guidance on Construction Site Communication'. Section 3 of the document deals with drawings.

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Unit 8: Building Regulations and Control in Construction

Delivery guidance

The majority of work that is designed by architects has to go through an approval process where drawings are examined and the approved documents applied to them. The focus of this unit is for learners to understand how the design for a domestic or commercial building achieves compliance with building regulations and to also understand the administrative processes that accompany this compliance. Learners will gain knowledge of how to submit a building regulations application, the documentation that is needed and the processes that are used to check compliance.

The local authority planning website will provide a valuable resource to download submitted planning and building regulation applications for use as case studies. Learners' skills in evaluative processes can also be drawn from this resource in terms of compliance against the regulations. Links to other units – especially *Unit 7: Graphical Detailing in Construction* – enable drawings produced to be used for assessments across both units.

Obtaining a guest designer or architect would provide a valuable resource in support of the demonstration of the application of the building regulations. They could provide drawings and examples of applications to support delivery.

Approaching the unit

Learners will need to be clear that the application of the regulations differ depending on the type of submission and the type of project. For example, window replacements are subject to checks on glazing and thermal bridging, whereby new windows would have supports and reveals checked for structure and thermal bridging.

To highlight the evolving legislation, Government influence on regulations could be covered, such as initiatives in energy saving, reduction in carbon, reduction in wastage and increased sustainability. Learner understanding of theory will therefore need to be developed along with the practical demonstration of compliance and the examination of the forms used for submission and control.

Delivering the learning aims

Learning aim A

Learning aim A can be delivered in two parts, initially looking at the Building Act 1984 before moving onto the control and implementation of the Building Regulations. You can introduce the Building Act to learners by providing them the summary information downloaded from the content page of the document (see web address provided in the Resources section for this unit). Independent learner study will work well here, along with supporting tutor presentations.

Topic A2 covers the control of building work through the two methods of submission – full plans and a building notice. A local authority building regulations department website will provide an explanation on both processes, and you could task learners to research this information ahead of a class discussion. A guest speaker from the local authority building regulations department could be invited to talk to learners about their typical involvement during the various stages of a project. This could be followed with a tutor presentation to highlight the differences between local authority supervision and

the role of private inspectors. Video clips from such firms can be utilised here. Finally, learners could then be tasked to research the aims and function of the National House Builders Council ahead of a class discussion to consolidate key points.

Learning aim B

Learning aim B covers two topics – the approval documents and the alternative methods of achieving compliance. Each of the approval documents deals with an aspect of the Building Regulations, and learners will need to demonstrate familiarity in navigating this content in response to a set of requirements. Topic B2 covers the alternative methods of achieving compliance, and learners will need to examine the approval documents for references to applicable British Standards. Learners will also need to explore the NHBC approval service through independent online research (see Resources for web address). The competence schemes are all listed at the end of the Building Regulations and cover a range of specialist installations, for example, FENSA for replacement upvc windows, Gas Safe for compliance with gas installations and Part P approval for electrical installations.

Learning aim C

Within learning aim C, you will reinforce learning from topic A1, looking at the two types of applications for submissions for building regulations, that of full plans and building notice applications. Many local authority websites provide details of the two types of submission that would support your delivery here, and you may wish to simply contrast the two methods of submission listed within the legislation.

In topics C2 and C3, you will go on to define the two methods further and expand into an explanation of the detailed processes associated with each. Good links with the Local Authority Building Control department should help secure a building control officer who could act as a guest speaker in explaining the methods of submission. Obtaining examples of completed forms for each type of submission, along with published guidance notes, would be of benefit in your delivery here. The advantages and disadvantages of each method need to be considered, with learners demonstrating their enhanced analysis and evaluation skills required in the assessment evidence.

Assessment model (in internally assessed units)

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 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

Assessment guidance

Learning aims A and B are recommended to be assessed using a written report and presentation. This could be set up as a report to an EU client who wants to build a construction project and does not know how the system of control operates within the UK. The first part would cover the legislation that applies to any construction work and the second on compliance against some common features, such as thermal, sound and light. A flow chart could be included that details the logical sequence of obtaining approval through the inspections and certification of building works. The presentation could be in the form of a video recording or a slide presentation for the uninformed client.

The second recommended assessment is through a portfolio of evidence. Drawings of a building could be used from *Unit 7: Graphical Detailing in Construction* with an extension added onto these. A full plans submission could then be made using the centre's local authority documentation for learners to provide a realistic submission.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 8: Building Regulations and Control in Construction

Introduction

The understanding of the application of the building regulations to a project is a skill that is developed as you gain knowledge of how each of the 14 approved documents is applied. Learners need to be able to analyse drawings to apply the regulations effectively along with being able to comprehend the technical language that is used in the documents. Access to the internet is required for this unit to be delivered. Many resources are available through Local Authority websites where public access portals allow documents on projects to be accessed and used for delivery.

Learning aim A – Understand the requirements of building regulations

This learning aim is heavily steeped in legislation, and as such, you should aim to make the sessions as interactive as possible to engage learners and encourage participation in group work. Learners may wish to start and maintain a legislation log that lists all the relevant legislation for construction, along with acronyms.

- You could begin by directing learners to the Government website to access a copy of the Building Act 1984 and help them locate the summary of the act, which they should read. This should include Regulation 3, which provides details on the exemptions to the regulations that apply, and Regulation 8, which covers the relaxations that may be applied to certain classes of work.
- In a tutor-led discussion, you could then ask learners to formally define what building work is under the Building Act and the Building Regulations – this can be found under section 121. Learners could then be asked to define 'material alterations' – what does this mean? A formal definition of material change of use is also provided within the regulations document, and you should direct learners to review this (see Building Regulations 2010).
- Learners could then pair up to examine and compare the Building Act and Building Regulations, and identify the similarities and differences. Their findings could be fed back to a class discussion, with key points highlighted and expanded upon by you.
- To gauge learner understanding, you could set multi-choice questions on the Building Act. For example, what powers did the act produce? How are these enforced?
- Learners could work in small groups, each to examine a different set of scenarios outlining construction proposals. They can be tasked to investigate if the proposals are exempt from building regulations, or if they require an application to be submitted. They will need to provide full justification for their analysis.
- In an activity to explore the relaxation of the regulations, you could lead a class discussion, asking learners, under what circumstances would the regulations be relaxed and why? Notes from this discussion should be collated for learner reference.
- You could then give learners a case study activity in which a listed building is to undergo major restoration work. Learners could then identify the specific regulations that apply to this work, and look for examples of how regulations could be relaxed due to the historical significance of the project's completion.
- To stretch and challenge learners, task them to research and define the differences in 'relaxation' against 'dispensation' of the regulations. This could include investigation of a local 'crown' property in terms of does it have to meet building regulations.
- Learners could then each submit an application for relaxation on a mock project proposal. The completed application form will need to fully justify their rationale for

relaxation of regulations. This activity would give you the opportunity to review learning and offer further guidance where required.

- Moving on to the control and implementations of Building Regulations in topic A2, you will introduce the stages of obtaining approval using Full Plans and a Building Notice. This could be delivered with learners working in small groups, each group taking one form of submission for investigation. Groups can then merge for a class debate on the advantages and disadvantages of each method.
- If opportunity allows, invite a guest speaker from the building control profession to provide detailed information on each method of submission. Alternatively, learners can research online at the local authority or the planning portal websites for examination of the two methods of submission. To bring this to life (as otherwise this topic could be very document heavy), centres could visit a completed property, after viewing plans on the portal, to see how the conditions or plans specified were eventually implemented. This might need to be a public building.
- To explore the powers afforded to building inspectors, learners could work in small groups to research and then present their findings to the class on one of the following: local authority inspector, a private inspector, National House Building Council (NHBC). They will need to identify the specific powers each holds, and what types of inspections are statutory.
- In a tutor presentation, you could then run through an example of a final certificate and its significance for a client. Following this, you could present a range of building work scenarios to learners to check if they can be self-certified. Class discussion could then follow for you to consolidate key points and correct understanding as required.
- The non-compliance with building regulations is best delivered using one of the following methods:
  - a case study that demonstrates what the consequences are of not complying with legislation
  - a set of press cuttings that illustrate cases where buildings have been demolished due to non-compliance
  - Building Control officer as a guest speaker to illustrate cases where they have enforced non-compliance.

Learning aim B – Examine the requirements of the building regulations

- For topic B1, learners will need a complete set of all approval documents listed in the specification. Learners should each download the documents and for their own folder. You could provide them a full list of titles so they are informed on what each document covers. Note that topic B1 requires knowledge of how to use the approved documents and apply these requirements.
- An effective method of delivery is to set learners simple activities to be checked against the regulations. You will need to prepare some activities that cover the typical issues to be examined, such as any of the following compliance problems:
  - depth of a foundation in a soil type
  - proximity of a tree to a foundation
  - DDA ramps into buildings
  - gradient of stairs
  - fire precautions
  - insulation requirements
  - ventilation to a kitchen
  - what security is required to windows.
- The aim here is for learners to quickly understand which approval documents to look in and find the solutions to a given issue.

- To explore the alternative methods of achieving compliance, learners will need to further analyse the Building Regulations approval documents and identify the British Standards, European Standards and NHBC standards referenced. In each case, learners should develop an understanding of how each impacts compliance (e.g. if you can prove that a standard that you apply covers or exceeds the regulation requirements, then this is acceptable to the Local Authority Building Control).
- It is important that learners can understand what 'acceptable' (and if possible 'unacceptable') looks like in terms of documents submitted. For example, level of detail, standard of drawings, project description statements, statements of compliance, mitigation statements.
- Learners will need to access the NHBC website to investigate how they provide compliance in the same way as the local authority. This work can be evidenced in a brief written report.

Learning aim C – Undertake a building regulations application

- Here, you will have an opportunity to recap on the content previously covered in topic A1 on the conditions surrounding application for Full Plans and Building Notice. Some recap questions could be provided to test learners' understanding of the two types of applications.
- In a tutor-led activity, you can task learners to download and examine current applications from a local authority building control department. If some of the applications have been rejected, then learners could analyse the documentation to find out why and try to resolve the conformance issues. If they have been 'passed with comments', then a similar process can be applied.
- You can then task learners to further explore each of the two types of applications in separate investigations. You will need to provide supporting documentation for each scenario that should support learners working independently through both types of applications. This activity should include an examination of the fee schedules, so learners price an application for a client. Learners will need to complete the application forms with all the necessary detailed information.
- You can challenge learners to design a drainage provision against existing details for submission. You would need to download a setting out drawing from an application that does not have any drainage upon it. Learners then design the drainage. As a conclusion to this exercise, you can then reveal the actual drainage design that was proposed to discuss and debate.
- Learners could also work on an activity centred around the production of a specification for a feature to comply with regulations, e.g. the design of a foundation. The specification they produce would need to meet the approved document that applies to this type of feature. Sample specifications are available that you could use to illustrate this conformance, along with notes on drawings that detail this.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

The following units provide links to drawings and technology to use within the assessments for a building regulations submission:

- 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
- Unit 10: Building Surveying in Construction

Resources

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Textbooks

Billington M and Bright K, *The Building Regulations Explained and Illustrated* (13th Edition), Wiley-Blackwell, 2007 ISBN 9781405159227 – an informative guide to building control in England and Wales

Evans H, *Guide to Building Regulations* (3rd Edition), RIBA Publishing, 2015 ISBN 9781859466179 – a useful guide to the updated Building Regulations

Topliss S, Hurst M, Cummings S and Donyavi S, *BTEC Nationals Construction Student Book + Activebook: For the 2017 Specifications (BTEC Nationals Construction 2016)*, Pearson, 2017 ISBN 9781292184043 – coursebook to accompany the qualification

Tricker R and Alford S, *Building Regulations in Brief*, Routledge, 2014 ISBN 9780415721714 – includes latest amendments to Building Regulations and Planning Permissions

Videos

An introduction to building regulations (https://www.youtube.com/watch?v=xPs3SM1yf-w&list=PLctKzCZuc_INz0qleiG5H4MvNu2288IaM)

How does the process work? (https://www.youtube.com/watch?v=Yi86Jk0Fr0U)

Information on services provided from a private building inspector firm (https://www.youtube.com/watch?v=iXQEK_45Xnk)

What is Building Control and how does this help you? (https://www.youtube.com/watch?v=IndW90Fr5_M)

Websites

https://www.gov.uk/government/collections/approved-documents – The portal to download all 14 approved documents

https://www.labc.co.uk/ – The Local Authority Building Control website

http://www.legislation.gov.uk/ukpga/1984/55 – The UK Legislation website and the original published Building Act 1984

http://www.legislation.gov.uk/uksi/2010/2214/pdfs/uksi_20102214_en.pdf – The current 2010 Building Regulations

http://www.nhbc.co.uk/ – The National House Building Council website

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 9: Management of a Construction Project

Delivery guidance

Approaching the unit

The management of a project in construction is a complex operation with numerous operatives and contractors to be organised, coordinated and communicated with. All aspects of a project must pull together towards the successful completion and hand over the building, and this unit will show learners the many techniques and considerations management roles must take on in order to realise this.

Employer engagement through a site visit that demonstrates how a construction site is organised and managed is an ideal method to get learners motivated and interested in various aspects of site, contract and project management. This would provide a valuable opportunity to discuss the management role with a site manager in a live construction context.

Building good links with a local main contractor would provide you with a valuable resource of information, personnel and live examples that would cover many aspects of the unit's content and you will find learners motivated and engaged by working with relevant and tangible source material.

This unit or *Unit 17: Projects in Construction* may be selected by apprentices to meet the requirement for contextualised project work, specific to their occupation. Therefore any apprentices should be encouraged to derive evidence for this unit from workplace activities. The employer group for the apprenticeship may work with providers to agree specific guidelines for completion of project work.

Delivering the learning aims

Learning aim A

Learning aim A covers the principles and practice of site management. Tutor presentations to introduce the concepts, supported by the engagement of guest speakers, would provide an ideal combination for delivery. If possible, the guest speaker should be a site manager, a contracts manager or a project manager. All would be able to provide a view upon the roles of the construction team and their individual responsibilities, along with an overview of the various techniques used on a construction site. Learner research and presentations on the principles of scientific management (Maslow, Fayol, McGregor) could then be followed by small group work, each focusing on a specific role within the construction project management team for further presentations to class.

The practical application of construction management techniques could initially be introduced by the tutor, but you may also consider online video resources to lay the foundations for understanding. Learners will need to understand the purpose of creating critical path analysis, Gantt charts and line of balance charts. There are many working examples of software to achieve the programming demonstration that produce Gantt charts and critical paths. Microsoft Project is also part of the office suite and is available to use to demonstrate the ease of putting together a programme. Demonstrate examples of each that learners can then work through in a logical sequence.

Obtaining a site layout plan from an existing contractor would prove a valuable resource to demonstrate the reasons why certain sites are set out in a particular way. This could be delivered by providing learners with a planning application downloaded from the Local Authority website and asking them to set out the site and submit this for evaluation.

Learning aim B

Learning aim B examines the application of purchasing methods. Obtaining the services of a buyer within a large construction operation would cover many of these aspects. Similarly, any person with a procurement capacity would be able to help with the delivery of the aspects of the content such as, ethical purchasing, purpose of the purchase order, enquiry documentation and meeting planning requirements.

Materials and their supply (from various sources) can be investigated using small group work. You could ask learners to resource, procure and order a material to meet a given date on a programme using mock documentation. Obtaining administrative documentation from a contractor's buying department would provide a valuable resource in illustrating how orders are procured and placed in time to meet a main contract programme. In addition to this, online research and review of example purchasing policies would provide an effective illustration of industry concern regarding ethical buying, sustainability, social responsibility and conformance with legislation.

Moving on to look at cost management techniques, you can explore opportunities here to link delivery with *Unit 3: Tendering and Estimating,* as many common themes exist. Content for this learning aim could be delivered initially with a review and analysis of example budget and valuation data. Learners would benefit from hands-on practical application through mock budget and cost control exercises to reinforce their understanding. Such activities could be carried out in a small group or as individual work.

Learning aim C

Learning aim C covers the production control systems and the measurement of progress. Programming construction activities can be explored through a range of means. For example, you could task learners to view a video of a work activity and ask them to write a method statement for the task that is been conducted. Learners could work individually or in small groups to produce key documents, such as a site layout plan from a provided design layout, and an environmental waste management policy for the site. Learners will also need to demonstrate their understanding of the importance of accurate progress measurement, and this can be done by revisiting the Gantt chart produced in learning aim B, and providing data to learners that needs to be captured.

Assessment model (in internally assessed units)

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

Assessment guidance

Learners who are undertaking the qualification as part of an apprenticeship should be encouraged to derive evidence from their workplace activities for this unit, or for *Unit 17: Projects in Construction*. For example, this could be a project that they could investigate, or be seconded to within the company, to meet any employer apprenticeship requirements for contextualised project work relating to that occupation.

There are three key areas of assessment that address each learning aim, as recommended above. The report for learning aim A should contain a system of management, followed by applications of these techniques and include examples of how they are used on a construction site. Learners should demonstrate their understanding of the management requirements for both employees and sub-contractors.

The second assignment covering learning aim B is recommended as a training pack for a trainee site manager. Learners will need to show knowledge of the process of procurement, cost control against budgets and social ethics in purchasing as they describe the procurement, administration and supply of materials to a construction site.

Finally, learners will produce a presentation of the various methods that can be used for the production of programmes. The presentation should contain relevant imagery along with clear explanation on monitoring the elements, both critical and non-critical.

All three assignments can be produced using traditional word-processing methods. There are some software programmes (such as Microsoft Project) that could be used to prepare programmes – some suggestions have been listed in the Resources.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 9: Management of a Construction Project

Introduction

This unit covers management techniques and methods specific to construction, therefore a site visit would provide an ideal opportunity for learners to witness them being utilised to operate and manage a construction site. This would also provide a first-hand opportunity for learners to interview the site manager and gain valuable knowledge on all aspects of site management.

You may struggle to find a holistic method of applying assessment tasks for this unit as the learning aims are too distinct. However, you will be able make links between the aspects of learning aims A and C where contract programmes can be delivered to meet the content requirements of both.

For learning aim C, learners have to develop a programme of activities for a project; therefore access to a real site with real project documentation would be of great benefit as it will enable them to see the impact of the management tools and techniques on the project progress and outcomes. In the absence of this, learners must be given a realistic scenario or a brief around which programmes can be planned and monitored.

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

This aim covers the principles and application of management. When delivering topics, you will need to ensure that there are examples of how these are applied within industry to place the learning in a vocational context. Developing a relationship with a main contractor would prove valuable in this case. As an opener, ask learners to examine what is the principle of management and brainstorm this activity.

- Invite a guest speaker to come and discuss the principles of management, as outlined in topic A1. The guest speaker should ideally have a background in site management, contracts management or project management. To maximise the time spent with them, learners should be encouraged to prepare questions in advance relevant to the learning aim content. The session could also be videoed (with the guest speaker's permission) for future use and debate in class.
- An effective introduction to the management theories to be covered could be through learners working in small groups to research, prepare and deliver a presentation on one of the methods of scientific management from the unit content. Presentations should be focused towards its application in a construction context, providing examples where possible.
- For a deeper exploration to define roles and responsibilities within the construction project management team, learners could remain in their groups and be issued a specific role from the unit content; architect, quantity surveyor, construction manager, project manager, structural engineer, services engineer, site manager, buyer and planner. They would need to research and define:
  - the role of this person
  - their responsibilities in the management of a project and
  - finally, how they would interact with two other teams.
- Results of this activity could be shared in a tutor-led discussion, to collate and summarise key points, and fill in any gaps in the content. Group presentations could then be saved to the VLE or server so all have access to this resource for reference.

- A site visit would prove valuable in allowing an opportunity for learners to examine aspects of plant, materials and labour management, along with the management of sub-contractors. This perspective on management needs to cover incentives, motivation, organising, procurement and coordinating and controlling of all resources. These management functions can then be contrasted with those that would fall under the responsibility of a head office.
- Techniques for site management could be delivered through a combination of online research, demonstrations and practical activities. You could begin with a tutor-led discussion to gauge prior knowledge of the purpose of planning a project and the various means by which you can monitor its progress. Learners need to be able to interpret the data on example Gantt charts, line of balance charts and critical path analysis and can work individually or in pairs to examine this.
- This could lead into the following task: learners are given a list of programme activities with sequencing and durations from which they must prepare a contract programme. This programme can take the form of a Gantt chart that has a range of activities included within it, opportunities for sub-contract inclusion and a critical path identified across the timeline.
- A further extension could follow where learners are each given a technique from the following list and asked to examine exactly how it manages the aspect it is used for:
  - daily activity sheets
  - drawing registers
  - materials testing
  - CSCS card scheme
  - site layout plan.
- Learners then collaborate in a group exercise and capture findings on a flipchart sheet, each to be presented for discussion and debate.
- The two aspects of the management of directly employed labour and sub-contractors can be delivered by some of the following activities:
  - Setting a task on motivation of labour force, without using money as an incentive. For example, identifying good working conditions on site, to include a safe and dry environment and one that enables effective production.
  - An application for a CSCS card for one of the trade areas. This would allow learners to understand the processes and procedures involved in obtaining a CSCS card.
  - Outlining the methods that can be used to communicate with the workforce and sub-contractors. For example, notice boards, site induction, safety committees and toolbox talks.

Learning aim B – Understand purchasing and cost management techniques

This learning aim covers the procurement and buying of materials for a construction project and provides opportunity for a range of different and engaging delivery methods for learners to practically apply the techniques covered. Such activities could include the following:

- Learners are tasked to formulate a list of selected suppliers for a given material, stating why they have been included as a viable option. Learners need to understand that a 'select' list contains a pre-approved resource that already meets the company's procurement strategies.
- Scheduling materials enquiries from a given bill of quantities section provided by a quantity surveying company. This would demonstrate that a bill has to be worked through to identify any materials with long lead in times so that, prior to delivery on site, these are recognised to have a major effect on a programme.

- Analysis of a given contract program to obtain the dates required for delivery to the project. For example, examination of the dates sub-contractors are required on site for coordination with others.
- Establishing lead-in times for a given material.
- Learners will need to understand the implications for contractors of the terms and conditions specified by suppliers. This can be done by obtaining a typical purchase order and analysing the terms and conditions. Researching supplier terms online and in example contracts should also be explored in a tutor-led activity, asking learners to identify the benefits of such arrangements (for contractor as well as supplier).
- To initiate class discussion and debate, you may wish to view online videos outlining the position construction firms are taking on ethical purchasing, sustainability and social responsibility. You could ask learners what they see as the main challenges in evaluating the sustainability of materials for firms to meet their own 'green requirements'.
- Researching the green status for materials in terms of standards. For example, PEFC is an organisation that provides a quality mark to use on timber products.
- Methods to ensure sustainable compliance of materials, such as, 'fair trade' status for the supply of products.
- To explore the ethical supply chain further, learners can research the UK Government website for policies on the ethical supply of materials for Government contracts. You could then task learners to analyse an ethical purchasing policy from a construction firm to see how it compares with the Government policy.
- A builders' merchant sales representative could be invited in to discuss their supply chain and how it operates. Learners could be invited to submit questions in advance for an interview style Q and A session.
- Working in pairs, learners can investigate how a supplier can offer a discount and the methods that can be used for a main contractor. This should include a trade discount, annual discount, cash discount and loyalty schemes
- Learners can carry out a number of practical and analytical tasks, such as the completion of a mock purchase order from given data or checking a provided quotation against a specification for compliance. They could also match the requirements of a material to a specification item and checking compliance and advising a 'client' if this does not match their specification. Learners can then swap and peer review each other's work.
- Moving on from purchasing methods to cost management techniques, learners could be issued examples of interim valuations for a project. This should be demonstrated in a way that learners can clearly identify the breakdown of items from various sources to see how this is compiled into an overall valuation.
    - Use of a mock budget to identify costs savings that could be recommended by learners. This covers aspects of cost value engineering where a project's tender value may be over the original budget and savings have to be made. Learners could make recommendations as to changes in specifications for cheaper products
    - Small group working, with each given a technique to manage costs, e.g. unit, elemental, marginal and variance. This will allow each group to investigate and then report back collectively what each of the costing techniques is and how it operates.
    - Learners can then be asked to prepare a budget from given data. This should be a simple set of data that learners have to analyse, from which they must produce a new budget. For example, simple rates per m^2 against a new area taken off a drawing would be ideal.

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

For this learning aim, learners have to develop a portfolio of programmes and other contract documentation that demonstrates certain aspects of the following:

- Method statements that describe the resources, including how they are used, for an activity such as forming a foundation or constructing walls.
- A site layout plan that details traffic management, location of offices, accommodation and compounds, site entrance and security, waste storage and removal and parking.
- Use of Gantt charts, including updating of data for given activities on site, so learners are aware what affect one key critical activity can have on a programme's timeline.
- To capture measurement of progress on site, you could provide a list of completion percentages against activities and ask learners to update their control system to understand which activities are behind or ahead of schedule.
- Preparation of financial information could be accomplished by demonstrating the type of administration that is generated on site. For example, goods received sheets, plant hire sheets, site diary and site returns on labour.
- If you could obtain the services of a guest speaker, such as a planner from a large construction company, this would provide an ideal opportunity to enhance learners' knowledge of the above unit content.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- 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 17 Projects in Construction
- Unit 19: Quantity Surveying
- Unit 20 Quality Control Management in Construction
- NVQ3 Construction Contracting Operations

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Clark W, *The Gantt Chart: A Working Tool of Management,* Nabu Press, 2012 ISBN 9781278642062 – a useful resource for producing Gantt charts

Cooke B and Williams P, *Construction Planning, Programming and Control* (Third Edition), Wiley-Blackwell, 2009 ISBN 9781405183802 – this will help with the development of a contract program.

Harris F, McCaffer R and Edum-Fotwe F, *Modern Construction Management* (Seventh Edition), Wiley-Blackwell, 2013 ISBN 9781405133258 – this book deals with aspects of management for construction projects.

Topliss S and Hurst M, *BTEC National Construction*, Pearson, 2017 ISBN 9781292184043 – the core textbook that accompanies the qualification

Videos

A day in the life of a Construction Manager (https://www.youtube.com/watch?v=68QKztH4d8A)

Career Advice on becoming an Assistant Construction Manager by Scott D (Full Version) (https://www.youtube.com/watch?v=RwO-Qsb07QM)

How to create a Gantt chart using excel (https://www.youtube.com/watch?v=CzLC7yNSks4)

Tata Steel on responsible sourcing (https://www.youtube.com/watch?v=GRvPjxm-5Ys)

Websites

http://www.ciob.org/ – Chartered Institute of Building: The UK Professional Body for Construction Management, including educational resources, CPD, career advice and standards

https://www.cips.org/Documents/Knowledge/Procurement-Topics-and-Skills/4-Sustainability-CSR-Ethics/Sustainable-and-Ethical-

Procurement/Ethical_Purchasing_Practices-Knowledge_How_To.pdf – Ethical purchasing policy

https://www.designingbuildings.co.uk/wiki/Home – General construction website full of useful links

http://www.ganttproject.biz/ – A free application to create Gantt charts

http://www.iom3.org/ – The Institute of Materials which has some publications that may be useful

https://products.office.com/en-gb/project/project-management – Microsoft Project

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Unit 10: Building Surveying in Construction

Delivery guidance

Approaching the unit

This unit will give learners an opportunity to explore different building styles, methods of construction and defects associated with each, and conclude with them undertaking a building survey to produce a detailed building survey report and accurate scale plans.

Delivery of this unit should be both practical and theoretical, allowing the learner opportunity to inspect properties, identify and analyse defects and synthesise their findings into a high-quality report. It will reinforce learning from several other units – such as *Unit 2: Construction Design*, *Unit 4: Construction Technology* and *Unit 1: Construction Principles* – allowing the learner to apply that theoretical learning to the practical discipline of building surveying.

You may draw on a range of delivery methods and teaching styles, with emphasis on practical hands-on interaction. Allowing learners access to real properties with various defects can be challenging, but you can easily consider the educational centre. It should include all the elements learners need to inspect, and even if it is a new build, there are likely to be some suitable defects for analysis. Ideally, tutors should attempt to find a suitable property for the second assessment – a typical two-storey house, for example – however, it is not essential providing the learners a place they can inspect, measure and produce a report on.

Visiting speakers, such as current practising building surveyors, would be advantageous, especially if they can demonstrate some of the more advanced technology to the learners.

This unit is ideal for all learners, but especially those who wish to pursue a career in surveying, or architecture and to some extents construction management.

Delivering the learning aims

Learning aim A

Learning aim A covers the different styles of construction and the traditional and modern methods used in building. Learners will be aware of the different types of residential property, such as detached, semi-detached and so on, but the styles of construction may be new to them.

This is a very visual subject area. Learners should be given lots of images to analyse and identify the different features, materials and unique aspects of each period and style. Learning aim A should be taught homogenously as this will allow the learners the opportunity to make the appropriate cognitive links between material use and development and methods and styles of construction. This topic area will enable the learners the opportunity to reinforce learning from the other technical construction subject areas, such as *Unit 4: Construction Technology.*

Learning aim B

Learning aim B develops progression to consider how buildings fail and what is required in terms of maintenance to prevent failure. The external envelope is considered first then the internal one – as would be the approach in a survey. Delivery should utilise real-life examples, preferably an actual property to inspect, but also through good quality photographs. Taking your own photographs may be of benefit, as it will allow you to capture the wider area around the defect as learners will need to consider the wider environment when inspecting a property – looking solely at a crack may not tell them why it is cracked.

To reinforce learning throughout delivery of learning aim B, you should reference the methods of construction, the possible defects associated with each method and the remedial methods employed to extend their typical life span. You could set learners research tasks to specifically investigate areas in greater detail, or hold in-class quiz activities to check their understanding.

Learning aim C

The culmination of learning aim C is the production of a written report and scale plans of a building and if the learners have had access to a suitable property throughout the delivery, this can then become the subject of their final assessment. In an introductory session on the different types of survey, you could provide learners real-life examples for comparison, analysis and class discussion.

Accuracy and tidiness are key skills to highlight when learners start to compile their own notes and drawings, along with the well-ordered collation of other supporting information, such as photographs, leases, plans and so on. In the practical inspections, you should also reinforce that a systematic approach is essential to the collection of accurate data and the production of a high-quality report.

Learners should be encouraged to take ownership and to act in an appropriate, professional manner at all times and through well thought out delivery and regular formative feedback during the module, the learners will develop a range of higher order skills that they can transfer to other units, further study and into employment.

Assessment model (in internally assessed units)

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	

Assessment guidance

It is recommended that assessment is in the form of two assignments, the first will cover learning aim A and the second addressing learning aims B and C.

Assessment 1 can be in any number of formats, such as an illustrated report, presentation, info-graphic style poster, booklet or guide. The key here is to allow the learners the opportunity to be creative while ensuring access to the higher-grade areas. Depending on the assessment instrument you choose, there should be no real need for special resources. The learners are required to demonstrate their understanding of different styles of housing and methods of construction. They should be allowed the opportunity to evaluate different styles and methods of construction and maintenance requirements.

It is recommended that learning aims B and C are assessed together; however, they could be assessed separately. If you adopt a three-assessment strategy, you could assess learning aim B using a report or an illustrated guide to defects and methods of repair and remediation. Assessment 3 would then see the learners undertaking a building and measured survey of a property.

If you adopt a two-assessment strategy, then you will need to provide a suitable building for the learners to undertake the building and measured survey. Please note that provision of a suitable building would also be required for a three-assessment strategy, just not necessarily one with defects. This could be problematic as it will need to have sufficient defects to satisfy the requirements of the criteria for B, be safe enough for the learners to work in and not too large, as they will need to measure and draw it too. If you can find an appropriate property, it is acceptable for learners to work in pairs on the building and measured survey (as this will make measurement easier) but they should produce their own survey notes and reports. The building survey should be similarly detailed akin to the RICS Level 3 survey.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 10: Building Surveying in Construction

Introduction

The aim of this unit is to equip the learners with the knowledge and skills to undertake a building and measured survey – to produce detailed high-quality survey reports with the minimum of help and assistance from you.

As a practical unit, every opportunity should be taken to get the learners out of the classroom, inspecting the different elements of a building and identifying defects. This could be utilising the teaching centre, or with learners conducting visual surveys of their own places of residence.

Through such activities, you should witness independent, critically thinking learners who can identify a building element, analyse methods of construction, assess different defects and produce recommendations for suitable and appropriate methods of repairing and remediation.

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

- Delivery of this section can be undertaken by way of a history of residential development. A tutor-led discussion could initially outline how residential property has evolved over time, encouraging learners to consider issues such as societal changes, the desire for more space or the need for more house, for example.
- Tutor presentation and imagery could progress to review typical examples of particular styles and periods seen in residential properties, while learners capture the key information for each period of architecture in a learning mat (or structured handout) with space to produce some sketches of the key features and capture the different methods and materials employed to create the houses.
- Learning can be reinforced with a walk through your nearest town or village. The learners can identify the different types, periods and styles they see, picking out the key features and materials used. By providing them details of why housing evolved will allow them to make evaluative decisions on the environment in which they live. There is an opportunity to link topic A1 to both A2 and A3 here (traditional and modern methods when considering the evolution of housing styles) so it would be a good idea to ensure learners can see some modern developments. Wherever possible, you are encouraged to push the learners to link the learning in the classroom to the built environment all around them. If the local area is not suitable, you should utilise pictures of towns and cities across the country to find suitable examples. The aim here is to enable the learner to identify the type and style/period of a property in preparation for their final survey inspection and report.
- Topics A2 and A3 could be taught together; however, it might be sensible to teach topic A3 first, as this will reinforce learning from other modules such as *Unit 4: Construction Technology*, where the topics are covered in more detail. You could gauge prior learning with a simple in class test or Q and A style session before giving each area due consideration by way of a refresher, incorporating an analytical slant on defect diagnosis.
- As well as referring to a lot of images, where appropriate, get the learners to draw their own sketches of the different elements and methods of construction as active engagement will improve the rate at which the learner remembers it. A good class activity is to get learners to come up and draw on the white/smart board – learners

will find large scale, accurate drawing a challenge, but this type of activity is great for reinforcing learning. During the exercise, you may wish to recap on how material development and construction methods have changed over the years.

- When focusing on traditional construction methods, again you can use images and sketching activities in your delivery. In a tutor-led discussion, you ask learners to consider why buildings were constructed in a particular way, and perhaps task learners to work in small groups to research a given method and present back to the class.
- There are several episodes of Grand Designs that refurbish old buildings, highlighting the methods of construction and skills used. If you do utilise any of these property programmes, you should create suitable resources (such as learning mats or structured question sheets) to ensure the learners are actively watching. A well-placed Q and A activity is a good way to recap at the start of the next session.
- A fun way to conclude this learning aim, and check on learner progress, would be a quiz activity. Splitting the class into small groups, task each 'team' to write 10 questions and answers relevant to the topic area that will be presented by you to the other teams. The team with most correct answers will be winners.

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

- You can consider an integrated approach to the delivery of this learning aim. For example, if you are presenting a session on structural failure of foundations, it would be logical to consider the various methods of repair and remediation. Learning could start with theoretical classroom-based delivery to impart the initial knowledge content, before moving onto practical surveying activities.
- Incorporating a brief refresher of learning aim A as you progress will allow you to develop the discussion; from the specific methods of construction for the different elements and how the elements are built, on to consideration of the different defects, how they occur and the resulting consequences. This development of knowledge will carry through to the analysis of the mechanisms of failure and ultimately the processes of repair and remediation.
- Classroom delivery should be very visual and there are options for a variety of activities, such as providing the learners with a photograph of a defect which they then annotate, or in some instances – such as looking at structural failures – it would be possible to give the learners a description of a defect and ask them to draw it. Using these methods will allow you to monitor learning by way of the work produced in class.
- Once you have delivered the classroom content, you can then translate this into actual surveying practice. Using the environment around the centre where you are teaching, you can take the learner out to try to identify the defects you have previously been discussing in class. This will reinforce the learning, develop high-level critical thinking skills and be developmental towards the final assessment.
- You may wish to cover the internal defects of buildings following the methods suggested above, or approach them element by element. If breaking it down into the different elements, you could provide learners with an outline of the issues and defects, along with appropriate resources and reference points for research activities. Working in small groups, learners could undertake the appropriate research and produce a presentation or an information booklet for the class. Asking the learners to teach a subject area is a very successful mechanism for learning; however, you will need to ensure that the other subject areas the learners did not research are fully understood. This can be done through in-class quizzes and tests, or by asking them to undertake surveys and produce short reports on the defect analysing the cause and methods of repair.
- Analysis of methods of repair and remediation will have been considered throughout delivery of this learning aim. To ensure that the learners know the different levels

of intervention, and when each is applied, you could give learners a copy of a survey report that highlights a variety of defects. From this, you can ask them to produce a schedule of appropriate repairs. The key here is the word appropriate. Taking down a building and rebuilding it is not a proportionate response to a few minor defects!

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

- Learners will need to understand the difference between the survey types. To introduce them to this, you could obtain copies of the different types listed in the unit and ask the learners to analyse them. You may wish to direct their thinking for the detailed analysis of the reports by providing them with a table containing appropriate headings. Learners can then work through the different report types and differentiate between the levels of detail in each one. To test learning, you can ask the learners to describe the differences between two (or more) different reports in a group plenary session.
- With the contextual knowledge secured, the best way to deliver this topic is for learners getting out and undertaking surveys. The surveys they are required to undertake are all visual and not intrusive in any way. Before you take learners out of the classroom for the first time, you must do a full health and safety briefing. The RICS has a very good document called Surveying Safely, which could form the basis of your session.
- Early on in this learning aim, you could walk the learners through an inspection. A good way to do this would be to produce a survey of a building you have access to. Your sessions can then be based around how you undertook the inspection and the information you gathered. If you include field notes, the learners will learn how to collect data and how it is used in the survey report.
- It might be useful for the first few surveys to provide the learners with a structured handout that will encourage them to focus on key aspects of the inspection. As the unit develops, you will be able to reduce the level of input you have in the actual planning and data-gathering elements.
- A good activity to help with data collection is to have learners swapping their site notes to produce the report form another learner's notes. For example, if you have a small group working inside and another outside, there will be no cross contamination of the data and they will be writing only from the field notes. You should emphasise the need to produce neat, accurate and detailed field notes as this will be vital when it comes to the final assessment.
- Once the learners have captured the data from site, they will need to start producing written survey reports. You could provide the learners with different template formats (as used in the profession) for them to input the relevant data and supporting images and descriptions. There are several template examples available online, or your local surveying firm may be willing to supply one.
- Learners should also note the importance of appropriate and professional written communication in this unit, with particular emphasis placed on the use of language, giving clear reasoned and justified recommendations. Tutor should demonstrate some good and bad examples of language and communication here.
- A key skill for all construction personnel is the ability to interpret and produce drawings. Throughout the unit, you should develop the learners' sketching skills when out on site so that they are confident to produce sketches of all aspects of a property.
- Learners will also need to produce formal drawings to scale as they will need to undertake a measured survey and produce scale plans of a property for the assessment. The act of measuring and recording data should be done as practical tasks outside the classroom. A good activity is to ask the learners to each measure and draw a small section of the centre you are in. To test accuracy, you can then

join the drawings up and, hopefully, they will all sit neatly alongside each other for a larger scale floor plan. Again, swapping field notes is another good way to develop the learners' skills when producing scale drawings from measured surveys.

- Tutor demonstrations would be beneficial on some of the technical challenges of surveying, e.g. how to locate isolated parts of the property (such as columns), how to triangulate, how to measure elevations and measuring cross sections and the thickness of upper floors. Learners could then carry out these measurements and swap data to draw up their colleague's field notes.
- You may need to teach the learners how to set up a drawing page initially, but beyond this, letting them work at their own pace to produce scale drawings is the best way. You will provide support and advice as they work, but learning as they draw will be the best way to deliver this.
- At all stages of your delivery, you should reinforce the need for professionalism and independent learning. Get the learners working in groups, sharing information and demonstrating levels of professionalism you would expect to see in a junior professional within the industry.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

The knowledge and skills required for this unit will complement, enhance and reinforce several other units within the qualification. These include:

- 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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Glover P, *Building Surveys*, Routledge, 2013 ISBN 9780415635844 – a very good guide to the process of undertaking and writing up a survey

Hollis M, *Surveying Buildings*, RICS Books, 2005 ISBN 9781842191927 – comprehensive guide to building surveys and defects

Marshall D, Worthing D, Heath R and Dann N, *Understanding Housing Defects*, Estates Gazette, 2013 ISBN 9780080971124 – an excellent resource that details the common defects found in residential construction. Detailed illustrations and clear descriptions

Journals

Building Surveying Journal (RICS Journals) – this is the journal for building surveyors and has a lot of useful articles on defects and dealing with them – http://www.rics.org/uk/news/journals/building-surveying-journal

Videos

Domestic defects on modern properties (https://www.youtube.com/watch?v=1FENY2nJ24Y)

Example Building Survey highlighting some of the key issues to look for on a survey (https://www.youtube.com/watch?v=r3BxPyh3l1c)

Producing a RICS Condition Report (https://www.youtube.com/watch?v=IFZ7NPBzSFE)

Seminar on building defects in multi-unit developments (https://www.youtube.com/watch?v=0WGde8HBvFs)

Undertaken a residential survey, guide to the process and things to consider (https://www.youtube.com/watch?v=NGc-1LthULM)

Websites

http://www.channel4.com/programmes/grand-designs/ – Grand Designs – the popular Channel 4 programme website that contains links to the various episodes and related articles

http://www.channel4.com/programmes/the-restoration-man/ – Restoration Man – the popular Channel 4 programme website that contains links to the various episodes and related articles

http://www.rics.org/uk/ – Website for the Royal Institution of Chartered Surveyors provides links to several very useful resources and sources of information relevant to the unit.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 11: Site Engineering for Construction

Delivery guidance

Approaching the unit

In this unit, learners will investigate and develop the essential skills required for setting out construction and civil engineering projects, exploring a range of approaches that can be used to make sure that construction projects meet their specified tolerances.

Through investigative and problem-solving activities, learners will appreciate the importance of ensuring specifications are met, for example, understanding the reasons for ensuring that roads are set out to the correct level.

Learners will explore the techniques that are involved with surveying, including how these are used to ensure both sub-structures and superstructures meet specifications. They will need plenty of opportunities to develop their confidence in using a range of surveying equipment to set out construction works for both roads and buildings. This can be either optical (traditional) equipment or digital equipment, for example, a total station.

This unit will also develop learners' understanding of methods of controlling the horizontal and vertical aspects of structures and excavations and how they can gather and interpret data for these control purposes.

The knowledge and skills developed throughout this unit are highly valued within the construction industry. This will be reinforced to learners through the involvement of local employers in the delivery of this unit.

Delivering the learning aims

Learning aim A

For learning aim A, you could begin with a site visit to observe setting out taking place. This would be an interesting way to introduce learners to the terminology that is used for setting out. Learners could be given a site plan on which to annotate the key terms they pick up, and these can then be referred to and discussed in detail in following classroom sessions. Tutor-led demonstrations and practical tasks could be used to develop an understanding of the equipment and methods used in the setting out of site. You could follow this with practical activities for learners to apply techniques for setting out right angles and transferring benchmarks in a site-based environment.

You could then examine methods of interpreting drawing information and how these are used to set out excavations and external walls. This could be achieved through fieldwork tasks where drawings are provided and learners complete the setting out appropriately. Throughout the activities, learners should become familiar with the traditional and digital tools that are used in setting out.

Learning aim B

With learners now confident in their understanding of how the tools and techniques are used for setting out on-site, you can begin to introduce them to the practical application of these methods through learning aim B. You could begin by considering the methods used to set out drainage – including locating key design features – and carrying out related calculations. This offers the opportunity to apply the theory learned through learning aim A and should be complemented by the use of site visits as appropriate.

You could use a similar method to introduce learners to procedures for setting out embankments and cutting profiles before considering setting out roads. You could then introduce learners to the drawings and documentation used for road designs, before considering the methods used to set out road curves.

Learning aim C

Learning aim C could then be introduced through the consideration of the various requirements for ensuring the vertical and horizontal control of structures and excavations. Visiting speakers could explain the different approaches to vertical and horizontal control in setting out, drawing on their own experiences and outlining any particular challenges they have faced. As with learning aims A and B, learners would benefit from site visits to observe structural steelwork or concrete works being used to construct a multi-storey building, and to witness the controls in place to ensure that tolerances are met.

The assessment outcomes require learners to undertake setting out of work on plan and of infrastructure works. Centres will need to provide a physical space as well as the equipment appropriate for surveying of the site and marking out. For greater realism, they would benefit greatly from more than just site visits, rather, where possible, from the opportunity to carry out some site engineering activities, such as data collection and measurement, supervised on location infrastructure projects.

Assessment model (in internally assessed units)

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	

Assessment guidance

The assessment of this unit is most likely to be in the form of two assignments, one for learning aim A and a second for learning aims B and C.

For the first assignment, learner evidence would normally be presented in the form of a method statement for a setting-out task that communicates all technical considerations required before commencement of the practical exercise. They will also need to evidence their justifications of the selection of tools, equipment and processes for the stated purpose.

Learners need to demonstrate that they can set out, from plan, a building for initial excavation, using corner pegs, containing a void for differentiation, to an agreed tolerance specified by a known standard. The setting out then must be extended for the construction of the building walls, with central, internal and external grid lines established.

In the second assignment for learning aims B and C, learners are required to demonstrate their analytical skills with a pre-excavation survey for the setting out of infrastructure works. Learners will need to clearly present a range of evidence collated from fieldwork activities, including an evaluation of the methodologies used in completing a range of practical setting-out tasks for a drainage run, an embankment or cutting and a road curve. Each will be supported by calculations and appropriate diagrams.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 11: Site Engineering for Construction

Introduction

This unit enables learners to gain practical experience of setting out methods used for a range of applications in the construction sector. There are opportunities for visiting speakers to explain to learners the techniques that can be used, along with site visits to gain first-hand experience of the processes involved in setting out.

Learners will need to be confident in the interpretation and communication of setting out data and plans being considered. You should give learners real-world scenarios and tasks to allow them to practise and develop the skills needed to set out a range of construction features in a fieldwork setting. Learners should also gain experience of the control methods used on site to ensure that horizontal and vertical tolerances are met.

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

The purpose of learning aim A is to give learners the background knowledge and understanding of setting out that will prepare them for carrying out setting-out tasks using a range of techniques and equipment.

- You could firstly introduce learners to terminology that relates to setting out on construction sites. This could be achieved through site visits, demonstrations and visiting speakers. Learning could be further supported through class discussions to confirm the meaning of terms and the applications of key pieces of equipment. Learners could then carry out research activities within small groups to produce information sheets that explain the application of equipment and how it is used.
- Learners could then be introduced to the use of coordinates and related measuring methods. This could be explored initially through case studies and classroom-based exercises for learners to plot coordinates using a range of techniques. Tutor demonstration could then introduce learners to further measurement methods, including the use of diagonal and offset measurements, before tasking learners with practical setting-out exercises to reinforce theory.
- You could then introduce learners to the techniques used to establish basic setting-out points. This could be achieved through paired practical activities to apply a variety of methods to construct right angles. Videos could be used to demonstrate techniques using theodolites and total stations. Learners could then be set tasks to construct a range of right angles in the field.
- You may wish to follow this with a tutor-led group discussion on benchmarks, including how to source them, and the methods used to establish temporary benchmarks on site. Learners could then carry out activities to establish a temporary benchmark from a given point. You can conclude the session with a class discussion on the reasons for taking recordings on site and the importance of protecting a temporary benchmark.
- This could be followed by paired research activities to investigate the use of digital information and storey tapes on construction sites. The results of investigations could be compiled into a shared resource for all learners.
- You could then demonstrate to learners how to interpret drawings to obtain setting-out information and dimensions for use on site. This could be developed through the use of exercises to set out voids for excavations and the outlines for buildings using corner pegs and profile boards as appropriate.
- Throughout the activities, learners should be encouraged to make notes about the use of tools and equipment for setting out. Learners could also be set paired research

tasks to investigate how and when various pieces of equipment and tools are used, and these could be collated into a guide for learners.

- Finally, you could introduce learners to the use of digital technologies, using a tutor-led class discussion to consider the benefits of using this equipment, including total stations, laser levelling and laser measuring.

Learning aim B – Undertake the setting out of infrastructure works

The range of surveying techniques introduced in learning aim A are further explored through practical application in learning aim B, as the learners progress through a range of setting-out activities for a given situation. You could make use of peer assessment of practical tasks, with tutor consolidation of knowledge.

- To introduce learning aim B, you could lead a discussion with learners to examine their understanding of the purpose for setting out on site. This could reflect on an earlier site visit from this unit, or be discussed as part of a further site visit where setting out is being carried out.
- In a class-based session, you could then introduce learners to the approaches that need to be taken when setting out drainage. You could demonstrate how to calculate gradients from design drawings and then assess learner understanding through the use of case study-based questions.
- Further demonstrations could be used to show learners how to transfer temporary benchmarks to on-site drainage positions before dividing the class into smaller groups to complete the activity themselves on a suitable work site.
- You could then introduce learners to the calculations that they need to use to determine heights of profile rails and the length of traveller. As with previous calculations, learners could complete task sheets to assess their understanding of the processes.
- Further demonstrations could be used to introduce learners to the methods needed to set up profile boards, to establish profile rails and the positioning of level indicators. This could be reinforced with the use of video resources prior to learners working in small groups to carry out the activities themselves.
- Once learners are competent with the techniques required for setting out drainage, you could introduce them to the methods used for setting out embankments and cutting profiles. You could adopt a similar process of demonstrating to learners the calculations that they need to be able to carry out before assessing their understanding. This could then be followed by demonstrations of the activities that need to be completed, with learners then carrying them out in small groups.
- You could discuss with learners the methods used for setting out roads, including the need to ensure that road curve points are correct in accordance with road design drawings.
- With an understanding of how to interpret road design drawings, you could introduce learners to the chord point method of setting out curves. This could be achieved using demonstrations of calculations and the physical setting out road curbs using pins. Learners could then work in teams to set out a road curve from a given drawing.
- You could then introduce learners to the deflection angle method. Initially, you could demonstrate to learners the methods of establishing the deflection and tangent angles and chord lengths. Learners could then be shown how to use a theodolite to establish each tangential point from the data produced. Learners could then work in teams to set out a further road curve.
- This could be followed by a tutor-led discussion to evaluate the relative benefits of each method of setting out roads, with learners considering which is more appropriate for given situations.
- There should also be an opportunity for fieldwork or site visits for this learning aim (along with learning aim C), as this will give learners the opportunity to observe and

perhaps even undertake measurements in a real environment.

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

Learning aim C is intended to introduce learners to the techniques that are used for the vertical and horizontal control of structures and excavations. As with learning aims A and B, there are opportunities for site visits and visiting speakers to contextualise theory and practice in a site-based environment.

- You could introduce learners to the topic by discussing the reasons for horizontal and vertical control of structures; this could be expanded upon through the use of case studies where control has not been effective, and discussions to explain the effects of not using control methods.
- You could use practical demonstrations to introduce learners to the methods of positioning kickers for *in situ* concrete columns; this could be supported through the use of videos. You could then demonstrate the methods used to confirm verticality of column shuttering and check tolerances, with learners working in small teams to carry out similar checks on shuttering.
- Learners could then be introduced to methods of checking squareness and diagonals of shuttering profile on plan, and visual checks of the cover of reinforcement.
- You could then discuss the similarities between concrete works and structural steel works, and the approaches that need to be taken when checking profile lines and the position of holding down bolts. Learners can then complete a range of practical exercises that involve inspection and checks to ensure that both concrete and steel structures are within tolerances.
- A visiting speaker who specialises in setting out excavations could discuss how data are collected and used prior to excavation, e.g. to establish and record ground levels. This could be followed by group activities to set out a grid over an excavation area and plotting a grid of levels to reduced levels.
- You could then demonstrate to learners the techniques used to produce an interim and final grid of level from reduced excavations. You could also demonstrate to learners the methods of establishing volumes, including calculating the formation level achieved and confirmation of depth.
- This could be followed by group tasks to apply theory in a field environment.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Chudley and Greeno, *Building Construction Handbook* (Seventh Edition), Butterworth-Heinemann, 2008 ISBN 9780750686228

Manley S, Charters M, Francis C, Topliss S and Doyle M, *Construction and the Built Environment*, Pearson, 2008 ISBN 9780435499914

Osbourn D and Greeno R, *Introduction to Building* (3rd Edition), Pearson, 2002 ISBN 9780582473034

Smith J, *The Management of Setting Out in Construction*, ICE, Thomas Telford, 1997 ISBN 9780727726148 – Includes techniques for setting out a range of features

Journals

Building Magazine (Building) – http://www.building.co.uk/ – has case studies of a range of commercial, industrial and domestic construction projects

Construction News (EMAP Publishing Ltd.) – http://info.constructionnews.co.uk/ – includes information about health and safety, current practice and projects

Videos

CITB training video for health and safety on site when setting out (https://youtu.be/gL14tWDNIEE)

Examples of setting profile rails and travellers (https://www.youtube.com/watch?v=Wx41Y806DA4)

One method of using kickers (https://youtu.be/kNAtt-wKAj0)

Setting out processes for buildings (https://youtu.be/rBmTf8wp4xo)

Use of a digital theodolite (https://youtu.be/BZi0owCSsso)

Use of a level (https://youtu.be/j8poe2vvD2Q)

Websites

http://www.ciob.org.uk – The Chartered Institute of Building

https://www.ice.org.uk/ – Professional body for Civil Engineers in the UK. Resources, standards, career advice and CPD, providing useful context on the role of a civil engineer

http://www.qs4freshers.com/introduction-to-setting-out.html – Introduction to use of tools and equipment for setting out

http://www.raeng.org.uk/ – The Royal Academy of Engineering website, includes information and case studies of construction projects

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 12: Low Temperature Hot Water Systems in Building Services

Delivery guidance

Approaching the unit

Your focus during delivery of this unit would be on developing the knowledge and skills that would enable learners to understand low temperature hot water systems (LTHWS) and to design such systems for a domestic property.

Illustrations, images, animations and video clips are all useful resources to explain how LTHWS work in a domestic property. Such resources are freely available online and can be easily incorporated into your tutor presentations.

In addition to this, site visits would be of great benefit to learners, and could include a low temperature hot water control rig or a solar collector. Involving local professionals and experts from the building services engineering sector as guest speakers will be helpful to enthuse learners as they gain exposure to the current practices in the industry.

You could either develop a mock project brief or adapt an actual case study/design example to be used as a learning resource ideally throughout the delivery. This would help to develop a holistic understanding of the subject among learners.

Delivering the learning aims

Throughout the delivery, you should relate the content of this unit to number of units on this qualification, which will help to motivate learners.

Learning aim A is about not only understanding client needs and design requirements for a system – including space heating needs – but also considering factors such as efficiency, functionality and environmental issues.

You could start by introducing how LTHWS work using animations, DVDs, pictures, illustrations or web-based videos. You could then introduce an example of space heating needs of a dwelling.

Engage learners to develop an outline of a client brief and then introduce regulations and calculations. Learners will need to understand the importance of assessing the practical and functional uses of the system, and be able to demonstrate their problem-solving skills when considering potentially conflicting requirements or regulations.

Learners can be supported and challenged during delivery through a variety of means – such as knowledge quiz, paired/group activities, class discussions and presentations – to provide opportunities for peer learning alongside motivating the learners.

Whether content is taught in parallel or linear sequence, you could adopt a holistic project-based approach in combining the delivery of learning aims B and C, as these have a significant overlap in terms of their content. You could either develop a new mock project for learners or expand upon the one developed in learning aim A.

Learning aim B is about designing an LTHW installation for a domestic property and learners will need to apply their analytical skills to meet the project requirements with the appropriate selection of components. In learning aim C, they will be developing the specification for materials, components and equipment, including primary elements of heat generation and considering access and maintenance issues.

You would require access to relevant project information such as drawings – especially those related to component details as you would use these as learning resources – and you could contact the building services companies who are always willing to help.

Finally, where possible, invite a guest speaker who could be from boiler manufacturers, green technology solution firms, gas suppliers, LTHWS installation companies or from wholesale organisations. The guest speaker should be able to share with learners the current approaches and design practices ensuring efficiency and environmental sustainability.

Assessment model (in internally assessed units)

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	

Assessment guidance

There are a maximum number of two summative assignments for this unit. You should set the assignment briefs within the context of a domestic property. For assignment 1, which will cover learning aim A, you should provide adequate details about the client requirements so that learners could carry out suitable evaluation. Learning aims B and C will be addressed in assignment 2, and you should include, in addition to the above, component and materials requirements.

You could ask for assessment evidence in the form of a project report and a portfolio containing drawings and specifications. Ask learners, as part of the instructions, to include sketches, illustrations and a list of information sources used.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 12: Low Temperature Hot Water Systems in Building Services

Introduction

Introduce learners to the unit using animations, DVDs, pictures, illustrations or web-based videos relating LTHWS installation within a domestic property.

Engage your learners during delivery through knowledge quiz, paired/group activities, class discussions and presentations as well as through guest speakers and site visits.

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

- You could begin with a tutor presentation to introduce the topic by showing how LTHWS work using animations, DVDs, pictures, illustrations or web-based videos.
- Following this with a tutor-led discussion, you can engage learners to consider an outline of a client brief. You could ask questions such as 'what would you like in a heating system in your house' or 'would you consider minimising carbon emissions or lowering costs'. Summarise key points and add as necessary.
- Working in small groups, learners could then develop a client brief for a given scenario – taking into account the building use, the client needs and environmental considerations. Groups could present their recommendations to the class.
- In the following session, you can present in more detail, explaining types of systems, performance and environmental requirements, controls, external factors and sustainability. Use DVD/web-based video resources as appropriate. You can further engage learners throughout with informal Q and A sessions to check understanding.
- For a group activity, issue learners a set of example project documents, including client brief, design requirements and the final design. Split learners into groups and assign a specific topic out of the unit content for this learning aim. For example, group A to identify how performance requirements have been satisfied. All groups to share their findings. You would facilitate and add as necessary, collating group notes for the class in a shared access folder.
- Learners will need knowledge of the regulations and standards applicable to a domestic LTHWS design. Tutor presentation could introduce relevant regulations, legislation as well as Standard Assessment Procedure (SAP) calculations. Use the previous example project data to provide examples of compliance – rather than reviewing extracts from specific regulations – to focus on key requirements and examples. You could provide summary handouts with key features of regulations that learners could apply to the brief.
- Use a knowledge quiz to check learning before starting calculations on thermal transmittance (*U*-values) and heat losses. You could use the same example project data and ask questions to assess learning so far. Provide model answers, ask learners to do self-assessment and give constructive and developmental feedback.
- Develop task sheets for calculation of *U*-values and heat losses within a domestic property. In a tutor-led activity, do some example calculations before handing task sheets to the learners, and support learners while they are working to solve the tasks. This activity could also be conducted in small groups. Conclude this activity with learner feedback and summarise key factors for consideration.
- To review learning across this topic, facilitate a class discussion, evaluating factors to be considered while designing domestic heating systems, summarising learner feedback and expanding on key points as necessary.

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

- You may wish to revisit the project documents analysed by groups in learning aim A, or develop new mock project. Learners will require adequate details such as: comfort requirements, external conditions, constraints, building orientation, size of windows and openings, air infiltration rates, performance requirements and environmental considerations.
- Tutor presentations, using design examples, product videos, drawings or other interactive/graphical resources will provide underpinning knowledge about pipe sizing, requirements of pumps, selecting heat emitters and boilers, expansion and storage as well as access arrangements.
- Knowledge quiz: use the quiz to assess learners' understanding of design factors and components, draw on key points and summarise.
- Using an example design project – from learning aim A, or the new mock project – assign small groups a design task to research and develop. For example, you could ask a group to study the pipe network and identify the sizes, flow rates and zoning. Groups will then present to their peers, justifying design recommendations made.
- Develop a number of task sheets covering design exercises related to the mock project for a tutor-led activity. Demonstrate some example calculations before handing these to the learners, and support learners while they are working to solve the tasks. This activity could also be conducted in small groups.
- Learners can then apply this knowledge analysis to their own design for a LTHW installation.
- Learners could prepare and present their project analysis to the class. Ask them to justify their design choices and update plans following constructive and developmental feedback.

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

- Continue with the same mock project as used for learning aim B. Working in small groups, assign learners materials, components and ancillary equipment and task them to research the design specifications and present to their peers. For example, you could ask a group to study the pipe network and identify the materials and jointing methods used.
- Tutor-led practical activity: ask learners to use their design of the mock project and develop specification for materials, components and ancillary equipment.
- Develop a checklist, to support learners, based upon the unit content.
- Support learners while they are working to develop the specifications so that they use the correct terminology and style. This activity could also be conducted in one-to-one tutorials with the groups.
- Ask learners to present their complete design along with specifications of mock project to the class. Learners should be able to provide evidence of extensive research carried out to finalise their choices. Ask them to justify their design choices and add using constructive and developmental feedback.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Burberry P, *Environment and Services* (Mitchell's Building Series, 8th edition), Routledge, 2015, ISBN 9781138167780 – this book explains principles of services installations and environmental considerations and is relevant to the content of this unit.

CIBSE, *HVDH Domestic Heating Design Guide*, DBSP, 2015 ISBN 9781906846350 – the guide provides useful information for designing domestic heating systems.

Hall F and Greeno R, *Building Services Handbook* (8th edition), Routledge, 2015 ISBN 9781138805637 – as the name suggests, a handbook covering all aspects of building services in a concise manner.

Steele G, *Central Heating: A Design and Installation Manual* (Revised), Elsevier, 2013 ISBN 9781483105604 – a very good resource to help in designing modern domestic heating systems.

Journals

Building Services Engineering Research & Technology (BSERT) (Sage Publishing) – this is CIBSE's quarterly journal containing useful research relevant to all aspects of building services engineering (http://journals.sagepub.com/home/bse).

P & HE Journal, (Chartered Institute of Plumbing and Heating Engineers, CIPHE) – this is CIPHE's online journal that covers a broad range of areas relating to plumbing and heating (http://www.ciphe.org.uk/professional-members/publications/).

Videos

A useful resource for pipe sizing (https://www.youtube.com/watch?v=2jJZIFEd-cs)

A fun-to-watch resource to understand how heating, ventilation & air conditioning systems work (https://www.youtube.com/watch?v=Otm1oQDx71Y)

An interesting podcast titled 'All About Home Heating Systems' (https://www.youtube.com/watch?v=zN5nzxCuuL0)

Websites

http://www.cibse.org/ – this is the website of Chartered Institute of Building Services Engineers (CIBSE), the professional body for building service engineers. The website contains information about the codes, products and industry updates.

http://www.ciphe.org.uk/ – this is the website of Chartered Institute of Plumbing and Heating Engineers (CIPHE), the relevant professional body. The website contains information about the codes, products and industry updates.

http://www.hetas.co.uk/about-hetas/ – this is the website of Heating Equipment Testing & Approval Scheme (HETAS), the official body to approve biomass and solid fuel heating appliances, fuels and services. The website has useful resources about relevant products.

http://www.ncm-pcdb.org.uk/sap/lowtemperatureheating – this website is owned by building research establishment (BRE) and provides support to UK building energy performance assessments. The website has wealth of information relevant to LTHW systems.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 13: Measurement Techniques in Construction

Delivery guidance

Financial control of projects cannot be undertaken without measurement of quantities, so rates can be applied and a contract sum established. Measurement is used for the valuation of variations and to provide quotations for contact instructions.

This is an optional unit and will be of interest to learners orientated towards a career pathway in quantity surveying. Here, they will explore the processes and procedures that would be involved for a client and main contractor, examining how quantities are extracted from the drawings produced by the designer, and develop understanding of the principles and procedures that cover budgets, pricing and estimating.

Learners who are interested in mathematics will engage well with this unit, along with those who have strong analytical skills – analysis to gain information forms a large part of this unit. Throughout delivery, learners will develop key skills in the following areas:

- Interpretation of drawings to obtain measurements for take-offs
- Mathematical skills in quantifying dimensions
- Analytical skills in using construction technology to interpret what to quantify
- The ability to work methodically through a sequence of operations.

Attention to detail is essential, so nothing is missed that could have a financial impact for a client's project. Within this context, learners will easily understand why quantity surveyors are in demand and highly valued as they are so essential to the financial management of a client's projects.

Approaching the unit

A large majority of the content for this unit is based around taking off quantities, so it is vital that you source suitable drawings for this purpose. These will need to contain sufficient detail and dimensions so no scaling is required (as this could lead to errors). Obtaining the services of a Quantity Surveyor would provide one method of engaging learners in employer-related projects where a lot of resources could be utilised to assist with the delivery of the unit. Demonstration using examples are the key focus for this unit. The internet can provide some examples to demonstrate the processes contained within this unit, but you should note that there will be some variation on these between countries and their different standards.

Delivering the learning aims

Learning aim A

Learning aim A introduces the learners to the reasons taking off quantities and the methods used to undertake this. A simple explanation would suffice for topic A1, which could then be drawn out into class discussion using a spider diagram to capture the key points. You need to explain what tendering and estimating are and the differences to approaches in both. You will only need one session for delivery of topic A1, as there is very little content associated with reasons for production of quantities.

Topic A2 carries more depth and explores the standard methods of measurement used in the UK. (It might also be worth mentioning a few of the different standards that are used around the world). You need to draw out why we need such rules, and this can best be approached through tutor-led discussion.

The Royal Institute of Chartered Surveyors (RICS) produces the New Rules of Measurement (NRM), and the Institution of Civil Engineers (ICE) the Civil Engineering Standard Method of Measurement (CESMM) and you will need to discriminate between the two standards of measurement – one is mainly for construction and the other is used for heavy civil engineering works. You will need to further explore the three separate standards – NRM 1, 2 and 3 – and explain the difference between the three.

Examination of the format of a page from a measured item needs to be undertaken so learners can observe that a standard set of columns are used to provide guidance, and to establish logical rules against each measured item. A similar approach needs to be done with the Civil Engineering Standard Method of measurement so a contrast can be made.

Learning aim B

Learning aim B is the main part of the unit and covers the production of quantities using taking-off techniques and use of dimension paper. Learners will do this for sub- and superstructures and for civil engineering projects. You will need to source some suitable drawings for this purpose and could look on the planning portal on a Local Authority website. The drawings downloaded should be checked for suitability to ensure they contain sufficient dimensions for this purpose and are not too complex.

Topics B2 and B3 cover the production of quantities for sub- and superstructure items. Here, links to the other units, especially Construction Technology, will help with an understanding of how the take-off will be built up. Each of the relevant work sections of the NRM 2 will need to be accessed, so students can see the detailed procedures for the take-off of each area covered within the unit. This will provide the unit of measurement and how this is applied along with any supplementary rules of guidance. A range of take-offs will need to be covered at least three from each of the content under B2 and B3 for sub- and superstructure. Drawings will need to be provided that are specific to each that contain dimensions and specifications where applicable. Topic B4 then covers the production of quantities using the Civil Engineering Standard Method of Measurement using the current version CESMM4. You will need to source suitable civil engineering drawings so that quantities can be taken off. These could be sourced from a local civil engineering firm.

Learning aim C

Learning aim C covers the production of bills of quantities, the final part of quantity production, after the taking-off process has been completed. The various methods related to this process will need explaining to learners. Demonstration of an actual bill example will be required to show how these are formatted, as would the use of section summaries, and a final summary should also be demonstrated so learners understand the layout of the final bill of quantities.

Examples of 'direct billing' will also need to be provided to show how this process differs from dimension, abstraction and bills of quantities. It should be noted that cut and shuffle as a process is now obsolete and is no longer considered a viable method of producing bills of quantities, and a class discussion around this topic would be useful to help learners understand the changing demands within the industry.

Assessment model (in internally assessed units)

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 sub-structure and superstructure elements	**B1** Processes in the production of quantities **B2** Production of sub-structure 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, sub-structure, elements of a superstructure and elements of external works Bills of quantities for a building, sub-structure, 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	

Assessment guidance

The assessment of this unit will require learners to demonstrate their knowledge of, and ability in, taking off some quantities using a standard method of measurement. The first assignment will require learners to analyse and evaluate the various standard methods of measurement used in construction. A written report would be the recommended format here.

For the second assignment, learning aims B and C are covered with one assessment activity, combining construction and civil engineering elements Learners will require a copy of NRM 2 and CESMM4 to apply the rules of taking-off. Dimension paper will need to be prepared for this purpose, along with abstract paper, and suitable drawings will be needed for sub- and superstructures so that quantities can be taken off.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 13: Measurement Techniques in Construction

Introduction

This unit involves the application of rules that are followed in the production of quantities. The various stages of a project, from inception, design brief, feasibility and construction, all require different methods of measurement and quantities. This is because the drawn information at the detailed design stages becomes more accurate and, therefore, so does the quantities for the bills that are taken from it.

Across all of the learning aims, the use of guest speakers and developing a relationship with a local Quantity Surveying practice will prove a very valuable resource. Examples of current practice could be demonstrated to learners, along with digital methods of taking off and quantifying building elements. Employer engagement through work experience placements by learners may also provide opportunities to capture resources for the delivery of this unit. This would rely upon finding placements within Quantity Surveying practices local to your centre.

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

This topic introduces learners to the rules of measurement for building and civil engineering projects. You will need to download a free copy of the New Rules of Measurement and purchase a copy of The Civil Engineering Rules of Measurement (one copy will suffice). Details for both are listed in the Resources section.

- You could begin with a tutor-led discussion to establish prior knowledge and collate information in a spider diagram, capturing the reasons why both approximate and accurate quantities are needed, and who would use them at the various points in a construction project.
- Engaging guest speakers from a range of backgrounds would be useful in these early sessions. For example, the Estates Manager for your centre could provide information on the different uses of measurement within your estates organisation. The use of a client's professional quantity surveyor could demonstrate the different uses of measurement rules for the different stages of a project. An architect could cover this specifically for the design stages and budgets.
- Using a timeline from a case study project would be a useful way of summarising what reasons you would use measurements and quantities for at each stage. Initial tutor presentation could be followed by a small group activity, providing a project brief and images to learners to explore in more detail the many different stages of the project and identify where you would use quantities at each stage.
- Moving on to the standard methods of measurement, you will need to ensure learners understand why there is a rulebook for the production of quantities and what the origins of measurement are. You could deliver this initially with a tutor-led review of the Standard Method of Measurement 7 (SMM7), the predecessor to the New Rules of Measurement 1, 2 and 3. This demonstrates the historic development of the rules of measurements along with the updating required for technological changes.
- You could split the class into three groups and task learners to go and measure a room. You will have primed each group with different rules. For example, one measures to the nearest full metre, one rounds up by one additional unit and the other measures exactly. All three groups then present and discuss their results and their understanding of the reasons and need for rules of measurement.

- Learners could then carry out detailed examination of a page from the NRM 2 and a page from CESMM4 on the same work item so comparisons can be made between the two. This should include an examination of the different columns and their meaning in each document.
- Learners could be asked to write a report summarising the status of RICS and the Institution of Civil Engineers (IVCE) each professional body regarding the rules of measurement. They should focus on what influence the rules have on each professional body and the considerations for its application within the construction and civil engineering sector.
- Ask learners to download NRM 1, 2 and 3 and divide the class into groups. Each group will prepare a presentation on what NRM 1, 2 and 3 means, in terms of what it covers and is used for. Presentations are delivered by the groups, which gives you the opportunity for constructive feedback in terms of important employment and development skills.

Learning aim B – Undertake the production of quantities for sub-structure and superstructure elements

- You could introduce this learning aim with a brief presentation on the 'rules' that are used for dimension paper, explaining what each column is used for. The standard format and rules when placing dimensions and how these are written should also be covered. Examples of how this is done should be provided so that learners develop a clear understanding of how the content (listed under topic B1) is applied on dimension paper. There are some materials available within the core textbook that accompanies the qualification that you could refer to here.
- Further activities to demonstrate the processes in the production of quantities and the vocationally correct format to be used could include the following:
  - A template sheet with the rules of how dimensions are laid out; a copy of such a method is available within the book for L3 Construction
  - Whiteboard demonstration and learners take down the methodology onto dimension sheets to form quick reference guides
  - Sheets from a quantity surveying practice that demonstrate the rules of taking off
  - Forming a glossary of standard quantity surveying abbreviations
  - Centre line activity calculation examples
  - Practical demonstration of the centre line calculation for a cavity wall so that the centre line can be calculated for each skin and the cavity.
- Topics B2 and B3 cover quantity production for sub- and superstructures, and links with content in *Unit 4: Construction Technology* and *Unit 19: Quantity Surveying*. You may be able to share resources across this unit and make assessment more effective. You will need to source suitable project examples to support your delivery, covering areas such as:
  - excavation take-off for a mass-filled foundation
  - construction of external wall to dpc level
  - solid ground floor construction.
- The recommend delivery approach for both sub- and superstructures would simply be a demonstration by you of the method followed by learner-centred worked examples. You should give them a change in dimensions for their starting point (e.g. you could change the perimeter dimensions for an external wall take-off). Learners should work independently throughout the exercises, with the availability of your support when required. Quantity surveying textbooks may provide several worked examples for this method of delivery.
- The final topic B4 covers the civil engineering take-off of quantities. Drawings will need to be sourced and could be provided by a civil engineering consultant or a

structural engineering practice. A simple concrete base or foundation would provide all the elements to be covered under the unit content. The drawings need to contain concrete works and reinforcement with associated earthworks. Drainage drawings could be used along with retaining structures and other details.

- It is worth noting that the recommended method of assessment crosses learning aims B and C, and therefore, elements of construction and civil engineering could be taken from one set of drawings.

Learning aim C – Undertake the production of bills of quantities

- You could introduce this learning aim with a tutor presentation on the changing nature of the production of bills of quantities in the face of technological advancements (such as BIM). For example, cut and shuffle is no longer a common method of abstraction, and you could task learners to explore why this is in a tutor-led activity. This activity can be based around BIM and how it can produce quantifiable elements straight from the BIM elements. Research on this aspect would open up discussion and debate on the use of 3D modelling.
- Learners will best understand abstraction techniques through practical worked examples, and you can utilise the take-offs produced for sub- or superstructures in learning aim B in this activity. This involves a sheet of A3 paper where quantities are collected and summated, then rounded to nearest whole unit. You will need to print off some A3 paper that has vertical lines across it spaced 25 mm apart to form abstract paper.
- There are several online sources that can be used to demonstrate the direct billing method, along with examples in quantity surveying textbooks that you can use. You may be able to obtain some direct billing paper from a main contractor to assist with this method. In this activity, you are looking for learners to understand how direct billing enables quantities to be calculated and the rates applied straight away without abstraction and forming a bill of quantities.
- Sourcing a bill of quantities from a quantity-surveying consultancy will assist with the topic C2. This will demonstrate:
  - how a bill is written
  - how page summaries are incorporated
  - final work section summaries
  - the final summary
  - the format and layout of the document.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- Unit 1: Construction Principles
- Unit 3: Tendering and Estimating
- Unit 4: Construction Technology
- Unit 7: Graphical Detailing in Construction
- Unit 19 Quantity Surveying
- Unit 23: Construction in Civil Engineering

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Institute of Civil Engineers, *CESMM4: Civil Engineering Standard Method of Measurement* (Fourth Edition), ICE Publishing, 2012 ISBN 9780727757517 – The standard method of measurement for civil engineering works

Ostrowski S, *Measurement Using the New Rules of Measurement*, Wiley, 2013 ISBN 9781118333013 – A comprehensive guide to the application of the technical measurement skills required in construction

Seeley I, *Building Quantities Explained* (Fifth Edition), Palgrave MacMillan, 2005 ISBN 978033371972 – A well-respected text on building measurements, including helpful worked examples to demonstrate approaches

Topliss S, Hurst M, Cummings S and Donyavi S, *BTEC Nationals Construction Student Book + Activebook: For the 2017 Specifications (BTEC Nationals Construction 2016)*, Pearson, 2017 ISBN 9781292184043 – Coursebook to accompany the qualification

Websites

http://arrow.dit.ie/cgi/viewcontent.cgi?article=1031&context=beschreoth – Introduction to taking off quantities

https://www.designingbuildings.co.uk/wiki/Taking_off_construction_works – The designing buildings wiki website

https://www.rics.org/uk/knowledge/professional-guidance/guidance-notes/new-rules-of-measurement-order-of-cost-estimating-and-elemental-cost-planning/ – Link to download the New Rules of Measurement 1, 2 and 3

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Unit 14: Provision of Primary Services in Buildings

Delivery guidance

The four primary services of water, gas, drainage and electricity ensure that our modern domestic and commercial buildings give us a comfortable environment in which to live, work and recreate.

In this unit, learners are given an overview of these services from the perspective of a construction professional, to gain knowledge and understanding of the complexities of the installation and operation of primary services within buildings.

Having access to a plumbing and electrical workshop within a further education institute would provide an ideal resource for the examination of hot- and cold-water systems. The balance of the content delivery would be through academic means.

Employer engagement and access to guest speakers to discuss the installation of services would prove a valuable resource. You should also look to regional service authorities who often provide installer and developer guides, which can be freely accessed and provide a high level of technical information.

Approaching the unit

The focus and emphasis of this unit is for learners to develop the required skills to explain or outline the installation of gas, electricity, water and drainage to a low-rise property. They will need to be able to produce drawings in support of this, and as such, this unit has links to the *Unit 7 Graphical Detailing in Construction*. Cross-sectional images through buildings and schematic diagrams will be useful for demonstrating how a primary service is installed into a building, and you will find a wide range of videos are available online, which will help considerably with the delivery of the technical element of the content.

A site visit to a domestic or commercial project would also provide opportunities to investigate the services that are installed around the structure. Where possible, site visit requirements across units should be coordinated to maximise access to information, images and topics for discussion.

Delivering the learning aims

Learning aim A

Learning aim A covers the water services of direct and indirect hot and cold installations. Learners need to be aware of the materials that are used for installation, and referring them to a plumbers' merchant website would be good practice. Using your centre as a resource to demonstrate the water services layouts would also prove useful. For all systems in this learning aim, you will find the internal distribution layout can be covered using diagrams and annotation with supportive text.

Having covered direct cold-water systems in topic A1, you can move on to the indirect cold-water supply, where cold-water storage tanks are used, housed within loft spaces to provide a supply in support of the incoming main. The installation of the water supply regulations tank should be demonstrated to learners. A cross-section diagram will be needed. The regulations concerning this have been referenced under the Resources section. Useful visual information on this aspect is available from tank manufacturers who provide regulation-certified products.

You will then move on to direct hot water heating. This is the traditional system that heated hot water and stored it in a copper cylinder. You will need to demonstrate that this type of system did not have a coil within the copper tank, but operates by displacement; thereby, the volume of water was continually replaced. Use of diagrams and online videos will be useful here. This will need to be contrasted with functioning principles of the indirect hot water heating system. There are images available (online or in textbooks) showing a cut down cylinder that would be useful to demonstrate the pipework distribution involved is such a system.

Learning aim B

Learning aim B covers the aspects of drainage that services a property and the principles and approaches that can be taken to ensure that waste products are removed safely and without risk to health. Topic B1 covers the principles of internal drainage and the need to use sealed traps and ventilation valves. Using a plumbing manufacturer's website will provide details of how this is can be achieved using plastic waste fittings. To investigate the above-ground drainage in more detail, you can access photographs to demonstrate single-stack and two-pipe systems to contrast the differences in both domestic and commercial applications. Obtaining the services of a plumbing lecturer or a qualified plumber would provide opportunities as a guest speaker to support this learning.

You will need to provide some drawn information for the delivery of below-ground drainage approaches and principles that explain how separate and combined drainage systems operate and are installed when applied to, for example, a housing development. You may be able to download useful resources from a Local Authority planning website where drainage drawing layouts are submitted as part of building regulation approval. Several manufacturers provide installation cross-sections for drainage component and run details. These are useful guides so learners understand the hidden systems that operate below ground level. Many Local Authority Highway departments provide standard design details for manholes and other drainage components.

Learning aim C

Learning aim C looks at simple electrical systems and gas installation systems for domestic applications. In the event that apprenticeship learners are working on commercial projects in building services engineering, it may be possible to cover electrical systems and products used in non-domestic installations, if limited to non-complex systems as per the outcomes and assessment criteria. You will need to cover the component types commonly used in electric installations. Learner research and product samples are a good place to start. Further online resources that demonstrate ring and radial circuits along with the consumer unit installation information will need to be sourced. These could be video and or schematic diagrams of installations.

The topics C5 and C6 could be delivered using a boiler manufacturer. The topic C5 requires that learners know about ventilation, flue arrangements and the discharge of combustion products. This can all be accommodated through obtaining the services of a technical sales representative from a boiler manufacturer.

The developer packs from a gas supplier would again help with illustrating the gas service pipe requirements for a connection to include the meter box and installation of the isolation valve.

Assessment model (in internally assessed units)

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 and practices associated with 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.

Assessment guidance

You will need to source some construction drawings for the first assignment that covers learning aims A and B. These could be sourced from a local housing developer or downloaded from a local planning application. Learners could then annotate these drawings to detail the layout, dimensions and materials required for cold- and hot-water distribution networks, and the above- and below-ground drainage systems. Their accompanying report should clearly present the advantages and disadvantages of the various systems.

Drawings need to be simple and uncomplicated, so they do not distract from the line drawings produced by the learners. The construction drawings can be duplicated for the electrical and domestic gas installation layout. Alternatively, a cross-sectional drawing through a house is an option to support the assignment for learning aim C. The accompanying report will need to demonstrate learners understanding of health and safety regulations.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 14: Provision of Primary Services in Construction

Introduction

The technology covered within this unit is evolving, with many variations and options to consumers and developers opening up, such as renewable energy systems to heat hot water. This presents opportunities to inspire and engage learners with relevant and meaningful examples of new approaches to the provision of services, and they will need to demonstrate awareness of the many variations and hybrid systems that now exist and are currently installed in UK domestic homes.

This is a technical unit that requires access to current specifications and distribution details. These can be sourced from industry, especially a building services engineer, a plumbing contractor or a heating engineering contractor. If your centre delivers plumbing and electrical installation, then this is an ideal opportunity to source resources and visit installations installed by those learners. The use of component manufacturers' websites can also provide information and installation details of their component inclusion within full systems.

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

- Topic A1 covers direct cold-water systems. Learners need to describe the route, components, depth and installation from the service authorities main into the building. There is a wealth of freely available material that will support this delivery. For example, learners could download a developer pack that will demonstrate the service pipe entry into a domestic building. A tutor-led discussion could be used with the developer pack to demonstrate the service entries into a building from the mains. The packs contain images and drawings to show how this is undertaken right up to the meter or isolation valves.
- Learners could then be directed to the Water Supply Regulations that are aimed at ensuring a safe supply of drinking water.
- Following this, learners could conduct small group work to examine various scenarios to establish when a direct cold-water system is or is not appropriate. They could feed back their analysis in a class discussion.
- A physical site visit to observe the installation of a direct cold-water system would be of great value. The visit could be recorded for future delivery to a cohort.
- Locating a video online of an installation for class viewing would be a useful. You could follow this with a Q and A session that will help highlight key points for learners.
- Once you have covered the initial service pipe installation up to the isolation valve, the layout of the system can be delivered with the support of materials such as:
  - schematic diagrams of typical installations
  - use of manufacturers for pipework diagrams
  - use of a plumbing merchant's components catalogue
  - contrasting the use of copper pipework to plastic.
- Topic A2 covers the indirect installation for a cold-water supply. You could initiate class discussion and gauge prior knowledge, asking learners what the main contrasts are between the direct and indirect cold-water systems that need to be considered. You could then go on to examine schematic diagrams of a layout for a cold-water storage cistern.

- You will need to source diagrams of the cold-water storage cistern, which can be obtained from a supplier's catalogue. This should detail a typical tank that complies with the regulations to include insulation, dimensions, ball cock valve, position of overflow and exit pipework and the cover with a vent pipe.
- Following this, you could arrange a viewing of a storage cistern in position, perhaps within your centre or plumbing workshop. A plumbing tutor could then advise how the installation meets the requirements of the water regulations along with the associated pipework.
- Moving on to direct hot-water heating, you could again make reference to the advances in technology, which mean this traditional system is not currently installed, but one which learners may come across in older buildings. Again, schematic diagrams are the best method of explaining how the system works.
- An ideal and holistic way of covering hot- and cold-water service installations would be to view a house that has been first fixed. This would provide a hands-on approach to see the whole system installed for hot and cold water, how it is routed through a house, connections, fittings, fixtures, tanks and boilers. Another approach would be to ask a sales representative from a boiler manufacturer to provide a talk to students. They may provide video resources of a boiler installation and how their product works.
- Topic A4 contrasts against topic A3 in the indirect method of hot-water heating. You will need to demonstrate this using a cut-away image of a hot-water cylinder that shows the coil heat exchanger.

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

- This learning aim examines the drainage that is above and below ground level. You could introduce the drainage principles to be covered using your education site. You could arrange to view an above-ground drainage installation in conjunction with the estate manager, who could give learners guidance on access and maintenance of such a drainage system.
- Back in the classroom, you could then introduce learners to Part H Drainage and Waste Disposal Approved Document from the Building regulations, which provides details of falls and sizes of pipework. Learners should also study schematic diagrams from construction or plumbing textbooks that show a typical distribution network for above-ground drainage.
- A paired activity could follow, to take the information from the above and Part H and ask learners to design a simple drainage system above and below ground for a bathroom installation on the first floor, and a kitchen on the ground floor. This would combine sub- and superstructure drainage and offer team working. which simulates what may happen in a design office.
- Learners will benefit from getting hands-on with some of the components available to reinforce understanding of the drainage principles. For example, you could demonstrate the functionality of a trap seal using a plastic component.
- You should task learners to research drainage supplier's websites for above-ground plastic pipework installation products for a given system requirement. This could be a single-stack system for foul water drainage. Ventilation to drainage also needs to be covered, and a series of fittings can facilitate this, such as one-way air admittance valves fitted to soil stacks.
- The above-ground drainage approaches of single stack-systems and two-pipe systems are covered next. Again, diagrammatic images are the best method of demonstrating the drainage installation. Many plastic drainage pipe manufacturers provide full-storey height details for a full, above-ground drainage system, and this should detail all of the components, branches and connections used for a single-stack system.

- Observation of installations within a further education college workshop can also provide students with a clear idea of how this pipework is installed and supported and how it connects all waste outlets to discharge into the main drain.
- To introduce the principles of below-ground drainage, you will again need reference to Part H Drainage and Waste Disposal Approved Document. This will provide a vehicle to deliver information upon depth of drainage, falls, pipe sizes, access points, manholes and inspection chambers.
- Finally, you will move on to deliver the approaches to below-ground drainage installations – namely separate and combined systems. Building regulation applications will contain drainage design drawings and so would provide valuable sources of information for delivery. Ideas for activities to deliver this would be:
  - After initial tutor presentation on the separate and combined systems, you could ask learners to design a drainage system around a footprint drawing by annotating their plan onto an existing layout.
  - You could invite a guest speaker from the highways department to illustrate the local council's drainage systems that operate in your region.
  - Also of value would be a guest speaker from a design or architect's practice to demonstrate drainage designs for housing projects. This would need a focus on the preparation of questions by learners that are assessment specific. You would need to direct these against the unit's content.

Learning aim C – Understand the principles and practices associated with the provision of simple, single-phase electrical systems and domestic gas installations

- When delivering on both gas and electric services, you will need to demonstrate; the service entry into the building, accommodating the service within the ground, meter installation and the isolation of the service. You will find service providers often make available 'developer packs' containing all the information that you would need as, e.g. a developer building a series of domestic properties. These packs are a valuable resource that you can refer to throughout delivery.
- Topic C1 covers the health and safety features associated with mains electrical supply. You could begin by holding up a smartphone charger and asking learners a sequence of questions to draw out the safety features, such as:
  - How does this plug protect you from shock?
  - What about the switch on the wall?
  - What about the fuse board?
  - Anything to do with different colours of insulation to wires?
  - What is an RCD? MCB?
- Following this, learners can start to investigate the electrical components. This can be delivered through reference to suppliers and manufacturer websites, and you could split the class, giving groups a specific focus for their research. From this activity, comprehensive notes could be gathered from across the groups and made available to the class.
- It would be useful to obtain sample products from manufacturers for learners to examine, combined, if possible, with a demonstration by a technical sales representative whom the learners can engage with.
- Examination of the components within your centre could be carried out, with small groups conducting an audit of a specific area to capture volume and variety of components used.
- The electrical meter set-up is best shown by a video from the internet that can demonstrate the enhanced functionality of the new smart meters that are now being introduced.
- Schematic diagrams are a good method of demonstrating the ring final circuits for

topic C3, along with the rules for spur sockets. Using coloured schematic diagrams will illustrate the three colours used in modern wiring.

- Again, a schematic diagram can be used to illustrate the loop in method of wiring lighting circuits for topic C4. For high-power appliances, the level of protection needs to be examined for ratings on the circuit (e.g. 45 amps). This can be done by examination of the installation of a cooker point for a domestic property and the rules and regulations associated with such supply.
- You will need to cover the combustion, ventilation and flue arrangements of gas installations. This could be done by gaining access to a boiler manufacturers' installation instruction manual or asking a technical sales representative to deliver a talk on their boiler installation requirements. This should help learners understand that the boiler installation for a combination system is subject to strict regulations (e.g. Gas safe, as referenced under resources).
- You could also ask learners to view an online video of a boiler installation, from which they could produce a summary report.
- For the examination of a cross-section through a boiler installation, you should again utilise online video resources. This will need to include the flue installation passing through an external wall.
- The principles of a gas installation can be delivered using a developer pack from a gas supplier to detail the service pipe entry up to the meter box, installation of the meter, gas isolation valve and the governor, and finally, the meter.
    - Finding a cross-section through the external wall to demonstrate the meter box and supply pipe installation
    - Demonstrating the range of meter boxes that are available for different locations.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

The drawings produced for the 2D house can be used for the distribution drawings for services from the following unit:

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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Hall F and Greeno R, *Building Services Handbook* (9th Edition), Routledge, 2017 ISBN 9781138244351 – A comprehensive guide on building services, updated in line with recent regulations and technologies

Linsley T, *Basic Electrical Installation Work 2365 Edition* (8th Edition), Routledge, 2015 ISBN 9781138848849 – Includes end of chapter revision questions for learners

Treloar R, *Plumbing* (4th Edition), Wiley-Blackwell, 2011 ISBN 9781405189590 – Accessible guide to plumbing, heating and gas installations

Videos

Domestic electricity ring main installation (https://www.youtube.com/watch?v=JgJRdHInRnY)

Flopast drainage system video demonstrating below-ground drainage installation in plastic (https://www.youtube.com/watch?v=FJn_aGX4PJ0)

Installation of a boiler (https://www.youtube.com/watch?v=sHRNJgr_TBA)

Plumbing plastic pipework installation (https://www.youtube.com/watch?v=yIr6lWRf8H0)

Websites

http://www.cibse.org/ – Professional body for building services engineers. Resources, standards and professional development routes

https://www.gassaferegister.co.uk/ – The Gas Safe installation certification scheme

https://www.gov.uk/government/publications/electrical-safety-approved-document-p – Part P of the Building Regulations for electrical safety

http://www.igl.co.uk/_ui/img/IGL%20WS%201.2.5%20-%20Thames%20Water%20Installation%20of%20Supply%20Pipes%20-%20Version%201.pdf – Water supply pipe installation

http://www.legislation.gov.uk/uksi/1999/1148/contents/made – The Water Supply (Water Fittings) Regulations 1999

http://www.wwutilities.co.uk/media/1235/wwu_developerspack.pdf – Developer pack for a gas service

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 15: Further Mathematics for Construction

Delivery guidance

Approaching the unit

Your focus during delivery of this unit would be on learners developing a range of mathematical skills that they can apply to solve construction problems.

This is an optional unit for learners taking the Extended Diploma, and throughout delivery you can motivate learners by relating the content of this unit to work and projects undertaken in other units of the qualification. You should also emphasise at the start of teaching that the skills developed in this unit are transferable and will support learners during higher education as well as in various job roles.

You could use illustrations, images, animations and video clips to help explain the application of mathematics. Such resources are often freely available online and can be easily incorporated into your tutor presentations and you may find that many construction learners engage well with these resources rather than other delivery approaches.

You could invite guest speakers – either from planning, structural design, geotechnics, environmental and traffic management businesses, or experts from higher education institutions – who would help learners understand the importance of mathematical skills for further study and the satisfactory performance of various job roles. This would help motivate your learners.

You should appreciate that teaching mathematics at any level is challenging unless you contextualise it within construction related problems. Doing this will ensure that your learners are engaged and motivated to progress through the unit. You could make use examples drawn from the industry, such as 3-4-5 triangles, as well as from other units of this qualification such as *Unit 6: Surveying in Construction*.

Delivering the learning aims

Learning aim A

Learning aim A is about developing a comprehensive understanding of algebraic and trigonometric techniques and how to apply these to solve construction problems.

You could start by introducing application of trigonometric techniques such as finding height of a building or pitch of a roof to generate interest at the start. Tutor-led activities, presentations and demonstrations can be supported by the use of animations, DVDs, pictures, illustrations or web-based videos as well as physical objects such as cross sections. Once the theory has been introduced by these means, you should then use number of activity sheets specifically targeting the techniques. Learners will be able to work independently or in pairs to develop the required skills, and you could review and summarise activities, sharing correct answers with the class before progressing to further activities that challenge learners' application of the skills to construction-related problems. Some of your learners would require more support while others might require to be challenged with more demanding and complex tasks. You could develop activity sheets that contain certain extension activities to cater for such learners.

Engage your learners during delivery through in-class quiz or on-line interactive tests, paired/group activities to prepare them for the formal controlled assessment.

Learning aim B

Learning aim B is about developing differential and integral calculus skills and applying these to solve construction problems.

You could start by introducing application of differential and integral calculus such as finding maxima and minima or areas and volumes to generate interest at the start. You could give examples of maximising load a structural member can carry or minimise the cost of producing a component. Make use of animations, DVDs, pictures, illustrations or web-based videos. You should then use number of activity sheets aimed to develop required skills followed by their application to construction-related problems.

Engage your learners during delivery through in-class quiz/tests and paired/group activities to prepare them for the formal controlled assessment.

Learning aim C

Introduce learning aim C using some traffic data and material testing results and demonstrate how such data could be manipulated into useful information to generate interest at the start. Make use of animations, DVDs, pictures, illustrations or web-based videos. You should then use number of activity sheets aimed to develop required skills followed by their application to construction-related problems.

Assessment model (in internally assessed units)

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.

Assessment guidance

There is a maximum number of three summative assignments for this unit, relating to the content of each learning aim. You should set the assignment briefs within suitable construction contexts or an overarching construction project brief.

Both assignments 1 and 2 are to be carried out under controlled conditions. You should develop briefs that provide opportunities for learners to demonstrate their skills in algebraic, trigonometric and calculus-related calculations and apply these to solve construction problems.

For assignment 3, you could give learners test results, such as concrete strength, to find characteristic values or traffic data to make informed choices about future needs.

You could ask for assessment evidence that is logically structured and easy to understand in the form of a report containing the results as well as sketches and illustrations. Give clear instructions for learners to use correct mathematical conventions, units and numerical precision using appropriate significant figures or decimal places.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 15: Further Mathematics for Construction

Introduction

You could introduce the unit by referring to case studies to demonstrate the application of mathematical and statistical techniques. Interesting problem solving examples will help engage learners and generate interest at the start.

Your aim should be that learners develop range of mathematical skills to solve construction problems and you will frequently find tutor led activities, demonstrations and presentations an effective way to introduce mathematical theory. Make use of a range of resources where possible, such as animations, DVDs, pictures, illustrations or web-based videos.

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

- You may wish to introduce this topic with a tutor-led discussion to gauge learners' prior knowledge and understanding, and encourage learners to suggest a number of ways these techniques are applied in construction projects.
- Moving on, you could introduce the application of trigonometric techniques with specific examples, such as finding height of a building or pitch of a roof. Make use of animations, DVDs, pictures, illustrations or web-based videos to generate interest at the start.
- In a tutor-led individual activity, demonstrate re-arranging formulae. Focusing on linear, quadratic and cubic expressions, give learners activity sheets and task them to work individually or in pairs to complete the exercises. Provide support throughout, and to conclude the session, share correct answers with class and recap on any areas learners found particularly challenging.
- In a tutor-led individual activity, use a similar approach to develop skills in calculations related to trigonometry by first demonstrating these yourself. You could carry out a practical activity using 3-4-5 triangle as well as use data from survey field exercises to demonstrate the application of trigonometry. Give learners activity sheets covering trigonometric techniques. Learners could individually or in small groups provide support and share correct answers as necessary.
- You could make use of a practical activity in another unit such as setting out exercise in *Unit 6: Surveying in Construction*) and use this to demonstrate the application of trigonometric skills in solving a construction problem. You could use illustrations, sections or physical objects while demonstrating the application to properties of sections. Follow your demonstrations with similar practical exercises and well-illustrated activity sheets based on construction scenarios. Learners can tackle these, working small groups to solve the problems, before feeding back their workings to class. Conclude the session by summarising correct answers as necessary.
- You should upload all the exercises and correct solutions onto your VLE, which learners could use as a revision aid.
- To conclude this learning aim, provide an overview of the techniques through tutor-led discussion, highlighting common errors (such as choosing the correct trigonometric function) and outline the assessment requirements with reference to the in-class activities.

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

- You may wish to introduce this topic with a tutor-led discussion to gauge learners' prior knowledge and understanding, and encourage learners to suggest number of ways these techniques are applied in construction projects.
- You could introduce application of differential and integral calculus such as finding maxima and minima or areas and volumes to generate interest at the start. Make use of animations, DVDs, pictures, illustrations or web-based videos to generate interest at the start.
- In a tutor-led individual activity, demonstrate differentiating polynomial, trigonometric, logarithmic and exponential functions. Give learners activity sheets covering all the relevant unit content. Learners could work individually or in pairs. Provide support and share correct answers as necessary.
- Use a similar approach by first demonstrating the application of differential calculus, such as finding maxima and minima, in solving a construction problem. You could use illustrations and animations or other web-based resources. Follow your demonstrations with activity sheets covering all the relevant unit content. Provide support and share correct answers as necessary.
- In a tutor-led individual activity, demonstrate integrating polynomial, trigonometric and exponential functions. Give learners activity sheets covering all the relevant unit content. Provide support and share correct answers as necessary.
- In a tutor-led group activity, introduce the application of integral calculus, such as finding area under the curve, in solving a construction problem, by demonstrating the solution yourself. You could use illustrations and animations or other web-based resources. Follow your demonstrations with activity sheets covering all the relevant unit content. Provide support and share correct answers as necessary.
- In a tutor-led individual activity, introduce numerical integration techniques and demonstrate how these could be used as an alternative method of solution. You could use, for example show validating values using the mid-ordinate rule by comparing them to those achieved using calculus. Learners could work individually or in pairs. Give learners activity sheets covering all the relevant unit content. Provide support and share correct answers as necessary.
- You should upload all the exercises and correct solutions onto your VLE, which learners could use as a revision aid.
- Guest speaker: Invite guest speakers either from planning, structural design, geotechnics, environmental and traffic management or from higher education institutions who would help learners understand the importance of mathematical skills for further study and satisfactory performance of various job roles. This would help motivate your learners.
- To conclude the learning aim, provide an overview of the techniques, discuss common errors, such as identification of products and application of chain rule, and outline the assessment requirements as well as its relevance with the in-class activities.

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

- Introduce application of statistical techniques such as by using some traffic data and material testing results and demonstrate how such data could be manipulated into useful information, to generate interest at the start. Use animations, DVDs, pictures, illustrations or web-based videos.
- In a tutor-led paired activity, demonstrate how statistical data could be

manipulated and presented in various ways to convey useful information. For example, material testing results could be presented to convey the characteristic values of strength or traffic data could be presented to identify peak traffic values. Give learners activity sheets covering all the relevant unit content. Provide support and share correct answers as necessary.

- In a tutor-led group activity, demonstrate the application of statistical techniques to solve a construction problem. For example, how to use statistical averages to determine the characteristic strength of concrete test cubes. Follow your demonstrations with similar practical exercises and well-illustrated activity sheets. Provide support and share correct answers as necessary.
- You should upload all the exercises and correct solutions onto your VLE, which learners could use as a revision aid.
- To conclude the learning aim, provide an overview of the techniques, discuss common errors, such as choosing the correct presentation technique, and outline the assessment requirements as well as its relevance with the in-class activities.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Graham A, *Statistics: A Complete Introduction: Teach Yourself* (Reprint edition), 2013 ISBN 9781444191172 – this book provides good coverage of statistical techniques relevant to this unit.

Virdi S, Baker R and Virdi NK, *Construction Mathematics* (2nd edition), Routledge, 2014 ISBN 9780415810784 – this book is written specifically for BTEC learners and covers mathematical principles required for this unit.

Videos

Both these are good fun videos to explain fundamentals of statistics (https://www.youtube.com/watch?v=ooOdP1BJxLg, https://www.youtube.com/watch?v=7T6alC3Pkb8)

These videos contain explanations of basic trigonometry, including sine, cosine and tangent (www.youtube.com/watch?v=XFh_JC7OSrg, https://www.youtube.com/watch?v=L00jzqN_K3E)

The video shows differentiation processes and some applications (https://www.youtube.com/watch?v=Qbt3QHn2uYM)

The video shows and some applications of integration (https://www.youtube.com/watch?v=EBfxiKQLnJ4)

Websites

http://www.mathcentre.ac.uk/students/topics – This website contains online lessons on every mathematics topic covered in this unit.

www.wiziq.com/online-tests/21-maths-mensuration – This website contains free online tests on mensuration.

http://www.purplemath.com/modules/index.htm – This website has useful resources for algebra and basic mathematics and trigonometry.

http://www.aaamath.com/sta.htm – This website has good resources for statistics as well as some basic useful resources.

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Unit 16: Work Experience in the Construction Sector

Delivery guidance

Approaching the unit

In this unit, learners will investigate the benefits of carrying out a work experience placement within a construction organisation. They will gain an understanding of the skills that they could develop during their placement, such as team working, communication and interpersonal skills, and explore the expectations which an employer would have of them.

This unit will also encourage learners to investigate the many different career opportunities available in the construction sector and to consider the nature of the specific roles within the industry. This will allow them to understand the detail and relevance of the tasks they will be carrying out while on their work experience placement.

Building good links and relationships with local businesses and construction firms will be of great benefit to your learners, not only in the work placements, but also in facilitating ongoing mentoring opportunities, arranging site visits and engaging interesting and inspiring guest speakers. You may also gain opportunity to involver local employers in the assessment of project work.

Learners will develop their own plans for their work experience placement, considering their own goals and progression objectives which they wish to achieve; these will include both personal and professional targets. They will then undertake a work experience placement with an appropriate construction organisation. Learners will need to commit the equivalent guided learning hours to cover 10 full work days. This will allow for a range of tasks to be carried out and should also offer scope for learners to shadow experienced members of staff.

Finally, learners will reflect on their placement on completion, considering their own personal and professional development. They will consider the wider impact of continual professional development in their chosen career pathway, whether inclined towards direct employment or onto higher education.

Delivering the learning aims

Learning aim A

To introduce learning aim A, you could initiate a discussion with learners on their perception of the benefits of work experience in developing their own personal skills and attributes. You could then focus on the different types of skills that would be required when working as an employee with a construction organisation, and you may find it useful at this point to task learners to conduct a skills audit to determine the personal and professional skills that they feel they already possess. Learners could also include information about their weaknesses so they can identify areas to be developed as they progress through their careers in construction.

With an understanding of the personal and professional skills that are needed for working in the construction industry, learners should consider their own expectations for employment in construction. They should consider the expectations of an employer in this sector, and there are opportunities to invite visiting speakers to discuss this with learners. Construction professionals would be able to explain to learners how they should prepare themselves for employment in the construction sector, providing learners with insight into the career opportunities available to them, including the benefits of belonging to professional organisations such as RICS, CIB or RIBA.

Learning aim B

You will begin to prepare learners for their work experience placement through learning aim B, including the expectations their employer will have of them regarding their conduct in the work place. This again offers the opportunity to invite a speaker in, or alternatively, to use examples of job descriptions that learners can investigate.

Learners will need to be clear that while their work placement may include some highly technical activities, the tasks allocated to them will be given based on their skills and ability. You could introduce the concept of work shadowing here, explaining that it is likely that learners will shadow staff who carry out more technical and complex activities and in doing so they will gain an understanding of those job roles using that method.

Having completed their skills audit for learning aim A, you should encourage learners to use this to set their own goals for their work experience placement. You should introduce the concept of SMART targets to learners, which they can then use when setting their targets. You should introduce learners to the standards set by professional bodies such as RIBA, CIOB, RICS, and ICE, along with their entry requirements for membership. These standards could then be used by learners to inform their own personal and professional development targets.

Learning aim C

Learning aim C will be addressed during the work experience placement. You should encourage learners to participate in a range of tasks and activities during their placement (including non-construction tasks) and develop a wider knowledge of the activities that are carried out by a range of employees. This can be achieved through observing staff carrying out specific activities or procedures, or through shadowing staff members in different functions within the organisation. At all times, learners should be encouraged to continue to develop their interpersonal and intrapersonal skills and develop their understanding of how these skills impact on working relationships.

You should emphasise to learners the importance of keeping a journal of their activities, as that they can link their practical experiences while on placement

with their theoretical studies in other units. Learners should also use their journal to reflect on the personal development activities that they have carried out while on placement.

Learning aim D

Finally, learning aim D should be used to draw together the preparation for the work placement along with assessment of the actual activities carried out while on placement. You should encourage learners to consider self-evaluation and reflection as a continuous process that they should carry out throughout their professional lives. You can introduce them to the theories and frameworks to support this process – comparing the approaches as outlined by Klob, Gibbs and Schön – and which learners can in turn apply when completing their reflective journal.

Learners should be encouraged to refer to their SMART targets when reflecting on their personal development, and as they consider their future career pathways and goals. This could include highlighting those areas where they need to improve their skills and devising an action plan which can be followed for developmental purposes.

Assessment model (in internally assessed units)

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 observation report signed by 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	

Assessment guidance

The assessment of this unit is most likely to be in the form of two assignments, one for learning aims A and B, the second for learning aims C and D.

For learning aims A and B, learner evidence would normally be presented in the form of a portfolio that includes a justification of their selection of placement for work experience. It is likely that the portfolio will consist of a written report that provides the background to the placement and an action plan to be followed during the placement.

For learning aims C and D, learners will present a reflective log that evaluates their performance on their work experience placement, including lessons learnt from work shadowing and observations. This should be accompanied by observation records detailing the tasks and activities that the learner has carried out during their placement.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 16: Work Experience in the Construction Sector

Introduction

This unit enables learners to gain first-hand experience of the professional and technical skills that are likely to be needed to complete a range of job roles within a construction organisation. There are opportunities for visiting speakers to explain to learners the skills that they would need to gain employment in the construction sector, while visits to a range of construction sites could widen the career aspirations of learners.

You should give learners the background knowledge, which they will need to be able to audit their own skills and to set themselves SMART targets for their placement. On completion of their placements, learners will need to reflect on their experiences, taking into account the personal and professional skills that they have developed in order to plan their future career development.

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

The purpose of learning aim A is to give learners a broad understanding and appreciation of their options for carrying out a work experience placement, and the opportunities that it will provide them.

- You could introduce the unit through a class activity to discuss and identify job roles from a range of sectors, for example, building services or civil engineering. This could lead into a discussion of the potential job opportunities and career options for those sectors as learners progress into employment. You could then ask learners to discuss in small groups what they hope to gain from a work placement, such as whether they already have thoughts for their career or if they want to find out more about a certain sector or job role.
- You could task learners to consider the reasons why work experience can be used to develop the range of professional and personal skills that are necessary for job roles in the construction sector. Working in small groups, learners could identify the skills they think could be developed during a placement, and to suggest whether these are personal or professional skills. Learners could then complete a skills audit on themselves, identifying the skills that they feel are strong and those skills that they need to develop.
- You should emphasise to learners that the work experience placement will allow them to put into practice some of the theory that they have learned in other units, and that this is an opportunity to develop technical skills that may increase their chances of employability within their chosen construction pathway. This could be reinforced through the use of visiting speakers from one or more construction organisations, who would explain to learners the skills and qualities they look for in prospective employees.
- You could give learners examples of person specifications and job descriptions for a range of apprentice or technician-level roles within construction organisations, such as assistant site engineer or architectural technician. Individually, or in pairs, learners could then identify the qualities and skills that an employer would be looking for in new members of staff. Learners could then feedback their thoughts to a class discussion, with attention paid to significant similarities or differences in the attributes identified.

- In order to consider the various career options available to learners, you could encourage them to work in small groups to investigate the different career pathways available to them in the construction sector. They could consider the information available from professional organisations, including RICS, CIOB, ICE and RIBA, alongside specific construction organisations (whether local, national or international). You should encourage learners to access a wide range of resources in order to find appropriate information. A tutor-led discussion could reinforce the importance of work experience as a means to informing their decisions regarding career progression, and learners could be encouraged to share what they have found interesting, or surprising, about the various pathways they could follow. Discuss with learners if the results of their investigations have changed their decisions regarding potential placements.
- You could then begin to focus on the organisational and teamwork skills that learners will need to apply while on placement. This could be achieved through scenario-based activities where learners need to work together to solve a problem, identifying and allocating roles within a team and managing the team to ensure tasks are completed on time. This could be used to develop skills needed for a positive working relationship while in a controlled environment.
- Learners would then set tasks in which they need to prioritise actions and manage their time; this could be a desk-based activity to produce an outline design for a building. Learners will need to identify the tasks to be completed, indicating which activities should take priority and suggesting time scales for each.
- You could conclude by considering the rights of employees within the workplace. This could be through the use of online resources and discussion. You should make learners aware of the need to respect diversity, equality and dignity within the workplace, and the consequences of failing to do so. This could be linked to discussions relating to confidentiality and how employers will require learners to maintain confidentiality related to their placement. You could reinforce understanding with a Q&A session using typical situations where learners need to identify if information is confidential or not.

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

Learning aim B should give learners the background knowledge and understanding needed to effectively complete their work experience placement. Again, there is an opportunity for you to invite a guest speaker from an appropriate construction organisation to explain the expectations that they have of new employees joining their organisation.

- You should give learners sufficient guidance to allow them to independently research a range of potential work experience placements within an appropriate construction organisation. This should take into account the suitability of different roles, along with possible alternative organisations with placements available. Learners need to understand that restrictions may be in place due to their relative lack of experience and training, therefore it will not always be possible for them to carry out all the tasks related to their chosen job role. However, they may be able to shadow a more experienced employee while they carry out specific duties.
- You should also make learners aware of the role that their mentors will play in the workplace, including the production of observation records that will form part of the learners' submission of evidence for the second assignment.
- Once learners have a secure understanding of the roles that could be available to them for their work experience placement, you should introduce them to the idea of setting personal goals and SMART targets to achieve while on placement. Learners could use the initial results of their skills audit as a starting point and then consider where the gaps are to be filled. You should emphasise to learners that these gaps are the areas that they should aim to develop during their work experience

placement. A group discussion to debate methods to develop such skills can generate some interesting ideas for learners to take away with them.

- You could refer to information available to learners from professional organisations, and encourage learners to investigate the entry requirements for membership of professional bodies such as RIBA, CIOB, RICS and ICE. The focus should be on the skills and qualities that these bodies would expect a construction professional to possess. This research could be used to inform the setting of SMART targets by learners. You should discuss targets with learners to make sure that they are realistic for their work experience placement, and that they address personal and professional developmental goals. Learners will need to demonstrate their understanding of how to measure against these targets.
- Learners should collate their evidence for the first assignment, which should clearly set out the importance of work experience to their professional development. Learners should be encouraged to identify how they could use their work experience placement as a method of informing their future career choices. Furthermore, you should ensure that learners provide a comprehensive development plan that they can follow while on their placement; this should consider the expectations that the employer will have of them, a reflection of the learners' existing skills and their targeted areas for development. Learners should make sure that they consider the SMART targets they have set for themselves related to various activities that reflect their personal and professional development needs.

Learning aim C – Carry out work experience to meet set objectives

Learning aim C is most likely to be addressed while on work placement, where there will be little in the way of formal teaching. However, prior to the start of the placement, you should prepare learners for the ongoing training opportunities that may be open to them.

- You should make sure that learners have knowledge of their roles and responsibilities within the workplace, and understand that these extend beyond pure construction tasks to the wider range of activities that take place within the organisation. You should encourage learners to have as broad an experience as possible (including involvement with non-core activities) that may be office based, or involve attending meetings as an observer. This wider understanding of the different functions within the organisation should therefore allow the learner to reflect on their experience at a deeper level.
- You should make sure that learners are aware of the importance of their reflective journal, as this can be used when considering future career pathways. Observation records and notes concerning tasks and activities carried out could be recorded in this document on a regular basis. Learners should be encouraged to note where links between classroom theory and workplace practice can be made, in relation to all their topics across the qualification as appropriate.
- Prior to placements, you should also guide learners in the development of the intrapersonal skills that will be necessary for working in a construction workplace. They should be encouraged to develop their working relationships with colleagues while on their placements. You could direct learners towards online assessment tools that can be used to check their ability, personality type and judgement skills.
- Learners will need to be proactive while on their placement in order to gain experience of processes and activities that they are not able to carry out themselves. This experience could be in the form of work shadowing or observations and will need to be recorded appropriately in their journal. You should encourage learners to reflect on their experiences on a regular basis, as these could influence their developmental needs for the remainder of the placement.

Learning aim D – Reflect on the development of own personal and professional skills and practices

Many of the activities associated with learning aim D will be carried alongside those for learning aim C due to the cyclical nature of professional development. You will need to make sure that learners are aware that it is important that they reflect on their development on an ongoing basis and provide them with the appropriate frameworks to achieve this.

- You should encourage learners to reflect on their experiences at the earliest opportunity as this is most likely to result in them identifying further training or developmental needs that can be achieved while on placement.
- It is important that learners understand that their reflective journal is also a record of the training and opportunities that they have had while on placement.
- You should highlight to learners the importance of continual professional development during their professional life, and that they should view all feedback as formative. Learners should be made aware that feedback, which is constructive, may also identify areas that require further development in the future. Feedback can also highlight where skills need to be honed and enhanced and such comments can be used to generate an action plan to achieve this. Future job roles can also be considered so that a career pathway can be mapped and future goals identified.
- The evidence submitted by learners to address learning aims C and D is likely to consist of two aspects. Firstly, it should contain detailed and personalised witness statements or observation records that describe, in detail, the activities that the learner has carried out and how these enabled them to meet their targets. Alongside this, learners will need to produce a comprehensive reflective log that evaluates their performance in the workplace. This should consider three tasks in which they have participated while on placement, three activities that they have observed through work shadowing and also a personal development plan based on their reflective log that sets future targets and goals.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Cottrell S, *Skills for Success: Personal Development and Employability* (Third Edition), Palgrave Macmillan, 2015 ISBN 9781137426536 – this book covers a wide range of aspects, including personal development planning.

Moon J, *A Handbook of Reflective and Experiential Learning: Theory and Practice*, Routledge, 2004 ISBN 9780415335164 – this book covers a range of reflective practices, including Kolb experiential learning.

Schön D, *The Reflective Practitioner: How Professionals Think In Action*, Basic Books, 2008 ISBN 9780786725366 – this book covers Schön reflective practice.

Websites

https://www.architecture.com/ – Royal Institute of British Architects (RIBA) career progression and opportunities for prospective architects

https://www.barclayslifeskills.com/ – Barclays Skills for Life site allows learners to practice online assessment tests and includes advice for interview technique.

www.ciob.org.uk/ – Chartered Institute of Building (CIOB) – career progression and information about the construction sector

https://www.citizensadvice.org.uk/work/ – Citizens Advice with guidance on work based issues including discrimination, health and safety, and workers' rights.

https://www.gov.uk/browse/working – UK Government site with information about working, including rights and responsibilities

www.ice.org.uk – Institute of Civil Engineers – Career information, professional standards and information about the civil engineering sector

http://infed.org/mobi/donald-schon-learning-reflection-change/ – Schön reflective practice

https://www.mindtools.com/pages/article/reflective-cycle.htm – How to use the Gibbs reflective cycle

https://nationalcareersservice.direct.gov.uk/skills-health-check/home – Careers service website that has interactive tools to help identify strengths and weaknesses.

www.rics.org – Royal Institution of Chartered Surveyors (RICS) – career progression and information about the surveying within construction

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 17: Projects in Construction

Delivery guidance

Approaching the unit

This internally assessed unit is an opportunity for the learners to explore a live construction project that is either being built, or has been completed. You may choose to provide the learners with a scheme, or you may choose to let them pick their own project.

You can approach the delivery of this unit in several ways. You may choose to deliver all the knowledge 'upfront' and then allow the learners to work on their projects with tutorial support. Or, you may choose to follow the learning aims delivering each in turn before allowing the learners to work on their final assessment. Whichever method you choose, delivery of the unit should be interactive and encourage open questioning of the features of a project.

Choice of a suitable construction project is key to the successful delivery of this unit. A good example would be a large, mixed-used scheme, with ready access, and a complete online archive of plans and details from the planning stages. This could be a local sports stadium, or retail development, with community elements bolted on (such as affordable housing), or community centres, for example, a new library. Alternatively, a new large residential estate with commercial facilities could be a good option for delivery. Although this type of scheme would be too large for the learners' assessment project, you would be able to visit, speak to the residents, the designers and builders – all of which will underpin the knowledge and illuminate the subject matter. This exposure would prove invaluable to the learner's own scenarios and assessments.

Delivering the learning aims

Learning aim A

Learning aim A is primarily concerned with the design of a construction project. Learners will develop their knowledge in order to categorise the different types of project, styles of construction and the influences to those styles. A walk around the local neighbourhood can provide a good introduction to the various classifications of buildings for learners to identify. Alternatively, you could give the learners the different classification headings and ask them independently source examples of projects that come under that heading. The local environment can again be useful when introducing topic A2 and the different design considerations to be factored in. This would be further enhanced if you have the opportunity to bring in a local architect to talk about design and design influences of local projects.

A good activity to show the developmental nature of styles could be getting the learners to produce a timeline for the local town or area around the centre or to produce posters for different phases of history and the key influences and features of the design style. A local historic town, pictures, video, and even excerpts from period drama TV shows, are all useful visual resources that can show the architectural styles of different periods. Through the use of your well-placed questioning, you can get the learners to identify, interpret, analyse and synthesize the features, and the thinking that went into the building they are studying.

Learning aim B

Learning aim B will equip learners with the skills to be able to analyse the methods of construction for an existing building, analyse the drawings and the actual structure and materials used. Because they will have covered this in a lot more detail elsewhere (such as *Unit 4: Construction Technology)* you can use this part of the unit as a refresher, incorporating quiz activities or the use of annotated sketches, to identify the methods of construction and materials used. If you identify any gaps in the knowledge, you can design interim sessions to plug the gaps. You may find that the learners are not as familiar with some of the modern commercial techniques used. However, a trip to an ongoing project or through a case study of a live project will help you to provide them with the information they need.

Where possible, you are encouraged to consider how materials and construction styles are used in alternative contexts from their normal or established use. For example, the use of steel frames to build and extend houses – this form of technology is traditionally associated with commercial buildings. However, the fashion in design for large-scale picture windows and big open spaces has seen a shift towards their use in residential construction.

Learning aim C

Learning aim C considers the impact of a construction project and if you are using a completed project in your locality, the impacts should be easy to ascertain. A lot of the learning will come from the analysis of the project and you can use several examples of different projects of different size to show the different types and scales of impact.

If it is possible, make this topic area personal to the learners. For example, what impact did building 500 new houses have on them? Did it create more jobs, more noise, access to modern leisure facilities? Then ask them to consider the impact it may have had on their parents or grandparents. Stretch their reasoning to consider the impact of a new housing development on the future generations who live there; will there be sufficient provision for schools or open spaces, where would the extra 2000 people get medical treatment, or buy a pint of milk.

Assessment model (in internally assessed units)

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

Assessment guidance

Learners who are undertaking the qualification as part of an apprenticeship should be encouraged to derive evidence from their workplace activities for this unit, or for *Unit 9: Management of a Construction Project*. For example, this could be a project that they could investigate, or be seconded to within the company, to meet any employer apprenticeship requirements for contextualised project work relating to that occupation.

It is recommended that you have one assessment instrument that is split into three parts to match each learning aim. You are encouraged to allow the learners an opportunity to select their own project to study. Ideally, this would be a project they have access to and can visit. However, a visit is not essential, providing they can get sufficient information to allow them to access the higher grading criteria then it would be acceptable. You should introduce the assessment instrument early in the delivery plan and plan tutorials to discuss the learner's choices.

Part one of the portfolio submission will assess learning aim A. The learners are required to explain how the design of the project they have chosen meet both functional and aesthetic requirements. To do this, they will need to consider the project in its wider context, such as the local environment and the local vernacular style. To set this up to enable them to access all the grading criteria, you could pose a series of questions in the assessment instrument that will promote critical thinking. For the aesthetic consideration, the learners can present several images that show how the project works in the environment.

The second part of the portfolio submission will test learning aim B. Within this section, the learners are required to analyse the methods of construction, assess their suitability and justify their use. In principle, you are asking the learners two describe what, how and why. This again lends itself to a series of images with supporting annotations and justification of the methods used.

Assessment for learning aim C will be captured in the final part of the portfolio submission work and will consider the impact of the project. Typically, learners will find this section is more difficult than the first two and you will need to consider in greater detail how you pose the questions. You may find the economic and environmental impacts tend to be easier concepts for the learners to grasp. Without creating excessive scaffolding for the learners in relation to the societal impacts, you could set up the assessment instrument with a series of carefully thought out and well placed questions, that will prompt appropriate thinking towards the subject or area.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 17: Projects in Construction

Introduction

The aim of this unit is to allow learners to investigate, explore, and analyse the success of a construction project – from the initial design through to the wider impact on the global environment.

They will be encouraged to consider how the buildings around them came about – the styles, methods of construction and the resulting impact of the building. Wherever possible throughout the unit, you are encouraged to take the learners out of the classroom to interact with the environment around them.

Delivery of this unit will be enhanced by talks from professionals, such as architects, surveyors and builders. If you can find ones who have worked in your local area, allowing the learners to interact with the creators of the environment would be hugely beneficial. Throughout the study of this unit, there is also opportunity for the learners to interact with the communities who use the same buildings and the environment as the learners. Learners will find that most people have an opinion – especially where architectural style is concerned.

Learning aim A – Examine the design of a construction project

- The terminology used in this learning aim should have already been encountered by the learners, so you may wish to treat this as a refresher. One initial exercise could be to provide the learners with several images, which they must order into appropriate categories. Alternatively, you could play a dominoes type game. Each domino would be split to show both a category of construction project and a building type and the learners would then need to match properties with the categories as the dominoes are played.
- To enhance learning, you could provide extracts from the local development plan for your area and ask that the learners to analyse the local authorities use of class zones. You could further develop this activity by allowing the learners to visit the areas, identifying the different categories of building and evaluating their uses in relation to the zone that they are in.
- The aim of topic area A2 is to prepare the learners to be able to identify, interpret, analyse, and justify why a particular building or project is designed the way it is. When looking at the design considerations of projects, you'll have the opportunity to bring a guest speaker – ideally a local architect – to describe the processes and design considerations they go through to produce a finished design.
- Learner-lead, interactive sessions (based around Socratic question of techniques) could be employed here. In a session like this, your role is one of facilitator, and you should try to guide the learner without telling them what they need to know. For example, if you are considering the local vernacular, a simple question of why does building A look at different to building B, which again is different to building C? You can then direct the learners to look at different influences on design, different periods of architecture, legislative control and fashion and trends. A walk through a town centre would provide you with a rich tapestry of examples.

Learning aim B – Investigate methods and techniques used in a construction project

- Topic area B1 is again reinforcement of prior learning from other units within the course, particularly *Unit 2: Construction Design* and *Unit 4: Construction*

Technology. The learners should be familiar with the different forms of construction and the different methods and techniques used in the construction of the areas mentioned within the content. You could test through an in-class test or quiz, where the learners devise their own questions and answers and you act as the quiz master. Alternatively, you could conduct a learning walk around the local environment, asking learners to identify and describe the different methods and techniques seen.

- Learners should now be able to demonstrate that they can analyse the suitability of the method of construction for the end use and location. To encourage their critical analysis and thinking, regular questioning of learners as to why buildings are designed a certain way, what the alternatives might be, what could be improved, will develop these essentials skills that will be required for the final assessment.
- Moving on to material selection for construction projects, once you have tested learner understanding of the broader subject area, you can then again start to test their interpretive and analytical skills. Use regular questioning of why the materials selected are fit-for-purpose. This will prompt the learners to start to analyse the materials and the suitability for the use they have been put to.
- As part of your delivery of this topic area, you can show how inappropriate material selection fails in use or creates additional problems elsewhere. For example, the use of hard cement mortar when by pointing soft stonework, or excessive wear and tear of decorative finishes in public areas.
- The learners need to understand that different building uses will require different material selection and when they analyse their building for the assessment they should take this into consideration. Learning can be tested through the use of partially completed learning mats. Learners can be asked to complete the missing information on the mat. You could provide them with a building type, location and use and ask them to select appropriate materials, justifying their answers. This could be a small group task with group plenary.

Learning aim C– Explore the impact of a construction project

- Learning aim C is quite often the most difficult part of the unit for the learners to understand, so when delivering this part of the unit, you should try to make it as practical and relatable as possible and use a lot of local examples the learners will be familiar with. Selecting a suitably sized scheme, such as a large retail or housing developments in your area, will make delivery easier for you and for the learners to relate to. Allowing the learners to interact with the environment around them and to speak to local people who use the environment will help them to understand some of the broader conceptual areas.
- To deliver topic area C1, you should find a suitable scheme where an area of previously run down land has been regenerated. Ideally, this will be somewhere local, but if you cannot find anything local to you, then you could consider using the regeneration of East London for the 2012 Olympic games. This was an area that was run down, lacked significant investment in recent years and had several empty and dilapidated properties.
- In a tutor presentation, show learners how the area was before the development and how it looks today. You can discuss the economic impact in terms of the intermediate financial benefits during construction and the long-term benefits through the ongoing regeneration and use. Using the Olympic project, you can demonstrate examples of development that has continued, resulting in a thriving area with a broad range of property types and uses. You could contrast the success seen in London with previous Olympic projects, such as Athens 2004, highlighting that economic impacts should be sustainable and provide long-term benefits to the community they serve. Learners can then follow this up by identifying similar issues on a project they have independently researched and produce a one page infographic on the subject. These can be checked for accuracy and then shared with

the rest of the class.

- The learners' own critical analysis of the societal impacts of a construction project is key to learning, but some knowledge input will be required from you. You may choose to base your delivery around a large-scale project, such as the Olympics, as you can provide various examples of fit-for-purpose properties.
- An activity you could undertake with the learners is to get them to identify what a large development will need to provide to satisfy the needs of the local population. This could be a theoretical exercise and focus on a rundown area of your town, or you could select a real-life project with available access to the before and after information. Learners should be encouraged to rationalise why such things as improved services, buildings, open spaces, and so on, are a good idea.
- The learners ultimately should be able to describe the societal benefits from a redevelopment scheme, both short and long term. For example, high-rise developments that replaced the city slums in the 1950s and 60s are now being demolished to make way for a different style of housing. The learners should also consider the negative aspects of a redevelopment project and the impact on the local environment, particularly during construction. If you have a local construction site you can visit, get learners to walk around the local environment to ascertain what impact it is having. Issues such as noise, dust, and increased traffic could all be perceived as being negative.
- You should develop the discussion with the learners to consider if there are any negative impacts on completion of the scheme. For example, a larger housing development may be viewed positively by many, but will ultimately create an increase in traffic for the existing residents in the area. After your initial input to consider the positive and negative impacts of a development, you could set up a debate, dividing learners into groups speaking for and against a proposed development (you could act as the impartial arbiter). This session can be set up like a planning committee meeting with the various bodies allowing a maximum of three minutes to speak for or against the proposals.
- Learners should understand that there are both positive and negative impacts from a construction project on the environment and they should be able to identify what they are for any given project. Images or videos of construction sites will allow them to identify the issues that may have a negative environmental impact. Similarly, images and videos of rundown areas that have been redeveloped will demonstrate the positive impact on the local environment. If it is feasible, take the learners to a regeneration scheme that will highlight and reinforce these benefits. The debating activity above could also be used here to reinforce several of the key topic areas.
- Working in pairs, you could task learners to plan the use of large areas of land, incorporating a mix of uses in response to needs of the area. Learners could then present their proposals to the class, providing a one-sided handout to copy for the rest of the class. This activity is a good way to generate discussion about the positive impact on the environment that suitable design and development can have. At the closing of the session, learners could be balloted on their favourite proposal.
- Wider environmental considerations can sometimes be difficult for the learners to grasp, so you may need to stress the impact a construction project can have in terms of consumption of resources, energy production and use and the importance of considering sustainable construction methods. Online videos and TV programmes, such as Grand Designs, will have several good examples of sustainable methods of building. Using these resources along with a series of prepared questions as part of your delivery will actively engage learners when watching. For example, rather than just asking them to describe the sustainable methods, you could ask them to consider the benefits to the local and wider global environments, both short and long term. At the end of the teaching input for this section, the learners should be able to make well-informed reasoned, balanced and justified statements about the issues covered.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

The knowledge and skills required for this unit will compliment, enhance and reinforce learning within several other units within the qualification. These include:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 9: Management of a Construction Project

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Chudley R and Greeno R, *Building Construction Handbook* (11th edition), Routledge, 2016 ISBN 9781138907096 – a comprehensive guide to methods and types of construction

Emmit S and Gorse C, *Barry's introduction to construction of buildings* (3rd edition), Wiley-Blackwell, 2014 ISBN 9781118255421 – a good starting point for some of the wider consideration of the unit

Journals

Architects Journal (EMAP Publishing Limited) – https://www.architectsjournal.co.uk/ – the journal for architects and design professionals. It is a good resource for details on design ideas and the thinking behind schemes

Building Magazine (UBM) – http://www.building.co.uk/ – construction industry journal that covers construction, design and the wider environmental issues

Websites

http://www.channel4.com/programmes/grand-designs/ – Grand Designs – the popular Channel 4 programme website that contains links to the various episodes and related articles

http://www.channel4.com/programmes/the-restoration-man/ – Restoration Man – the popular Channel 4 programme website that contains links to the various episodes and related articles

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 18: Building Information Modelling

Delivery guidance

Approaching the unit

This optional unit is intended to give the learners the underpinning knowledge and skills in relation to the process of Building Information Modelling (BIM) and its associated tools and procedures. Although this is an optional unit designed to introduce the concept of BIM in isolation, the importance of BIM and its impact on almost all aspects of a Construction Technician's work cannot be overstated; from design, to project management, architecture, costing, quantity surveying and more. Companies are required to demonstrate certain levels of BIM implementation ('maturity') to bid on public sector building projects. The unit does this by capturing the progress and development of the model as it passes between project participants throughout the life of the building, exploring the roles and procedures in place to ensure that this collaborative process is thorough and efficient.

You could deliver this unit by harnessing a range of collaborative working principles with an emphasis on digital interaction, collaborative editing and decision-making by consensus. There are many opportunities for learners to carry out a range of interactive problem-solving activities as well as solitary tasks and wider group activities, each bolstered by hands-on practical usage of the many BIM tools available.

The opportunity to use and examine many types of software adds relevance and appeal to the subject, while enlightening learners with regard to the modern day approaches to these new and emerging roles.

Delivering the learning aims

Throughout the delivery of the unit, learners will benefit from using real-world software and standards and documentation in the context of realistic project scenarios. Note that several of the major software companies for BIM do provide free downloads to educational institutions. The use of such software is strongly encouraged not just for this unit but also for units focusing on design and project management, which provide some opportunity to holistic teaching, should this unit be selected. BIM seeks to replace the many wasteful processes and procedures of old, so the new roles and approaches outlined in this unit lend themselves to practical or role-playing explorations in class. The spirit of inclusivity should be cultivated at all times, where group work and a team ethos are the norm thereby creating an environment in the classroom for the hands-on problem solving that underpins the collaborative environment needed to make BIM really succeed.

You could introduce the topic overall with a whole-class, tutor-led presentation that outlines the thrust, drive, meaning and significance of BIM, before any tools are discussed and explored. Taking the opportunity to examine BIM maturity levels, the BIM mandate and the push towards Digital Built Britain will be of value before clarifying any terminology, misunderstandings and misconceptions in class. Learners should be encouraged to complete collaborative glossaries and infographics as they go.

The benefits of BIM can be explored in these introductory sessions, for example, by looking at video clips of changes to job roles and the BIM software typically used in these roles. Learners could capture these key points in their own documentation, on a poster, or even by creating a series of TV commercials that sell the benefits of BIM to a potential client or participant.

Learning aim A

Learning aim A could then be introduced by an overview of the RIBA Plan of Work 2013 and how this has translated to the RIBA Digital Plan of Work (DPoW), as part of the wider BIM Toolkit. Dummy projects could be set up with learners being assigned roles and responsibilities in smaller teams so they can really explore the DPoW in full. Key documents and processes at each stage could then be captured by the learners via online collaborative editing, with the output shared on the VLE.

Following this, learners should be introduced to the general *purpose* of the BIM Protocol, before working in small groups to suggest their own folder structures and means of organising and updating project documents. This would lead into a study of a typical Common Data Environment (CDE) as stipulated by PAS 1192:2 and existing proprietary solutions.

Learning aim B

Learning aim B can be addressed by exploring common file types used in BIM (specifically IFC) before introducing Construction Operations Building information exchange (COBie). COBie contains a stripped-down version of the Industry Foundation Classes (IFC) data that generally relates more specifically to Facilities Management. An appreciation of why clients would want this information could be determined through a class discussion, before looking at the necessity to capture Employers Information Requirements (EIRs) sufficiently well at the start; the EIR being separate to the Project Brief, and carrying the types and levels of information that the supply chain needs to deliver at key stages, notably the operational stage.

You could then task learners to investigate the options for project participants to remotely access and contribute to the model via markup software, considering hardware requirements and security measures at the same time. Understanding the client's need to view and review the model should also be discussed, before learners complete a quiz-type document that examines project stakeholders and their relationships with one another in a collaborative capacity.

Learning aim C

Learning aim C could be broached by looking at BREEAM initiatives as well as an overview of the emerging WELL standard, with learners capturing and discussing their learning in small groups via presentations. Case studies could then be examined, perhaps even resulting in mock BREEAM assessments being made.

After this, a natural pairing of the two realms of BIM and LEAN (minimising construction waste) should be identified, before learners capture LEAN principles as well as modern techniques (such as modular construction, scan to BIM, 3D printing and drone usage) in illustrated leaflets.

Learning aim D

Learning aim D could be addressed by looking at the role of Construction Design Management (CDM) regulations in relation to all parties and the potential benefits that BIM provides, such as better planning for Health and Safety during design, construction and in use. The use of drones to verify the progression of the works on larger projects could also feature, with accompanying videos and case studies.

Following this, learners could be split into groups and each could perform a presentation that explains the role and purpose of the many bodies in existence and their specific influence (or approach) to BIM. Learners could also design a one page handout that captures the presentation information that can then be made available to others. A look at the role of the British Standards Institute and the formation of the PAS standards could then follow, with learners capturing the main purposes of each standard via summary sheets/posters/handouts.

Finally, a look at the legacy that BIM seeks to leave behind could then be explored, together with an overview of the agendas going forward; openBIM, BIM Level 3, Digital Built Britain, the Construction Strategy 2025 and the emergence of Smart Cities.

Assessment model (in internally assessed units)

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 common data environment	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** BIM-related standards and effect on working practices **D5** 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

Assessment guidance

The assessment of this unit could be in the form of a report for learning aim A, a report and presentation for learning aims B and C and a further presentation for learning aim D. Each of which should be supported by relevant graphics and references to appropriate industry procedures, standards and legislation along the way.

The assignment for learning aim A is most likely to be in the form of a report showing the function of the RIBA DPoW and its application on a real-life project. The report captures the requirements of the BIM Protocol, and in particular, the CDE.

There is flexibility in the forms of evidence, however, and many class tasks could be adapted so learners create actual project documentation, submitting this individually or collaboratively, complete with an individual reflective journal that expands their points along the way. Posters and infographics could also be considered providing they fulfil the necessary requirements of the assessment criteria and are individual to each learner.

Evidence for the assignment covering learning aims B and C could be combined into a presentation or report that captures the meanings, significance and usage of IFC and openBIM, as well as COBie and EIRs. Learners will need to identify the means in which project participants can engage in a synchronous or asynchronous manner and the tools and hardware available to do so. They will also need to demonstrate knowledge of sustainability initiatives and modern methods of construction.

Again, flexibility is an option and a distinct assessment vehicle capturing learning aim B (a report perhaps) can be offered as a standalone task, before separate tasks are employed (a presentation or mock assessment) for learning aim C.

Finally, in the assignment for learning aim D, learners should present or report on the items that convey the roles of the many industry bodies and legislative standards, before capturing the changes to existing (and emerging) roles and responsibilities wholesale.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 18: Building Information Modelling

Introduction

Learners will need to understand that BIM as a term is very broad and serves to capture both the Building Information Model (noun) and the Building Information Modelling process (verb) before they can go on to identify, use and examine the general principles, processes and tools that are outlined.

Emphasis needs to be given to collaborative working processes and the mindset or 'culture change' that practicing professionals are faced with while they migrate to a BIM-enabled environment. Learners should appreciate that they are at a unique point in time when the sector begins to transform to a digital way of working. Also, be aware that this unit may positively influence learners regarding their future career and further education choices by touching on the many roles that will come to rely on updated BIM processes and new software tools in the future.

Caution needs to be applied at all times to not go too deep into the details. A deep dive of the documents mentioned should be reserved for learners in higher education and a general appreciation is sufficient at level 3. Case studies and videos of the above being used will also help in any lesson (note that the Standards and the BIM Protocol can be particularly 'dry').

Learning aim A – Examine the application of the RIBA Digital Plan of Work in an information management environment

- You could introduce the topic overall with a whole-class, tutor-led presentation that outlines the thrust, drive, meaning and significance of BIM. Identifying the BIM Mandate and studying infographics, case studies and video presentations that seek to capture the overall process further. This could conclude with a discussion about how these approaches differ to those of old. You should also highlight that while some companies have been using BIM tools and processes for a long time in isolation, advances in communications and computing now see the whole *process* available to all. An appreciation of how the easy sharing of information affects the wider supply chain should also be regarded.
- The need to identify and examine BIM maturity levels and the push towards Digital Built Britain should be introduced by tutor presentation before tasking learners to annotate or capture how they would explain these principles to one another via handouts or posters.
- Learners could now start a collaborative Glossary using a shared Google Doc or the like, as set up by you, to edit and update at the start or at the end of each session. Learners should be given time in class to determine their own way of organising who is contributing what to this shared resource in order to bolster collaboration. Contributions should include the terms discussed in the sessions, and images could be added to some entries too to reinforce learning. Learners may make videos or slideshows to capture these points – the rule being that the output *has* to be shared on the VLE.
- At this point, you could introduce video clips of the typical types of BIM software that professionals tend to use at each stage of the project (commonly referred to as 3D, 4D, 5D, 6D) with learners creating their own documentation to capture the many options available and evaluating which have the most features and the like.
- Learners need to understand that BIM is the entire *process* needed to deliver an accurate model at each stage of the project, and that the model changes ownership

(and level of detail) as the work progresses. All personnel at all stages of the project will need to interact with the model and how they do this requires absolute collaboration often on an international scale.

- Once the merits are known and understood, learners could capture these on posters or better still, by creating a series of TV commercials selling the benefits of BIM to a client or other project participant.
- As a lead into topic A1, the RIBA Plan of Work 2013 Overview could be introduced with a run through of each stage in general, progressing to how this has translated into the online RIBA Digital Plan of Work.
- A walkthrough presentation of the DPoW would be helpful, showing the type of tasks and levels of detail that participants would expect to be seen at each stage. Explore with learners the meaning of Level of Detail, Level of Information and Level of Development.
- To maximise learning and explore the DPoW further, you should create a dummy project - or better still split the group into teams and have learners create their own dummy projects – with learners being assigned roles and responsibilities themselves, before examining the typical duties recommended from one stage to the next.
- Key documents and processes at each stage could then be captured by the teams via online collaborative editing, with each team being responsible for creating an infographic for each stage.
- For topic A2, a quick look at what have been termed the 'eight pillars of BIM' may be required.
    - PAS 1192:2, PAS1192:3, BS 1192:4, and PAS 1192:5 are Publicly Available Standards issued to speed industry adoption up before they become full blown British Standards. Learners should capture the general gist of each in their own documentation.
    - CIC BIM Protocol – is a short document containing contractual terms that legally facilitate the usage of Level 2 BIM by 'overriding' certain parts of standard construction contracts.
    - (Government) Soft Landings – ensures that a good handover process is arranged and honoured, and looks at training people to use the systems and information contained in the models once handed over and the like. Other industries would call it 'customer care' and these steps pay dividends when it comes to Post Occupancy Evaluation ('customer satisfaction') after the event. With some contractors also being responsible for the upkeep of the facility for many years of the assets life, their own demand for an excellent model is already established and learners need to appreciate this via group discussion.
    - Classification – Uniclass 2015 allows project information to be structured according to a recognised standard. With tables of codes for different project types and objects being available (as plugins for BIM software) and the design and construction team will code the items accordingly as the work progresses. Classification also helps for checking compliance historically too.
- Topic A2 can now be delivered in earnest and the BIM Protocol should be discussed with students, with key terms captured in the glossary. There is an Appendix in the back that project participants need to complete. Changes to the Protocol and its Appendices should be treated as variations to the Contract.
    - Appendix 1 – Model Production and Delivery Table. This must include references to all Building Information Models that are required by the employer at each project stage.
    - Appendix 2 – Information Requirements. This details the information management standards that will be adopted on a project.
- For topic A3, in groups or individually, learners should be encouraged to come up with their own folder structures that they see a CDE containing, before looking at

actual CDE requirements in PAS 1192:2. Industry-leading CDE providers and automatic filename revision systems should be looked at as well.

- To conclude this learning aim, summarise the above items for learners; the DPoW details expected tasks and responsibilities, and the project information kept in a CDE and the BIM Protocol provides a legal addendum to existing contracts that authorises the use of BIM in the first place.
- The assessment brief for this aim should be made available as early as possible and referred to in each lesson where appropriate.
- Inviting industry participants familiar with the above into class is also critical.

Learning aim B – Examine the construction information management environment

- Construction Operations Building information exchange (COBie) needs to be looked at from a Facilities Management (FM) perspective, with learners detailing what would be the information needed by them if they were tasked to manage a facility, rather than design or build one.
- In a tutor-led discussion, highlight to learners the fact that priorities change enormously in terms of client versus contractor and when the construction team walks away from a project, the real work of looking after it begins. The FM team can only do this effectively if the information they need is captured in the first place, which is where COBie comes in.
- COBie can be looked at essentially as industry's attempt at 'second guessing' what information FM teams would need to know for different object types. If this was not captured in the first place, it is hard to 'reverse in' after.
- COBie manifests visually on a spreadsheet arranged into convenient columns such that model-viewing tools need not be used. You could task learners to 'mock up' their own version of how they think it would appear. Once they have done this, look at examples of actual COBie spreadsheets with learners correcting theirs to suit.
- What is to be understood here is that the popular data standard IFC captures what industry agrees to be key information vital to describing different elements of the building for *all* users, while COBie merely considers the properties that are relevant to future maintenance and FM (rather than information about geometry etc). You should also highlight links to the use of Product Data Templates (PDTs), which are aimed at manufacturers too, as some of this information will be of interest to FM teams as well.
- A series of word searches, crosswords or quizzes may then be used to underpin the above learning, before moving on to look at BIM deployment strategies; within the office, among the design team, across the entire project team.
- Remote access of project information from any location is vital. Synchronous and asynchronous communication methods should be explored via class discussions of the technologies familiar to them (as BIM often sees international cooperation too).
- Software such as BIMsight should be introduced here, showing how team members can add notes to models and send them to each other in real time.
- Facilities Management teams can similarly access model information once the asset is functional, and example videos are available online. Encourage learners to further research and explore more examples themselves before completing a quiz-type document to capture their learning.
- How the client will use the model should always be in the forefront of a construction professional's mind. Learners should demonstrate their awareness of this, showing appreciation of the software available to carry out the above, plus hardware requirements needed for a given scenario or case study. For example, you could look at the Birmingham City University BIM O&M case study and the barcode (RFID) tags applied to the rooms for easy navigation.

- For topic B3, learners should be encouraged to contribute their thoughts on the main concerns regarding the security of data outright.
- To relate these principles more easily, discussion could begin with a look at personal computing, security, passwords, viruses and alternative operating systems such as Linux. This should help to familiarise and reinforce understanding further. Learners could then be quizzed on the above, regarding terms like 'phishing' and backup options and the like. Being 'IT savvy' is core.
- Approaching topics B3 and B4 together is an option, as both security of data and flow of information in the CDE is explored comprehensively in PAS 1192:5 and PAS1192:2, respectively.
- Focusing on the flow of information in the CDE, you could lead a discussion on how items progress from 'Work In Progress' to 'Published', asking learners to consider the implications of failing to follow an agreed process. Learners could then create their own process diagrams or flowcharts to capture the critical stages.
- Again, videos and visiting speakers should be utilised where appropriate. If the opportunity allows, learners could select and interview key personnel on nearby projects to gain real insight.
- The assessment brief for this learning aim and learning aim C should be made available as early as possible and referred throughout where appropriate.

Learning aim C – Investigate the contribution of information management technologies in a BIM-enabled design and construct project

- When discussing the advantages of BIM in design, reduction in costs to the project is a clear benefit: for example, the ability of certain software packages to model, ahead of implementation, the effect of changes in design on a building's attributes. This may include energy performance, or specific material or labour costs, aligned to asset registers and bills of quantities, thus providing further time and labour savings.
- Learners should be familiar with the sustainability requirements and considerations for a construction project as encountered in other units, such as *Unit 2: Construction Design.* You could gauge prior knowledge in a class discussion before presenting a recap of the innovative incentives and controls in place, such as BREEAM, LEED, the prior RIBA 'Green Overlay' and perhaps the new WELL Standard.
- This can then be further explored by encouraging learners to discuss and present what they expect will improve an assets' BREEAM credits, before reviewing actual documentation and a case study/video to underpin this learning.
- If possible, invite a guest speaker to discuss their experience of using BIM to obtain statutory approval. Ask learners to identify the specific benefits BIM offers to the approval process, for example, 3D simulation methods, daylight planning and other factors. Identify what aspects of the process of obtaining statutory approval remains the same as carried out by non-BIM/ traditional means and what has changed or improved.
- To introduce topic C2, you could begin by highlighting the complimentary realms of BIM and LEAN; BIM streamlines the information side of the project, LEAN principles can be used to examine processes on site and look to make them more streamlined and efficient. You may wish to use online video resources to look more closely at LEAN manufacturing and its growing influence in construction.
- In view of the above, modern methods of construction designed to reduce waste and improve efficiencies should then feature. Video clips can illustrate this point well, including off-site assembly and modular construction, scan to BIM, 3D printing, drone usage, and so on.
- Learners could then be encouraged to search the internet and find their own modern

methods before capturing them in a leaflet that identifies their wider positive and negative impacts.

- The assessment brief capturing learning aim C should already be available in B and again referred to where appropriate throughout.

Learning aim D – Investigate the effect of policy, standards and legislation on the BIM-enabled environment

- You could start this learning aim with a recap of the DPoW. Much will have been covered in topic A1. Extend learner knowledge with a look at how job roles and responsibilities are changing, and which new roles are being introduced.
- How the CDE supports accountability and traceability is paramount here as well if not covered earlier.
- Case studies or interviews with local employers may feature heavily as learners explore the direct impact of new working methods within the profession. Learners should ideally capture these findings in the assignment too.
- Learners will need the opportunity to study the role of Construction Design Management (CDM2015) on all parties, including the leveraging that BIM provides by being able to better interrogate the model for safety concerns in advance of construction and operational use cases, and in providing 4D simulations that mimic the progress of the works. Following the initial tutor presentation, learners should access or appreciate Navisworks/Asta/Synchro simulation type software to understand this process even more.
- The expertise needed to advise on buildability and the importance of early intervention by all parties in the BIM process should be explored.
- The use of drones or UAVs on larger projects to capture evidence of progress, which is then compared with the model, can also help to foresee logistical problems as well as temporary works items too.
- To introduce topic D3, learners could be split into groups, each delivering a presentation that explains the role and purpose of the many bodies in existence and their specific influences (or approaches) to BIM. The CIC, NBS, BRE, CPIC, ISO, BuildingSMART are good choices to name only a few. Professional bodies such as ICE and CIBSE could also be included.
- Learners could also design a one-page handout that captures their presentation information, to be shared on the VLE as a reference document for others. The tutor (or class peers) will need to verify that the information is correct prior to it being accepted.
- Topic D4 links well to topic D3 and allows a moment for a deeper look at the role of the British Standards Institute and the formation of the PAS documentation and what they further contain. However, caution is needed here so as not to overwhelm learners (who are already taking a lot in) so summary sheets/ posters/ handouts of each standard should be designed in small groups then shared on the VLE or presented to the class if note done so earlier.
- Further exploration of roles and resources (expanding on topic D1) will focus on concerns for the assets' end of life, demolition considerations and how to ensure that the software and file formats used will be accessible and operate as required in 50 years time.
- A look at the legacy that BIM seeks to leave behind could then be explored, together with an overview of the agendas going forward; openBIM, BIM Level 3, Digital Built Britain, the Construction Strategy 2025 and the emergence of Smart Cities.
- Remind learners that creating a 3D model alone is not 'doing BIM' at all. It is using a BIM authoring tool in an isolated manner.
- The assessment brief for this learning aim should be made available as early as possible and referred to throughout.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- Unit 2: Construction Design
- Unit 3: Tendering and Estimating
- Unit 6: Surveying in Construction
- Unit 9: Management of a Construction Project
- Unit 13: Measurement Techniques in Construction
- Unit 14: Provision of Primary Services in Buildings
- Unit 17: Projects in Construction
- Unit 19: Quantity Surveying
- Unit 20: Quality Control Management in Construction
- Unit 21: Building Services Science
- Unit 23: Construction in Civil Engineering
- Unit 26: Conversion, Adaptation and Maintenance of Buildings

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Crotty R, *The Impact of Building Information Modelling: Transforming Construction,* Routledge, 2011 ISBN 9780415601672 – a down to earth, realistic, insightful resource

Eastman C, Teicholz P, Sacks R and Liston K, *BIM Handbook: A Guide to Building Information Modelling for Owners, Managers, Designers, Engineers and Contractors* (Second Edition), Wiley, 2011 ISBN 9780470541371 – includes a comprehensive overview

Hardin B and McCool D, *BIM and Construction Management: Proven Tools, Methods, and Workflows* (Second Edition), Sybex, 2015 ISBN 9781118942765 – practical and up to date

Mordue S, Swaddle P and Philip D, *Building Information Modeling For Dummies*, Wiley, 2015 ISBN 9781119060055 – straightforward and friendly approach

Journals

AEC Magazine (X3D Media) – good overall scope and topics – http://www.aecmag.com/

BIM Journal (The BIM Hub) – quality journal that explores each topic in great depth – https://thebimhub.com/bimjournal

BIM Today (PBC) – compendium of many varied topics in a huge publication – http://www.pbctoday.co.uk/news/category/publications/bim-today

Building Magazine (UBM) – covers BIM and wider construction issues – http://www.building.co.uk/

CAD User (BTC) – frequently captures the latest software and developments – http://www.caduser.com/

Videos

A great many BIM-related videos of varying lengths and interests exist on YouTube, Vimeo etc. In the case of software examples, alternative solutions should always be shown.

3D printing – how to print ten houses in 24 hours (https://www.youtube.com/watch?v=SObzNdyRTBs)

Aconex BIM explained (https://www.youtube.com/watch?v=FCvjq3NNJ9Y)

Aconex Project Collaboration via BIM (https://www.youtube.com/watch?v=8U1HrzcgxwI)

Birmingham City University case study (03:30 onwards especially) (https://www.youtube.com/watch?v=Pe8_pEe9ov4)

BIM + Building Automation System for Facility Management and Work Order (https://www.youtube.com/watch?v=f8fp6DdJYxk)

BIM Enabled off site Prefabrication (https://www.youtube.com/watch?v=FQ1H6znR-_0)

Lean Construction (pairs well with BIM) (https://www.youtube.com/watch?v=OTH0z6xSSJM)

LEAN (https://www.youtube.com/watch?v=2GfdC1BsKss)

Modular Construction (https://www.youtube.com/watch?v=Ko3qqATDa5Y)

RIBA Plan of Work 2013 – introductory video (https://www.youtube.com/watch?v=98UGXi0nUbs)

Scan to BIM (https://www.youtube.com/watch?v=fqoNXUymGko)

YouBIM for Facilities Management (https://www.youtube.com/watch?v=yk7goMMVmlU)

Websites

http://www.autodesk.co.uk/products/navisworks/features/all – Navisworks

https://www.bentley.com/en/solutions/project-delivery – Bentley

http://bim-level2.org/ – British Standards (BSi) for BIM Level 2, providing UK centric information from the developers of the PAS standards

http://www.bimplus.co.uk/ – BIM Plus is a website from the Chartered Institute of Building. It has an online magazine style coverage with interesting guests.

http://www.bimtaskgroup.org/ – UK Government-supported promotion of BIM implementation, advice/ guidance

https://www.bre.co.uk/bim – BRE

http://www.breeam.com/ – BREEAM

http://www.cibse.org/ – CIBSE

http://cic.org.uk/download.php?f=the-bim-protocol.pdf – CIC BIM Protocol

http://www.cpic.org.uk/cpix/cpix-bim-execution-plan/ – CPIx BIM Document Templates

https://www.designingbuildings.co.uk/ – Industry policed wiki, not just BIM but all areas of construction

http://www.elecosoft.com/ – Asta Powerproject

https://www.exactal.com/en/costx/videos/demos/ – Cost X

http://www.graphisoft.com/archicad/ – ArchiCAD

https://www.ice.org.uk/disciplines-and-resources/information-sheet/what-is-bim – ICE

https://www.ribaplanofwork.com/ – Original RIBA 2013 plan of work site, great visual starting point before BIM Toolkit (DPoW)

http://shop.bsigroup.com/Navigate-by/PAS/PAS-1192-22013/ – PAS Standards

https://sustainabilityworkshop.autodesk.com/ – Helpful videos, concepts and software usage demonstrations relating to building design

https://synchroltd.com/ – Synchro

http://www.teklabimsight.com/ – BIMsight

https://thebimhub.com – The BIM Hub – global content driven networking hub for BIM companies and professionals. Thousands of curated articles, case studies, events, tools and connections. Parent company of BIM Journal.

https://thebimhub.com/search/?q=BIM+and+safety – BIM and Health & Safety

https://toolkit.thenbs.com/ – Home of the DPoW as well as classification, definition and product data templates.

https://toolkit.thenbs.com/articles/classification#classificationtables – Uniclass 2015

http://www.vectorworks.net/architect – Vectorworks

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 19: Quantity Surveying

Delivery guidance

Approaching the unit

This unit will give your learners a valuable insight into the many challenging responsibilities of a quantity surveyor, developing their knowledge and skills to understand the underlying principles of quantity surveying, whether working for the client or the main contractor.

They will examine the financial and contracts management aspects of the role, and build confidence in the interpretation of data, for example, to produce estimates and bills of quantities.

You will find the use of carefully considered mock project briefs a valuable learning resource throughout the delivery of this unit. You may also wish to adapt suitable case studies for your learners. Using such resources helps to develop a holistic understanding of the subject among learners, and gives you the opportunity to involve local construction or architectural firms in providing example projects and mentoring support to learners through some of the exercises.

Throughout the delivery, you should relate the content of this unit to number of units on this qualification that will help to motivate learners.

Delivering the learning aims

Learning aim A will introduce learners to the many varied and challenging responsibilities of a quantity surveyor. You could use video clips to provide this insight, and if possible, invite a guest speaker along to explain to learners the role of a quantity surveyor and their experience of working on projects for the client as well as for the main contractor. The guest speaker may be from a quantity surveying background, or a related field, such as building surveying. The guest speaker would be ideally placed to focus on the changing role of a quantity surveyor, discussing the changes in technology and procurement processes. Learners are really interested and enthused to hear about the current practices, so this exposure early on would be very motivating.

The use of an actual case study of a recent project to explain the functions of both a Professional Quantity Surveyor (PQS) and the main contractor's quantity surveyor will enable you to contextualise the theory. Opportunities to use real, completed project documentation from employers should be taken, to further illustrate taught theory: for example, tender documentation, or a completed bill of quantities document/spreadsheet for a given project, to show the format and norms used in professional documentation, including discussion relating back to the finished building, perhaps with photos of the development cycle or a site visit to put context to theory.

You will need to refer to industry standard processes and procedures in the delivery of this learning aim, and you will need to guide learners to the relevant source materials to help them navigate this information. Once you have introduced basic principles, you can engage your learners during delivery through knowledge quiz activities, individual, paired and group activities and class discussions.

You may wish to adopt a holistic, project-based approach in combining the delivery of learning aims B and C (this could be using the same example project/case study as used during the delivery of learning aim A). By doing so, learners will develop a complete, end-to-end experience based understanding of the role of the PQS and contractor's quantity surveyor as they produce quantities for a substructure and superstructure, as well as costings for variations and dayworks. You could either develop a mock project or adapt an actual case study/example.

Before learners start working on this mock project, ensure that you have shown them how to use a standard method of measurement such as New Rules of Measurement (NRM) or Civil Engineering Standard Method of Measurement (CESMM4). You will also need to give learners examples from the industry such as bills, take-offs and costings.

Assessment model

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 role 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.

Assessment guidance

There are a maximum number of three summative assignments for this unit relating to each learning aim.

For assignment 1, learners will need to demonstrate their understanding of the functions of, and differences in, the roles of professional and contractor's quantity surveyor. They could do this in response to an extensive case study, or a detailed project scenario, which contextualises the functions of a quantity surveyor at various points in the construction process.

For assignments 2 and 3, you could develop a project brief supported with drawings and bills, which learners could work on to produce quantities and costings as required.

The assessment evidence could be in the form of a report, presentation, bills of quantities and final accounts. Give clear instructions to learners to submit work in an appropriate format and with precision, accuracy and attention to detail.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 19: Quantity Surveying

Introduction

You may wish to introduce learners to this unit using online video clips showing the role of a quantity surveyor, highlighting its significance when tasked with representing either the client or the main contractor.

Provide an overview that illustrates the changing nature of the role under the influence of advancements in technology. Inviting a guest speaker at the start will also help to motivate your learners. Engage your learners during delivery through knowledge quiz, individual/paired/group activities and class discussions.

Both learning aims B and C will focus activities around practical application of tasks in response to a mock project specification. As such, lessons may be less structured, but you will need to provide regular tutorial support to learners both in their group work, and individually as required.

Learning aim A – Understand the functions of a quantity surveyor

- In your initial presentation to learners, you could introduce the functions of a PQS and the functions of a quantity surveyor who works for the main contractor. Online video clips can help in illustrating the differences and can help prompt class discussion for you to clarify points and gauge learner understanding.
- If possible, invite a guest speaker to expand upon this point, explaining the role of a quantity surveyor working for the client side as well as for the main contractor. The guest speaker could be from a quantity surveying or a related background such as building surveying. The guest speaker presents an ideal opportunity to highlight the changing role of a quantity surveyor, impacted by exciting developments in technology and procurement processes.
- When learners have a basic insight into the role, you could give them an example project to further analyse and discuss the role of a quantity surveyor. From this tutor-led discussion, you would need to summarise the key points presented by the learners and add as necessary. Outcomes from group activities such as this could be saved as a shared resource on the server or VLE for learner reference.
- In a tutor presentation, you could then explain bills of quantities before moving on to introduce the various financial and contractual management methods, techniques and contracts. Use the example project as in the previous activity to demonstrate these points further, before moving on to a tutor-led activity with learners constructing a process map that captures all the relevant documentation involved, along with the roles responsible for the input, issue and administration tasks throughout the process.
- Present an introduction to the New Rules of Measurement (NRM2) and the Civil Engineering Standard Method of Measurement 4th edition (CESMM4) to demonstrate their use. You may wish to use the example project documentation and the process map produced earlier to lead a group-based research activity where learners are to summarise methods available to produce bills. This should include the manual methods as well as the software packages available. Some useful resources are:
  - http://www.rics.org/Global/NRM_2_Detailed_measurement_for_building_works_1st_edition_PGguidance_2013.pdf
  - https://www.youtube.com/watch?v=B3v90Pzby2E
- This may now be a good point to gauge learner understanding through a knowledge quiz. You could use the same example project for the questions and then provide

model answers for learners to do self-assessment. You can use this opportunity to give constructive and developmental feedback.

- In a tutor-led activity, you can introduce learners to the forms of contract, looking at both Joint Contracts Tribunal Contracts (JCT) and New Engineering Contracts (NEC). You could then lead the group-based research activity, directing learners to find terms of the clauses relating to time, risks, insurance, compensation, payments and termination. Learners could work in small groups, each allocated specific clauses to examine and present their findings to their peers. Throughout the following class discussion, you can draw on the key points and summarise for learners.
- You could conclude this section with a group activity. Give learners more documentation about the example project, including bills, variations and contracts. Split the class into two with one group working for the client and the other working for the main contractor. Both groups will evaluate the roles of quantity surveyors from both perspectives and share their findings. You would facilitate and add to discussions as necessary.

Learning aim B – Undertake the production of bills of quantities for a project

- You will need to develop a mock project for learners to work on over the coming sessions covering this learning aim. It will need to include adequate details such as detailed sets of drawings including layouts, plans, sections and specifications, as well as detailed information about variations, valuations and final accounts. Issue the documentation to learners and split them into the groups for the initial examination of the material.
- In a tutor presentation referring to the mock project, demonstrate to learners how bills of quantities are produced for substructure and superstructure elements using an appropriate format and mensuration techniques. You could follow the same format as in the example/mock project.
- Following this, you could use a knowledge quiz to assess learners' understanding of the standard format requirements. Providing model answers, you may then ask learners to carry out self-assessment. This can be a useful focus for your developmental feedback and inform support required from you going forward.
- With the knowledge and theory understood, you can now issue learners the task sheets relating to the mock project. They must now produce bills of quantities for substructure and superstructure elements. It is a good idea for you to recap on example calculations demonstrated previously before handing the task sheets to the learners, and provide support to learners while they are working to solve the tasks. This activity could also be conducted in small groups.

Learning aim C – Undertake the production of a final account for a project

- This learning aim will again be focused on learners applying their knowledge to carry out practical tasks relating to the mock project you provided in learning aim B. To introduce this stage in the process, you could begin with a tutor presentation using an example project to demonstrate how Architect Instructions (AI) are used to administer and manage contract variations. Discuss examples of a variety of variations and how costings are carried out.
- You could then issue a knowledge quiz to assess learners' understanding of the management of variations and costing processes, providing model answers to learners to carry out self-assessment and for you to give constructive and developmental feedback.
- You will need to develop a number of task sheets covering exercises related to the mock project for learners to produce costings for variations. Do some example calculations before handing these to the learners and support learners while they are

working to solve the tasks. This could be set as an individual activity for learners, but also could be conducted in small groups.

- When learners are ready to move on, you should then demonstrate how interim and final accounts are compiled and discuss examples of a variety of situations, and how costings are carried out. This can be followed by learners tackling tasks sheets you have provided covering exercises related to the mock project. Learners will need to demonstrate their competence in producing final accounts. It would be helpful for learners if you demonstrate some example calculations before setting learners to work solving the tasks. Learners could work individually or in small groups for this activity.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

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 11: Site Engineering for Construction
- Unit 12: Low Temperature Hot Water Systems in Building Services
- Unit 13: Measurement Techniques in Construction
- Unit 17: Projects in Construction
- Unit 22: Economics and Finance in Construction
- Unit 23: Construction in Civil Engineering
- Unit 25: Property Law
- Unit 26: Conversion, Adaptation and Maintenance of Buildings

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Ashworth A, Hogg K and Higgs C, *Willis's Practice and Procedure for the Quantity Surveyor* (13th Revised Edition), Wiley-Blackwell, 2013 ISBN 9780470672198 – this book provides good coverage of the work of the quantity surveyor in private practice, in public service and in contracting organisations.

Brook M, *Estimating and Tendering for Construction Work* (Fifth Edition), Routledge, 2016 ISBN 9781138838062 – this textbook covers number of topics in this unit and has been popular among the learners for some time.

Lee S, Trench W and Willis A, *Willis's Elements of Quantity Surveying* (12th Edition), Wiley-Blackwell, 2014 ISBN 9781118499207 – a popular textbook for quantity surveying and covers range of topics relevant to the unit.

Journals

Construction Manager – this journal is published by the Chartered Institute of Building and contains updates on construction projects, methods and materials.

Journal of Green Building – the journal is published by College Publishing and addresses sustainability, new materials and modern methods of construction.

RICS Journals (http://www.rics.org/uk/news/journals) – RICS publishes number of journals that are of relevance to the unit content and quantity surveying profession.

Videos

This video provides an overview about role of a quantity surveyor (https://www.youtube.com/watch?v=vtT8SmEG7gE)

This provides an insight into format and use of bill of quantities (https://www.youtube.com/watch?v=LiSAMWyNxCs)

Bill of quantities software demonstration (https://www.youtube.com/watch?v=B3v90Pzby2E)

Websites

https://www.designingbuildings.co.uk/wiki/NRM2 – the website is owned by Designing Buildings Wiki Ltd, which is supported by a number of organisations such as CIOB, ICE and BRE. The website provides relevant information about New Rules of Measurement (NRM2).

http://www.jctltd.co.uk/ – this link provides useful information about JCT contract.

https://www.neccontract.com/ – this link will provide useful information about NEC contract.

http://www.rics.org/Global/NRM_2_Detailed_measurement_for_building_works_1st_edition_PGguidance_2013.pdf – this link is specifically for NRM2.

http://www.rics.org/uk/ – this is the website of Royal Institution of Chartered Surveyors (RICS), which is the relevant professional body. The website contains a wealth of information about standards, regulations and useful events.

http://www.rics.org/uk/shop/CESMM4-19209.aspx – this link is specifically for CESMM4.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 20: Quality Control Management in Construction

Delivery guidance

Approaching the unit

In this unit, learners will investigate the approaches that can be used to make sure that construction projects are completed on time and are fit for purpose. They will gain an appreciation for the reasons for controlling quality, exploring the job roles that are responsible for construction quality control and how they must interact to enable buildings to be completed to a high quality with minimal defects.

Learners will examine the systems that are used to control and record the quality of construction work, including how standards are used for benchmarking purposes. They will develop their understanding of the consequences of breaching standards by exploring case studies and conducting individual investigations.

Learners will also develop the skills required to produce quality plans for construction work, and this could involve local construction companies or real-life planned projects. Throughout delivery, you will find opportunity for engagement with local employers to be of benefit, providing stimulation for learners and placing the topics in context.

Delivering the learning aims

Learning aim A

You could initiate learning aim A with a tutor-led discussion, questioning learners to consider the underlying reasons for using quality standards in construction. You could establish the direct link between the improved quality of construction and the reduced need for costly remedial actions. With a basic understanding of the reasons why quality standards are used, you could then introduce the various standards that can be applied to improve the quality of construction outcomes. Similar approaches could be adopted for each of the methods, with tutor-led discussions providing learners with some background knowledge of how the various standards are used, before progressing on to relate how the standards impact on the quality of construction outcomes.

You could then set learners research activities to investigate the sources of different standards, along with case studies to explain how standards are used in given situations. This could be followed by introducing learners to quality management systems, as set out in ISO 9000. Learners could then investigate construction organisations that have ISO 9000 certification and produce case studies related to the quality management systems that they employ.

Learning aim B

You will begin to introduce learners to the various roles and responsibilities of different professionals through learning aim B. You could start off by considering the overall roles of the design team in the development of designs. This offers the opportunity to either invite a speaker in or, alternatively, to use examples of job descriptions that learners can analyse. You should also explain that although there are a range of different roles involved – from the client, through to designers and contractors – it is the collaboration between each of these parties that ensures the designs for construction projects are completed to the highest standard.

You could then introduce the concept of production quality to learners. This should include the roles of both site-based personnel and visiting inspectors; again, the involvement of local construction firms and professionals in the delivery of this topic would be of great value here. Specific roles should be investigated, including how the various parties interact to implement quality standards.

Learning aim C

Learning aim C will combine theory with practical application and could be approached using a range of methods. For example, you could first introduce learners to how quality control can be implemented on-site through the use of case studies to investigate specific approaches. Then, if facilities exist, learners could investigate the use of samples and mock-ups practically, and a similar approach could be used for testing materials. Should facilities not be available to complete activities practically, simulations or videos could be used to demonstrate testing methods. Visiting speakers could explain the different approaches to supervision on site, including the duties of different personnel in implementing quality control, and there are opportunities for learners to carry out practical investigations into checks that are used for dimensions and levels.

You should emphasise to learners the importance of recording and reporting quality and the methods used to do this. You should make sure that learners understand the reasons why corrective actions should also be recorded and the types of certification that are used in construction projects.

Learners should then be introduced to methods of corrective action that can be used in construction projects, including the impact of these corrective actions in ensuring projects are completed to high-quality levels. Finally, you should introduce learners to the methods that can be used to develop quality plans. Learners will need to understand the various objectives that can be attained, along with the methodologies that can be used to achieve these objectives.

Assessment model (in internally assessed units)

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.

Assessment guidance

The assessment of this unit is most likely to be in the form of three assignments, one for each learning aim. For learning aim A, learner evidence would normally be presented in the form of a research report into quality standards in construction. The report will consider a range of standards – including those for materials, workmanship and quality assurance – looking at the relative value and overall impact and effectiveness of these in ensuring a quality construction project.

Evidence for learning aim B should include considerations of the design team, site personnel and visiting inspectors in a written guide that explains how responsibility for quality is shared and delegated throughout the construction team.

Finally, for learning aim C, learners should produce a report that includes a quality plan for controlling quality for a given project scenario. The report should include the objectives for the quality plan, explanations for the use of quality systems and details of the appropriate systems to be considered, including the reporting mechanisms.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 20: Quality Control Management in Construction

Introduction

This unit enables learners to gain an understanding of the importance of quality control in the construction sector. There are opportunities for visiting speakers to explain to learners the responsibilities of various job roles in maintaining quality and the importance of using standards for benchmarking purposes.

You should give learners real-world scenarios and case studies to contextualise learning; this is a suitable approach to take when investigating corrective actions in response to quality standards not being met, and the responsibilities of those involved in the recording and certification of construction work.

Learners should also gain experience in producing quality plans for construction work, either using existing projects or through the development of scenarios.

Learning aim A – Investigate the sources of quality standards in construction

The purpose of learning aim A is to give learners the background knowledge and understanding of construction standards and the impact of these standards on the quality outcomes of construction projects. In addition to this, they will explore the significance of using appropriate quality processes to ensure construction projects meet the required standards.

- You could firstly introduce learners to the reasons why standards are used in general within the construction industry; this could be through a discussion or question and answer session to draw out the opinions of learners. You could discuss with learners the effects of non-compliance with construction standards, such as the need for remedial actions or financial penalties.
- Learners could then be set research tasks to investigate given building standards, including how the application of the standard impacts on the quality of construction projects. Learners could present their findings to the wider group, with the collective findings being combined into a reference for learners.
- You could then introduce learners to standards that are applicable to individual projects, including those specified by the IET or architects, or that relate to the location of a project. This could be supported by the use of case studies, or by inviting an architect or building control officer to speak to the group in order to explain the importance of meeting building standards.
- You could then introduce learners to material standard in a tutor-led discussion. Learners should be made aware of the range of sources of information, including British Standards, the BBA and product libraries. Learners could be given research activities based on case studies to determine whether given materials are suitable for an application. They will need to reference the appropriate sources to confirm suitability.
- You will need to introduce learners to the approaches and methods that are used in the testing of materials. This could be through an organised visit to a materials testing laboratory, in addition to video resources that show how testing is performed on each of the material groups. Learners could then be divided into small groups to investigate a given material group. Using this research, learners would then produce a revision resource that explains how and why materials are tested.
- With a sound understanding of how materials are tested, learners could be given further case studies to determine if materials are appropriate for the specified use,

based on factors such as trade advisory guidance, specifications, benchmarks and material standards.

- You could then lead a discussion with learners about their understanding of workmanship, in order to introduce the concepts of workmanship standards. You could demonstrate to learners examples of good and poor workmanship and discuss the consequences of each on the quality of a building.
- You could discuss with learners how some of the Building Regulation approved documents, such as A and B, would apply to the majority of projects, while others, such as document R, would only relate to dwellings. Learners would then carry out group activities to research how standards and guidance apply to a given situation, with results collated and shared by learners.
- Learners could then carry out some individual activities to investigate approaches taken to select contractors; this could be introduced by a visiting speaker who is involved with the selection process for contractors. You could then produce a spider diagram that considers the thoughts of learners relating to the factors that influence contractor selection. Address any misconceptions that may be held.
- Learners could then consider the methods that can be used to make sure that employees are trained to an appropriate standard, and the approaches taken by a range of employers to ensure continued professional development. This could be done through the use of a case study where learners investigate the progression opportunities within an organisation, or more generally, the progression pathways described by professional organisations.
- Once learners have a good understanding of the many standards that can be applied to construction projects, you could introduce quality assurance concepts to them. You could initially refer to case studies or video resources to look at how quality management systems are applied to construction outcomes.
- Learners could then complete individual activities to investigate the quality control systems that are used by ISO 9000-accredited organisations, including approaches to records and documentation management. This could be supported by a visiting speaker form an organisation that has accreditation who could explain the concepts of company quality and the various competences that combine within an organisation.

Learning aim B – Understand who is responsible for the quality of construction work

Learners should now have the background knowledge and understanding of quality standards and quality assurance. Learning aim B should provide progression, focusing on various job roles that interact to ensure construction projects are completed to the required quality standards.

- To introduce learning aim B, you could lead a class discussion to determine learners' understanding of design quality. You could develop this by considering how the quality of a building design is influenced by a range of professionals, including the client, the architect and the engineers, that are responsible for different aspects of a design.
- You could then give learners a case study that includes the client brief and their vision statement. It would be appropriate to make reference to *Unit 2: Construction Design* and the factors that are considered in that unit when producing design concepts from a client brief and vision.
- As with learning aim A, there are opportunities for visiting speakers from a range of specialisms to explain to learners their role within the design stage. This could be developed through the use of case study-led research tasks, where learners investigate the roles and responsibilities of various professionals and consider how these roles interact when designing quality buildings.
- A site visit would be an appropriate method of introducing learners to the roles of a

range of on-site personnel who have the responsibility for implementing quality standards. Alternatively, this could be achieved through the use of video resources, or visiting speakers.

- Learners could then work with a case study to investigate the responsibilities of given site personnel and produce a job description and brief explanation of their responsibilities. These could be collated into a document to be shared by all learners in the group.
- You could then introduce learners to the visiting personnel who also have responsibilities for ensuring the required standards are met. This should include the powers that they have to intervene or halt a construction project. As with site personnel, learners would benefit from a practising professional walking them through the various processes and activities they carry out. This could be developed to discuss how the various on-site and visiting personnel interact to ensure that standards are met, and identify the approaches taken to resolve issues related to compliance.
- You could give learners a case study-based research activity to investigate how the various on-site and visiting professional communicate and interact to keep the project on track. Learners should make reference to the significance and importance of individual roles in the quality process.
- Finally, it is worth discussing with learners how the traditional roles of design and production teams could in future change with modern practices. Roles may become more integrated and automated, and efficiencies in the quality assurance process may be introduced. One example of this could be in off-site modular construction of buildings, happening now, where much of design and production may be computer controlled, with the assembly taking place off site in a factory rather than on a traditional building site, more QA checks taking place off site and fewer errors in design. The advantages of such new methods in terms of quality control, labour cost etc could be examined.

Learning aim C – Apply systems used to control the quality of construction work

In learning aim C, the focus will be on site-based activities that introduce learners to methods that can be used to implement quality control for a construction project. Learners will find site visits and guest speakers to be enlightening, adding context to the theory and building their confidence to produce quality plans.

- In a tutor-led discussion, introduce learners to the concepts relating to the implementation of quality control. This would need to recap on the various standards and professional roles covered in learning aims A and B, before moving on to a deeper discussion on how specific quality control methods would be used by different professionals.
- Learners could then be set a research task to investigate the use of different specifications and standards when implementing quality control, and produce a report that examines the importance of each.
- A visiting speaker could introduce learners to approaches that can be used for training and briefings. There are opportunities to simulate toolbox talks among learners when on a site visit. You could then introduce learners to the selection criteria used in the recruitment of site staff to ensure their suitability for specific roles.
- Learners could then explore the various methods that are used to test both construction features and materials. The use of demonstrations, either on-site or in material laboratories, would be beneficial to learners; if this is not possible, then the use of video demonstration is appropriate. Learners could then produce a report outlining the methods of testing used for given materials, with these being collated to create a resource for all learners.

- You could set learners an activity to perform material tests, e.g. slump tests or compression tests on concrete or grading of aggregates to allow them to experience tests; alternatively, learners could complete control checks on materials to ensure they meet specifications by checking deliveries.
- After revisiting the roles of a range of personnel who have supervisory responsibilities, you could introduce learners to the checks that are carried out for dimensions and levels. Where possible, this could be complemented with practical tasks to carry out tests and checks in an appropriate environment. Learners should also be introduced to the methods of recording results and use these to produce a short report about the benefits and drawbacks of reporting values.
- You could then discuss with learners the methods that are used for daily, weekly and monthly reporting, including the importance of maintaining a site diary and recording minutes.
- Learners could then be introduced to methods of recording corrective actions. You could initially discuss with learners why remedial actions or replacements may be necessary, and then give them research activities to investigate the methods that are used to confirm that work completed meets specifications.
- You could then discuss with learners the impact of corrective action on a project, and consider the methods that can be used to communicate where corrective actions are necessary, using examples as appropriate.
- Learners could then be given case study-based research tasks to investigate the remedial actions required for a given project and the consequences of these for the parties involved. Learners could also examine how corrective actions impact on the overall construction programme.
- With an understanding of approaches that can be employed during the construction phase, you should introduce learners to the various handover checks that need to be carried out, including the impact of snagging issues and making good defects.
- Learners could be then divided into groups to carry out an inspection of mocked up samples of walls and other features (as listed in the specification) and produce a snagging report. Results of the reports could then be discussed as a whole group exercise and then shared through a collated document.
- You could then explain to learners the reasons for producing quality plans and their link to the quality outcomes on construction projects. This could be followed by a tutor-led group discussion to consider the objectives that need to be attained when implementing a quality plan.
- Further tutor-led discussion could consider the responsibilities of various parties throughout the different phases of a project, and how these responsibilities are allocated and communicated. Learners could then be set a scenario-based activity to allocate a range of given responsibilities for a specific phase of a project. These could be drawn together and discussed by the group to produce a coherent quality plan for the project.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- Unit 4: Construction Technology
- Unit 6: Surveying in Construction
- Unit 8: Building Regulations and Control in Construction
- Unit 9: Management of a Construction Project
- 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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Ashworth A and Hogg K, *Added Value in Design and Construction*, Routledge, 2000 ISBN 97810582369115 – the book provides coverage of strategies that could be used during the design and construction process to add value to a construction project.

Chartered Institute of Building, *Code of Practice for Project Management for Construction and Development,* Wiley-Blackwell, 2009 ISBN 9781405194204 – uses a range of examples to provide guidance on project-planning methods

Harris F, McCaffer R and Edum-Fotwe F, *Modern Construction Management (*Sixth Edition) Wiley-Blackwell, 2006 ISBN 9781405133258 – includes tutorials on construction management and focuses on the skills needed for a career in construction

Nunnally S – *Construction Methods and Management: International Edition* (Eighth Edition), Pearson, 2010 ISBN 9780132167451 – this book covers the management of a construction project, with reference to both buildings and highways.

Peterson S, *Pearson's Pocket Guide to Construction Management*, Pearson, 2011 ISBN 9780132156103 – a handy reference of construction information, including materials and interpretation of drawings and documents

Journals

Building Magazine (Building) – http://www.building.co.uk/ – this journal contains case studies of construction projects and materials used in construction.

Construction Manager (Chartered Institute of Building/Atom Publishing) – http://www.constructionmanagermagazine.com/ – this journal contains articles on management of projects and developments in the industry.

Construction Research and Innovation (CIOB) – http://www.ciob.org/cri – this journal is for construction managers and includes information about career progression.

Engineering, Construction and Architectural Management (Emerald Publishing Ltd) – http://www.emeraldinsight.com/journal/ecam – has case studies about a range of construction management issues including quality control

International Journal of Construction Project Management (Nova Science Publisher) – https://www.novapublishers.com/catalog/product_info.php?products_id=9057 – this journal has articles on a range of construction management issues, including quality management.

International Journal of Project Management (Elsevier) – https://www.journals.elsevier.com/international-journal-of-project-management/ – this journal links theory to practice of construction management through the use of case studies.

Journals in the Field of Construction Management (Association of Researchers in Construction Management) – http://www.arcom.ac.uk/res-journals.php – a range of journals that specialise in different aspects of construction, including construction management and project management

Videos

Concrete laboratory testing (https://youtu.be/2cTKsHM--qE)

Grading test for aggregates (https://youtu.be/TW81wOnObcs)

Mortar testing (https://youtu.be/lv0nCa70QJ8)

Quality control on construction sites (https://youtu.be/kTH-EFYwQDM)

Websites

www.apm.org.uk – Association for Project Management – online link to a range of project management tools

http://www.bbacerts.co.uk/ – British Board of Agrément, including information about services provided, certification and testing

www.ciob.org.uk/education – Chartered Institute of Building

https://www.fmb.org.uk/about-the-fmb/standards-and-practice/code-of-practice/ – includes reference to standards and warranties

https://www.gov.uk/government/collections/approved-documents – provides links to the individual Approved Documents of the Building Regulations

http://www.nhbc.co.uk/Builders/ProductsandServices/TechZone/nhbcstandards/ – NHBC Standards – provides links to the online standards related to NHBC standards

http://www.nhbc.co.uk/Productsandservices/ConsultancyandTesting/Acousticservices/FAQs/ – approaches for testing sound insulation in buildings

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Unit 21: Building Services Science

Delivery guidance

Approaching the unit

This optional unit for the Extended Diploma focuses on the underpinning theory related to building services science, including principles that relate to electricity, heat transfer, thermodynamics, combustion and psychometry.

There are a range of approaches that you could adopt when delivering this unit, such as lectures, discussions, presentations, site visits, supervised practical investigations, independent research using a variety of resources and use of personal and/or industrial experience. As such, you will find many ways to engage and inspire your learners.

There are also opportunities to carry out site visits and for expert visiting speakers to share current practices from industry. This will add to the relevance of the subject while motivating learners who may be considering a career in this sector, whether directly or following further higher education.

Delivering the learning aims

There are many opportunities for learners to carry out paired or small group investigations, with presentations and discussions being appropriate methods of feeding back to the wider group. Throughout delivery, learners will benefit from being given scenarios that relate to realistic construction problems for each of the topics. You will find some of the topics also lend themselves to practical investigation tasks and/or demonstrations of underpinning science. Use of audio-visual material and secondary sources would be appropriate where such resources are not available.

You could introduce learning aim A with a whole class, tutor-led discussion on the basic principles related to energy, gauging any prior knowledge and understanding, and taking the opportunity to clarify any misunderstandings and misconceptions. You could then set learners a task to investigate methods of heat transfer.

Following this, working in small groups, learners could carry out investigations into the properties and combustion of a specific fuel and give a short presentation on 'their' fuel to the class. Notes from this activity could then be compiled as a revision aid and made available for the wider class. If resources are available, learners could carry out supervised practical work to investigate combustion, or be shown demonstrations of the underpinning science where equipment is available.

Moving on to learning aim B, you could first introduce the principles of both direct current and alternating current. Where appropriate, demonstrations could be used, while practical investigations to carry out readings and related calculations for voltage, power, current and other related quantities would also be useful. Learners could be given a range of circuits to analyse either practically or virtually.

Looking at the generation of electrical supply and transmission methods presents a good opportunity to carry out site visits, whether this is to a power station, a small-scale wind or solar installation, or similar. This would provide some background context to the learning aim. You could then examine in more detail the components of the three-phase synchronous generator and the methods of driving the generator for both large- and small-scale electricity generation. The transmission and distribution, and the voltages in each part of this network, can form the basis of a learner-led research exercise. As part of this, learners will need to be able to produce a diagram showing the supply and its component parts.

Tutor presentations could be used to explain the conversions required for domestic installations from the local distribution transformer. Finally, you could discuss why different voltages are used for different settings, including commercial, domestic and portable equipment.

Learning aim C covers the basic principles of thermodynamics and the use of whole class, tutor-led discussions could be reinforced through group practical activities or tutor demonstrations of the principles of thermodynamics. If this is not possible, the use of appropriate video resources would be suitable. You could then introduce the general gas law, again making appropriate use of demonstrations or simulations to allow learners to visualise the relationship between pressure, volume and temperature.

Once learners have a good understanding of the fundamental parameters of thermodynamics, you build on this knowledge and introduce pressure–enthalphy (P–H) diagrams, graphical representations of thermodynamic processes and the combination of these to solve thermodynamic problems. To further prepare learners for investigating air conditioning systems, you could then consider the kinetic theory of matter and the reasons for changes in state. This would then lead into discussions relating to sensible and latent heat; again, there is opportunity to carry out investigations or demonstrations to support theoretical knowledge.

Whole class, tutor-led discussion on the basic principles of psychometry could be further enhanced with hands-on practical work for the learners and/or tutor demonstrations.

For example, learners could carry out practical investigations by taking measurements of actual air temperature and relative humidity in their classroom or working areas. They could then make use of charts to determine how to alter the condition of air to what is desired.

It would be appropriate to carry out site visits to observe the operation of suitable installations as well as utilising the expertise of external visitors to explain the interaction of factors when designing systems.

Assessment model (in internally assessed units)

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	Learners given a client brief that has to be analysed in terms of 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** Change 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

Assessment guidance

The assessment of this unit will most likely be in the form of three written reports, one for each of the learning aims. Each report should be supported by line drawings and diagrams. There is flexibility in the forms of evidence that are acceptable, for example presentations could be used, as long as the work submitted fulfils the necessary requirements of the assessment criteria and is individual to each learner.

Evidence for learning aim A is most likely to be in the form of an illustrated written report that will include line drawings and diagrams to support the text. Learners should support their judgements by providing clear links to the required installation and the information provided in a client brief.

The evidence for learning aim B is also likely to be in the form of a report for the given project scenario, and again, include detailed and comprehensive line drawings that support the evaluation of the advantages and disadvantages of alternative electrical distribution systems.

Finally, for learning aim C, learners should present a report that provides at least two alternatives for a given project scenario. The report should include an evaluation of the advantages and disadvantages of the alternative proposals and include detailed and comprehensive line drawings that illustrate the proposed systems.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 21: Building Services Science

Introduction

Good building services design requires an understanding of a range of underpinning scientific principles that allow internal environmental conditions to be examined and changes made to improve or modify those conditions.

You should give learners the background knowledge that they will need to understand the nature of energy, heat transfer mechanisms, thermodynamics and the theory of combustion of fuels. You should also give learners the opportunity to gain an understanding of the principles of electrical generation, transmission and distribution.

Finally, you will demonstrate the required skills to use psychometric charts and P–H diagrams to solve a variety of problems related to building services.

Learning aim A – Understand the principles of energy, heat transfer and combustion applicable to building services systems

- You could introduce the unit and learning aim through a tutor-led discussion into building services installation, perhaps by considering either learners' homes, workplaces or the centre. This could form the basis of a debate into the nature of energy – including electricity and thermal energy – and its use within building services installations. This could then be developed to consider the units that are used to measure energy and power, with learners considering the uses of each and conversions between them.
- Learners could then carry out either paired or small group investigations into the application of conservation of energy within building services contexts. This could be in the form of case studies or through scenario-based problems.
- Moving on, learners could be divided into small groups to carry out research and produce presentations that explain the different temperature scales that are used in building services science, giving examples of conversions between scales and typical applications of each.
- You could then introduce the principles and theory of specific heat capacity, reflecting on prior knowledge of materials and their properties. Learners could complete activities related to the selection of materials and components for given situations.
- As a lead-in to topic A2, you could first revisit the principles of conservation of energy, but then expand upon this with an overview of how the principles can be applied in heat transfer situations. You could then outline how this in turn impacts on the design and performance of installations and equipment.
- This could be followed with a paired investigation into methods of heat transfer, with learners producing illustrated reports that explain the processes of conduction, convection and radiation through structures and materials. They would need to demonstrate the ways in which calculations can be carried out.
- Learners could then be set a range of scenario-based problems to independently carry out further calculations relating to conduction, convection and radiation. This could be accompanied by individual research and investigation into the factors that affect the rate of heat transfer.
- With learners having a good understanding of types of energy and methods of heat transfer, you could then introduce topic A3. Following an introduction to the types of fuel that can be used in installations, you could allow learners to investigate a range of different fuels before investigating combustion in more detail. One approach could

be to divide the group into three, with each sub-group being allocated a fuel type, either solid, liquid and gas. The groups could then produce information booklets for their peers to inform on the properties and constituents of the different fuels.

- With learners gaining a sound understanding of different types of fuel, you could then introduce them to the principles of combustion. There are a number of approaches that could be used, including demonstrations or using video clips of the combustion process.
- Initially, you could demonstrate to learners using animations or video the requirements for safe and efficient combustion, and the differences between complete and incomplete combustion. Learners, working individually or in pairs, could be given scenario-based worksheets to research the causes and implications of incomplete combustion in domestic heating systems, along with methods to prevent this from occurring. To conclude investigations, learners could then investigate the implications of fuel-lean and fuel-rich combustion processes.
- To conclude the learning aim, you could introduce learners to the products of complete and incomplete combustion. This could form part of an extended investigation to be carried out by learners, which could also consider air requirements and the need to control excess air quantities.
- At this point, you could assess learners for learning aim A. This is likely to be in the form of a report that addresses a given client brief and installation scenario.

Learning aim B – Explore the characteristics of electrical supply systems applicable to building services systems

- You could begin topic B1 with a tutor-led discussion to determine learners' prior knowledge and understanding of direct current theory while also introducing learners to alternating current theory, referencing the similarities between some of the concepts, such as impedance and resistance.
- Learners could work in pairs to investigate the relationships between volts, amperes, ohms, joules and watts, including the SI units used for each, and the measurements that are taken for each in a building services application.
- Once learners have an understanding of each of the principles, you could demonstrate how to complete calculations for voltage, current, resistance, energy and power prior to learner completing calculations based on given information.
- There is an opportunity for learners to carry out some practical investigations into concepts. This could be through the use of electronic kits to construct direct current circuits from which they can take measurements of values such as voltage, current and resistance. Alternatively, the use of simulation software can enable readings and measurements to be taken virtually.
- You could review video clips or animations with your learners to illustrate the operation and principles of the three-phase generator. When the relationship between the phases is clear to your learners, you could give them a basic description of the process of generation in a conventional power station, where heat is used to produce steam, which in turn powers the turbine and then drives the generator. Learners could then be divided into small groups to investigate how each specific type of power station generates electricity, with groups investigating nuclear, coal, gas, oil, wind, tidal or hydroelectric power stations.
- You could then introduce local methods of generation, with learners working in pairs to investigate and produce research notes about solar, wind and biomass used for small-scale electricity generation.
- Learners would benefit from visits to sites where small-scale generation is used – for example a PV installation – and to be 'walked through' the various components of the system. If this is not possible to arrange, understanding could also be achieved through video resources.

- Once the principles of its generation are established, you can move on to the transmission and distribution of this electrical supply, looking at the process from the power station to the user. This will include transformer principles and the concepts relating to both step-up and step-down transformers. You could check understanding by setting learners some calculations that require them to apply the theory to determine values.
- Learners could then move on to the application of transformers in the transmission and distribution of electrical power. This could include a case study, but would be based on the typical form (where power distribution begins at the power station, is transmitted nationally via the Supergrid and National Grid and then distributed to local transformers).
- This gives scope for a learner-led research project to include information about the extent, make-up and components of the grid and local supply. The learners could research the various voltages and the hierarchy from the Supergrid to local supply. They could produce a block or family tree-type diagram, which shows the elements, and voltages that make up the network of transmission and distribution.
- Finally, you could introduce theory relating to the function and processes of a local transformer, which converts an incoming supply of 33 kV or 11 kV to 400 V. The transformer has delta-wound primary and star-wound secondary windings.
- Learners could investigate the different types of supply provided by a local transformer, including the supply of single phase to domestic installation from the three-phase mains and three-phase commercial supply. This could also include the need for a lower supply voltage for portable workshop equipment.

Learning aim C – Examine the thermodynamic properties for heating, air conditioning and refrigeration

- You could introduce learning aim C and topic C1 by refreshing learners' understanding of pressure, temperature, volume and mass. This could then be followed by individual investigations into the relationships between these quantities, the units of measurement and how they impact on the design and performance of installations.
- You could then introduce learners to the general gas law giving them individual research tasks to investigate the application of the general gas law to systems under pressure. This could be expanded upon by the introduction of the characteristic gas equations. Following worked examples, learners could be given some scenario-based problems related to building services science to test their understanding of the concepts of general gas law.
- You could then introduce learners to systems where a number of different pressures are found; this would allow you to demonstrate the application of Dalton's Law. The understanding of this could then be assessed through a number of activities that require learners to solve problems involving multiple pressures.
- Once learners have a good understanding of the principles of ideal gases and their applications, you could introduce them to thermodynamic properties and processes. You could initially discuss the concepts of saturation temperature and enthalpy, before setting learners an individual study task to investigate the relationships between pressure, saturation temperature and enthalpy.
- Once having an understanding of pressure and enthalpy, learners could be introduced to P–H diagrams. They should be able to identify the various different zones of the diagram, and be able to interpret the information that is presented. You could then demonstrate graphical methods of representing the thermodynamic processes of isothermal evaporation, adiabatic compression, simple vapour compression and refrigeration cycles.
- You could then introduce other methods of identifying values to solve problems, such as in the use of tables. This could then be followed with a range of scenario-based

activities that require learners to determine values such as saturation temperatures, enthalpy for given conditions and problems relating to refrigeration plant and equipment.

- Moving on to the kinetic theory of matter, individual or paired learner activities could investigate the reasons for changes of state of matter. This understanding could then be developed looking at concepts of sensible and latent heat, prior to linking the theory of enthalpy to problems relating to changes of state of matter.
- Learners could then be set some investigatory activities that consider latent heat, changes of state and also enthalpy, using the theory of enthalpy to arrive at solutions.
- Within delivery of topic C4, there are opportunities to make effective use of guest speakers, either in the form of an air conditioning sales representative or an installation sub-contractor or organisation.
- Initially, you could focus on the principles of air conditioning processes and cycles, introducing learners to psychometric terms and properties of air and water vapour. You could revisit theory from Unit 1 relating to human comfort at this point. Learners could then be set problems to investigate that would involve them in making use of a range of approaches that could include calculation, measurement, tables and charts to arrive at solutions.
- Moving on, you could consider psychometric process lines for a range of different conditions, with learners producing their own line drawings for given situations, such as dehumidification. It could also be demonstrated to learners how to derive the resulting conditions for a mixture of two air streams, with learners practising and developing their skills in the production of such diagrams.
- You could then develop understanding of psychometric process lines further by considering summer and winter psychometric cycles. You could introduce learners to a range of operating conditions and arrangements of plant; they could then carry out paired activities to plot summer and winter cycles based on the provided information, and explain the information that is represented by the diagrams.
- To conclude, learners could be introduced to the approaches they will need to take to determine plant duties from given psychometric charts, and then work individually to complete exercises based on these.
- In preparation for assessment, learners could be given scenarios for installations and they could consider alternative approaches to meet the needs of the scenario, comparing the proposals. They could develop supporting documentation, such as line drawings, and confidently refer to tables and diagrams when making or evaluating proposals.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit has links with the following other units:

- Unit 1: Construction Principles
- 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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Bird J, *Electrical Circuit: Theory and Technology* (5th Edition), Routledge, 2013 ISBN 9780415662864 – includes AC theory, DC theory, electromagnetism, transformers

Grimwood T and Jeffery A, *Level 2 and 3 Diploma in Electrical Installations (Buildings and Structures),* Pearson Education, 2013 ISBN 9781447940258 – gives a thorough grounding in all electrical principles and processes, with a comprehensive chapter on electrical science

McMullan R, *Environmental Science in Building* (7th Edition), Palgrave Macmillan, 2012 ISBN 9780230290808 – covers a wide range of principles and theories related to building services science

Moss K, *Heat and Mass Transfer in Buildings* (2nd edition), Routledge, 2007 ISBN 9780415409070 – includes chapters on heat transfer, heat exchangers, heat transfer, ventilation and other principles covered in learning aim C

Sherwin K and Horsley M, *Thermofluids*, Chapman and Hall, 1996, ISBN 9780412598005 – covers temperature, measurements, pressure, ideal gas laws, psychometry and combustion amongst other topics covered in this unit

Journals

Building Services & Environmental Engineer (Datateam Publishing Ltd) – relevant to each learning aim, including current practice and developments in the industry (http://www.bsee.co.uk/)

CIBSE Journal (Chartered Institution of Building Services Engineers) – relevant to each learning aim, including current practice (http://www.cibsejournal.com/)

Heating and Ventilating Review (Datateam Business Media) – relates to learning aim C (http://www.heatingandventilating.net/)

Videos

'Power to the People', a series of BBC documentaries about power generation and supply (http://www.bbc.co.uk/programmes/b06q4yqv)

Animation and presentation that covers both single-phase and three-phase generators (https://youtu.be/j3khXLmFgg8)

Walkthrough of a solar photovoltaic installation (https://youtu.be/umvd4183vZE)

Combustion processes (https://youtu.be/SVa55Fl1o9s)

Complete and incomplete combustion explained (https://youtu.be/cRnpKjHpFyg)

Websites

https://www.thebesa.com/ – The Building Engineering Services Association (BESA), formerly known as Heating and Ventilating Contractors' Association (HVCA)

http://www.bsee.co.uk/ – industry magazine for building services and environmental engineering

http://www.cibse.org/ – Chartered Institution of Building Services Engineers

www.docircuits.com – online simulator for electronic circuits

www.energynetworks.org/electricity – how the transmission grid works

http://www.energynetworks.org – local distribution design information

http://www.heatingandventilating.net/ – magazine for heating and ventilation contractors

www.learnabout-electronics.org/index.php – covers both AC and DC theory

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 22: Economics and Finance in Construction

Delivery guidance

Approaching the unit

This unit introduces learners to the financial considerations and requirements for the successful delivery of construction products and services. Learners should be encouraged to research and learn how to identify the factors and risks that may lead to business failure or construction projects not being finished on time or within budget.

You should focus on the composition of the construction industry and ensure that learners are aware that it delivers its services through small, medium and large business organisations. These businesses operate locally, nationally and internationally and are affected by many external factors that learners will explore in this unit.

You should encourage learners to consider how customer preferences, political decisions and worldwide events – such as war and changes in government – can all influence the construction industry. Learners will need to reflect on how changes in interest rates, availability of materials, access to land and labour costs affect the supply of and demand for construction outputs and their subsequent pricing.

Your learners will need access to a range of research resources and business analysis tools to complete this unit. They will benefit from construction business/project case studies and financial simulation models to show the impact of cost scenarios, and video presentations or TED talks on business practices.

You can involve local employers in the delivery of this unit by inviting them to engage as guest speakers and panel members for learner presentations or suppliers of case study materials and business materials as exemplars.

Delivering the learning aims

Learning aim A

For learning aim A, introduce the topic by asking learners to share their knowledge and experience of construction businesses. You could invite guest speakers from local and national businesses to present and discuss the structure, scale and areas of operation of their organisations. Working in small groups, learners could carry out secondary research on businesses by visiting their websites.

You could then provide an initial presentation on market structures with a follow-up class discussion on how markets work. Use examples – such as how weather can affect supply, or how consumer demand affects price – to show learners the relationship between demand, supply and price. Case studies focusing on the local housing market can be used to explore current issues. This could include learners determining how changes in interest rates and availability of finance have impacted upon supply and demand. Learners could then work in pairs using online economic resources to consolidate their understanding of the topic.

Learning aim B

For learning aim B, you could begin with an overview detailing the key factors influencing the construction industry. Divide your learners into small groups to undertake research on specific areas, economic resources, the internal environment or the external environment. Groups could then present their findings to the class, enabling them to share their knowledge with their peers. Questions should follow each presentation for learners to consolidate their understanding and consider how these factors can affect how the construction sector operates.

Introduce learners to case studies to determine how different construction organisations have shaped their business decisions in response to economic resources, the internal environment or the external environment. Ask how this has impacted on consumer demand for their products.

Learning aim C

You could introduce learning aim C by asking learners to share their own knowledge and experiences of budgeting and planning their personal finances. Learners could then research the different costs that affect a business and report back to the class on the variety of costs that need to be taken into account when costing a construction project.

You could then provide examples to illustrate cost control and planning and the approaches employed to manage costs within the construction industry. You could give learners a range of case studies to review the influence that cash flow has on business operations, asking them to identify how some businesses have improved their cash flow situation.

The use of a visiting speaker could help learners understand how a local construction business operates and to advise learners how they predict and manage costs on construction projects.

Learning aim D

For learning aim D, you could introduce the topic using case studies of different businesses. Using different business analysis methods, learners could work in groups to review and present on their allocated case study and methodology. Learners would be interested to hear from guest speakers from local or regional businesses to present how economic changes have affected the feasibility of their construction projects. You could follow this up by learners creating spreadsheets or using online resources to model how changes in costs and other factors can affect the feasibility of construction projects.

Assessment model (in internally assessed units)

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	

Assessment guidance

The unit specification gives specific detail on the criteria needed to gain pass, merit or distinction grades. This unit is internally assessed through two summative assignments, one for learning aims A and B and one for learning aims C and D. Assignments can include a scenario and a number of tasks to support learners to contextualise and apply economic theories and principles to the construction sector. It is however important that learners are given a realistic and achievable number of tasks per assignment.

All learners should independently undertake in-depth research to generate evidence for each assignment and ensure that is validated through inclusion of a fully referenced bibliography.

Getting Started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 22: Economics and Finance in Construction

Introduction

Begin by introducing the unit to learners through a group discussion exploring what learners understand by economics and finance. Discussion could begin with inviting examples from learners of their personal approaches to budgeting and preferences for specific products and services to introduce economic terms and concepts.

Use examples of high profile businesses that have gone out of business in recent years to explore why this may have happened in terms of cost planning and management.

Your learners could start to research and construct a glossary of economic terms and factors and share their definitions. Conclude with a group discussion on the four learning aims and the requirements for assessment.

Learning aim A – Examine how economic principles underpin the construction industry

You may use the following activities to give formative feedback to learners in preparation for the formal assignment.

- Introduce the topic through a whole class discussion on the range of sectors and business sizes in operation in the construction industry based on learner awareness and work experience. This will include learners understanding the legal status of businesses and you could engage learners with informal Q and A task, matching scenario business models to the given categories.
- Devise a group research activity in which different groups are allocated a different sector in the construction industry to produce a poster on its composition, outputs and examples of organisations operating in that sector. The research can be undertaken online or through visits to local businesses. Learners could research different businesses to compare different structures, size and the geographical spread of their activities.
- Following on from this activity, ask each group to research an organisation from the sector and present on its legal status, size, structure and activities and competitors.
- Lead a group discussion on how supply, demand, market place features and restrictions and pricing operate using examples that learners can relate to such as clothing, holidays and sales promotions such as 'Black Friday'. Extend this discussion to review how the characteristics of the construction industry influence how it functions aligned to economic principles.
- Ask learners to consider, discuss and research key economic terms including supply, demand, pricing, competition and elasticity of demand. Learners will need to update their glossary of terms.
- Ask learners to work in small groups to produce a briefing sheet on the interaction of supply and demand on prices in the local housing market. Groups could then feedback their findings to class and key points consolidated for tutor-led discussion.
- In a tutor presentation, you could refer to online resources that illustrate demand and supply curves before asking learners to work in pairs to assess the impact on these factors in response to changes on price.

Learning aim B – Investigate the impact of economic factors on construction projects

- Lead a group discussion to introduce this learning aim by asking learners to

consider the requirements for the development of a construction project. To present this visually, you could invite the class to contribute to a spider diagram, or task learners to work in small groups to create a poster highlighting key points.

- Plan a group research activity using reliable statistics and data on population and economic trends. Groups will need to produce tables on market data and predict the impact on supply, demand and price.
- Follow up this activity by asking learners to work in small groups and using local newspapers and employment agencies, determine the availability and cost of land and labour resources locally.
- Learners could investigate the variety and cost of finance options available to construction firms, accessing information on financial resources such as local bank websites. Learners could then clearly present findings through the production of an information leaflet.
- Ask small groups to review and present on video clips of best practice to introduce enterprise and entrepreneurship to give a broader perspective to help learners understand how these elements shape supply, demand and price.
- Visit construction businesses, or invite in guest speakers, so that learners can identify how organisations have adopted their business practices to react to changes in their internal and external environments.
- In a tutor-led discussion, consider how the UK's Construction economy has responded to alleviate pressures and challenges in the sector such as supply and demand challenges, the need for modernisation in the face of globalisation, increased competition from abroad and development of new construction techniques.
- Through online research, learners could collate a number of examples of corporate social responsibility (CSR) and ethical policies from local, national and international construction businesses. A class discussion on the similarities and differences could follow.
- In a tutor-led discussion to support assessment, review the political, technological and legal changes that impact on businesses and sectors within the construction, and learners should then work in groups to analyse and present on a range of case studies where businesses have failed or succeeded because of changes in the external environment to demonstrate their understanding, e.g. how the UK housing market has responded to the increasing need for affordable housing.
- Encourage learners to update their table/glossary of economic terms and factors and use their research to inform their assignments. You could conclude the session with an extended opportunity for a Question and Answer activity.

Learning aim C – Explore how to plan and control construction costs

- You could begin by asking learners how they personally plan and control their finances, manage their cash flow and budget for special purchases and then extend this activity to consider why and how construction businesses need to plan and control their costs.
- Introduce cost control techniques used by construction firms including templates and examples available online.
- Invite in a guest speaker or visit a construction project so that learners can determine why businesses need to control costs in construction projects, the different methods used by this business to plan and control costs and how costs are reconciled over the duration of a project.
- Encourage learners to update their table/glossary on economic terms used to plan and control costs.
- Ask learners to research sources of costs to price construction projects.
- Using tutor-provided construction examples, learners will work in pairs to prepare

the budget for a range of construction projects, including consideration of profit, loss, costs and variables.

- Building on this activity, learners should then review the impact of time delays on costs and income.
- Lead a group review to identify how businesses use cost control techniques to monitor and control costs over the lifetime of a project. You could provide a project brief for learners to investigate, working in small groups. The first group should propose two relevant sources of cost data and two suitable cost control techniques that they have identified, with each subsequent group then proposing aspects that other groups have not yet suggested, ultimately building up a complete knowledge base.
- You could access construction contract documents and arrange learners in small groups to decide how these are used by construction businesses to control costs.

Learning aim D – Examine the factors determining the feasibility of construction projects

- Using a simple construction project case study, support learners to develop worked calculations or spreadsheets from construction cost data (land, labour, materials) and income from the sale or rent of the completed project to reach conclusions on whether the project is feasible.
- Work through a range of 'what if' situations with your learners to determine which factors have the biggest impact on the feasibility of the project to model and test how changes in the factors affect feasibility.
- Introduce learners to the range of different methods available to check the feasibility of projects.
- Ask learners to work in small groups and to then select and research one of the following business analysis methods (PESTLE, SWOT, 5 Cs and Porter's 5 forces) and present their findings to the other groups. One group member should then join another group and work to produce a table on the similarities and differences between their two different methods. Once completed, a member from the original group should then join another group and carry out the same activity until there are comparison tables for all the methods. This allows learners to share their learning with peers through explanation of their research.
- Learners can then work in small groups on a given case study using a business analysis method and present their results to the other groups. Following on from this task, learners should apply their business analysis findings to their previously worked calculations to determine the impact on its feasibility working through a further range of 'what if' situations. The template for assessment could include a section where learners review the impact of different decisions.
- For assessment purposes, conclude with a tutor led review of the consequences of change on project feasibility.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Construction and the Built Environment

- 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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Cartlidge D, *Construction Project Manager's Pocket Book,* Routledge, 2015 ISBN 9780415732390 – this book details the skills and knowledge involved in construction project management.

Cooke B and Williams P, *Construction Planning, Programming and Control* (Third Edition), Wiley-Blackwell, 2009 ISBN 9781405183802 – this book covers the principles and practice of construction planning, programming and control during the preparation and construction stages of a project. The control of time, money and resources are considered in a risk management context.

Myers D, *Construction Economics: A New Approach* (Fourth Edition), Routledge, 2016 ISBN 9781138183728 – this book gives learners the principles and concepts underlying the relationship between economic theory and the construction industry.

Videos

TED offers short online talks covering an extensive range of areas including business and economic issues (www.ted.com).

Websites

http://www.bbc.co.uk/education/subjects – this site has learner guides and clips on a range of business and business management topics.

http://www.businessballs.com/index.htm – this site has business dictionaries, templates for undertaking SWOT and other business analysis approaches.

http://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2016/10/Farmer-Review.pdf – recent report extolling the need for modernisation in construction industry in the UK and the economic problems it faces.

http://edu.bankofengland.co.uk/knowledgebank/ –this is the site for the Bank of England, which includes educational resources.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 23: Construction in Civil Engineering

Delivery guidance

Approaching the unit

This optional unit for the Extended Diploma introduces learners to the large-scale construction projects that are undertaken by the civil engineering industry, such as highways, railways, bridges, dams or skyscrapers.

There is scope for external speakers to provide contextualisation and add relevance to the learning. The use of visits and audio-visual resources will enable learners to understand the size, scope and complexity of civil engineering projects.

There are a wide range of approaches that you could adopt when delivering this unit that will provide opportunities to inspire and stimulate learners. Approaches could include lectures, discussions, presentations, site visits and investigations. You could use a range of case studies, project profiles and real-life civil engineering project details to add realism and contextualisation to the activities. A successful combination of these approaches will stimulate, motivate, educate and inspire learners.

Delivering the learning aims

Since this unit follows a logical sequence that is representative of many civil engineering projects, a linear delivery through each learning aim would give learners a broad introduction to how a civil engineering construction project develops through the various phases. This could be supported by following a construction project, potentially through site visits, to monitor its progression.

You could introduce learning aim A with a whole-class, tutor-led discussion on the basic principles related to earthworks, gauging any prior knowledge and understanding. You could then clarify any misunderstandings and misconceptions before setting learners a task to investigate the various methods used for excavation.

You could then divide the class into small groups to carry out investigations into the types of earthmoving, compaction and concreting equipment that are used on site. Each group could give a short presentation on the equipment that they have investigated.

In the various research tasks that learners will undertake (individually or in groups), the presentations or reports produced could be compiled into information files that can then be shared with the whole class after comment, amendment and editing by yourself.

Moving on to consider temporary works, dewatering and piling operations, activities could be introduced through site visits, with learners being set scenario-based problems to identify and suggest suitable solutions for given situations.

To introduce learning aim B, you could first address the principles related to the design and construction of foundations and substructures for civil engineering projects. Where there is opportunity, learners would again benefit from site visits to gain deeper understanding of the different types of foundation that can be used. Learning could also be supported by visiting industry professionals to explain the principles related to the design of each foundation type.

Site visits and case studies could also be used to provide insight into how drainage systems and utilities are accommodated within substructures, with learners completing scenario-based problem-solving activities to produce alternative proposals for substructures.

You could introduce learning aim C using whole-class, tutor-led discussions on the basic principles of structures while reinforcing principles covered in other units – such as *Unit 1: Construction Principles* where structural members and failure modes are considered. Learners could complete investigations into the various methods that are used in the construction of steel and concrete frames.

Once learners have a good understanding of the structural members that are used in structural frames, you could use further whole-class, tutor-led discussion to introduce concepts of composite construction prior to setting learners scenario-based activities to develop designs for steel and/or concrete framed buildings.

You could then give learners opportunities to investigate retaining walls, including their effectiveness over the life cycle of a project. As with other topics, site visits or case studies could be used to give learners a deeper understanding of how and why certain solutions are used in given civil engineering projects.

Assessment model (in internally assessed units)

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	Learners produce 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	Learners produce 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	Learners produce a design for a civil engineering superstructure and a retaining structure for a given scenario

Assessment guidance

The assessment of this unit will most likely to be in the form of three assignments, one for each learning aim. It is likely that each assignment will be in the form of a report, be supported by drawings and diagrams as appropriate. There is flexibility in the forms of evidence that are acceptable, for example, presentations could be used, as long as the work submitted fulfils the necessary requirements of the assessment criteria and is individual to each learner.

Evidence for learning aim A is most likely to be in the form of an illustrated written report that will include drawings and diagrams to support the text. Learners should support their judgements by providing clear links to the requirements of the construction project they are considering, with reference to excavation methods, earthwork support and dewatering systems.

The evidence for learning aim B is also likely to be in the form of a report for the given project scenario. Learners will include their own designs for foundations, drainage work and utilities. They should include detailed and comprehensive drawings and diagrams that allow them to provide a reasoned evaluation of the suitability of their designs.

Finally, for learning aim C, learners should present a report that includes their own specification and design drawings for a given set of design parameters. The report should include both a specification for the superstructure frame and a specification and supporting drawings for a retaining structure. Learners should also evaluate their specifications against the given design parameters.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 23: Construction in Civil Engineering

Introduction

You could introduce the unit by visiting an appropriate civil engineering project so that learners can gain an understanding of the complexity of large-scale construction projects and be able to observe the nature of the activities that take place.

This would include the large-scale equipment that are used for excavation and construction, and the nature of different types of structure. The visit could be used as a stimulus for in-class discussion, and be referred to throughout the delivery of unit.

Learning aim A – Understand the methods and techniques used to perform earthwork activities

- You could introduce learning aim A by making reference to the visit to a construction site or using videos to introduce learners to the various earthwork activities that are used to reduce ground levels down to formation levels.
- You could discuss with learners the range of methods that are used for excavations before setting learners a group research activity to consider the advantages and disadvantages of trench and basement excavations. This could be followed by whole class activities using case studies of earthworks to consider the formation of cuttings and embankments, along with methods of supporting earthworks. You could use images and video resources to demonstrate examples to learners in order to reinforce learning.
- Moving on, you could then ask learners to work in small groups to research the features of a different type of excavation or earth moving plant for each group. The groups could produce a presentation that explains the advantages and disadvantages of each, making reference to their use, costs and time. The group could then deliver their presentations, to be followed by a group Q&A session to develop and reinforce points that are raised.
- A further activity could be to ask learners to produce their own research notes for the types of compaction plant that are used on civil engineering sites. These could be collated to produce a file of notes that learners could refer to when preparing for their assessments.
- With an understanding of the equipment and plant used for excavating, earth moving and compacting, learners could be introduced to the types of equipment that are used to transport, place and compact in-situ concrete into formwork. Again, you could ask learners to work in pairs or small groups to research the features of a given type of concreting equipment. Groups could then come together to discuss the equipment they have been researching and compare the similarities and differences between them.
- Using appropriate videos or site visits, learners could be introduced to the types of equipment that are used for compaction. Following this, learners could investigate how each is used and produce a brief report that contains information about a range of plant.
- You could then introduce the concepts relating to temporary works. You could then ask learners to work in small groups to investigate specific forms of temporary works. The groups could first detail the features of the temporary support systems before moving on to discuss the advantages and disadvantages of each. Groups could then present their findings to the wider group, which you could follow by discussing the relative merits of each.

- As a further activity, you could ask learners to work in pairs to investigate dewatering operations. Learners could produce short reports to explain the features of the types of equipment that are used for dewatering operations. You could then ask learners to consider the advantages and disadvantages of each type of equipment.
- Finally, you could introduce learners to piling operations. This could be achieved by small group activities with groups being tasked with investigating the types of piling operations that are used to support foundations, retain earth or act as a permanent method of dewatering. Groups could present their findings to the wider group, followed by a tutor-led discussion of the relative advantages and disadvantages of each method.

Learning aim B – Develop a substructure design for a civil engineering project

- You could introduce learning aim B through either a further site visit or by inviting a practising civil engineer to explain the principles relating to substructure design and construction. You could also introduce learners to the hazards and risks that are associated with civil engineering activities. This could be achieved by identifying potential hazards from video clips. You should also make sure learners are aware of relevant health and safety legislation – this needs to be embedded into delivery throughout the unit.
- You could then introduce learners to the methods and techniques to produce general and detailed drawings so that they can explain clearly the techniques used in civil engineering construction.
- You could use a whole class lecture to introduce learners to a range of types of foundation, including a brief outline of the design and construction of each. Learners could then investigate the details of each type of construction, including drawings and diagrams for each. Learners should consider the applications for each type of foundation, along with the relative advantages and disadvantages of each.
- This could be followed by small group activities to investigate the design of drainage systems as used in commercial applications. Learners could produce a report that considers the installation of deep sewers, pipe work and reinforced culverts where these are necessary.
- Learners could be given case studies to investigate and then produce designs for drainage systems that are appropriate for the given situations. These could be presented to the whole class, with discussions relating to the merits of each taking place and any misconceptions being addressed.
- With learners having a good understanding of the requirements for drainage, you could introduce other utilities, including water, electricity, gas and data services. This could initially be in the form of a group discussion.
- You could then ask learners to carry out paired investigations into the techniques that are used for the installation of utilities. The investigations should consider typical applications, with this supported by case studies and examples of installations.

When you are satisfied that learners have a sound understanding of substructure design, you could issue the second assignment that covers this learning aim.

Learning aim C – Develop a superstructure design and specification for a civil engineering project

- Learning aim C could be introduced with either a visit from an external speaker, a site visit or through video. Learners should be given an opportunity to visualise the various methods of construction, including frameworks, which come together to form the superstructure of a civil engineering project. This could lead to discussions about what forms a superstructure and how these come together in a project.

- You could then introduce learners to the principles that relate to the design of steel and concrete framed buildings. You could demonstrate to learners the techniques used for drawing up designs of steel and concrete framed buildings through drawings or animations.
- Learners could then be asked to investigate both concrete and steel frames, with small groups being given specific components to research. The research should include information about connections between elements and the advantages and disadvantages of each method researched. Learners could then present their research to the wider group, with theories being discussed and relative advantages and disadvantages considered. You could address any mistakes or misunderstandings.
- Learners could then be given a range of scenarios to produce either steel or concrete frames; these could be designed by learners with accurate drawings being produced to explain the design proposals.
- You could then introduce learners to a range of composite construction methods, discussing how concrete and steel can be integrated into frameworks.
- With an understanding of frameworks, you could then discuss with the learners the methods of providing retaining walls. Learners could carry out independent research into a range of methods and then evaluate each method in terms of effectiveness over their planned life cycle.
- Learners could then be given a task to design retaining structures for given scenarios and to justify their chosen solutions in each situation.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

- 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

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Chudley R and Greeno R, *Advanced Construction Technology*, Pearson Education Limited, 2006 ISBN 9780132019859 – covers site preparation work, plant and equipment, substructures, temporary works and safe working practices related to work on site

Chudley R and Greeno R, *Building Construction Handbook* (Seventh Edition), Butterworth-Heinemann, 2008 ISBN 9780750686228 – provides a broad introduction to elements of construction design, including diagrams and drawings of building elements

Manley S, Charters M, Francis C, Topliss S and Doyle M, *Construction and the Built Environment,* Pearson Education Limited, 2008 ISBN 9780435499914 – includes reference to structures and the equipment used on construction sites

Osbourn D and Greeno R, *Introduction to Building* (4th Edition), Pearson Education Limited, 2007 ISBN 9780582473034 – covers aspects of building processes and construction methods, including methods used for communicating information

Journals

Building Magazine (CMP) – http://www.building.co.uk/

Construction News (EMAP Publishing Limited) – http://info.constructionnews.co.uk/

Videos

Concrete compaction methods (https://youtu.be/Pseoz-0w7_k)

Dewatering techniques (https://youtu.be/WXVb-SuyKsM)

Hazards related to the construction of foundations and excavations (https://youtu.be/5wnSzjvUM3w)

High-rise office block constructions (https://youtu.be/Z3qmuphvhSE)

Methods of excavation (https://www.youtube.com/watch?v=EIthR6akGtw)

Methods of supporting trenches (https://youtu.be/UHuyMZIhukI)

Steel portal construction (https://youtu.be/g6sSbazsyLw)

Structural steelwork animation (https://youtu.be/aoOWzRpeDKo)

Websites

http://www.ciob.org.uk/ – Chartered Institute of Building

http://www.hse.gov.uk/construction/safetytopics/excavations.htm – HSE guidance for excavations

http://www.ice.org.uk/ – Institute of Civil Engineers

https://myconstructionphotos.smugmug.com/Construction-Galleries/Concrete-Construction/i-HrLXjvG – images of a wide range of construction activities appropriate for a number of topics from each learning aim

http://www.thomastelford.com/ – Thomas Telford is the knowledge business of the Institution of Civil Engineers.

http://www.understandconstruction.com/ – covers a wide range of topics including foundations, and both steel and concrete structures

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 24: Planning Application Procedures in Construction

Delivery guidance

Approaching the unit

Construction businesses will seek to identify a site or existing building as ripe for development and have the resources in place to release its potential through construction or refurbishment activities. However, for their development proposals to be viable, they must submit a planning application to the local authority that will ultimately make the decision to grant approval to the proposed development, or not.

This unit will support learners to identify the law, policies and planning processes in operation, which inform the planning decisions made by local authorities, along with the appeal processes available to developers.

Learners should be encouraged to research and learn about the local and national organisations involved in the planning process. They will also look at how planning law protects existing buildings recognised as culturally or historically significant, protecting wildlife and the environment and how planners intervene when individuals and builders have misinterpreted or ignored planning laws.

Your learners will need access to a range of online or hard copy research materials to complete this unit. They will also need to refer to case studies, for example, demonstrating the roles and activities of environmental and community groups in the planning process.

You can involve local employers and organisations in the planning and delivery of this unit by inviting them to engage as:

- guest speakers
- providers of tours of listed buildings or conservation areas
- panel members for learner presentations
- suppliers of case-study materials and business materials as exemplars
- providers of work experience opportunities for learners
- mentors for learners.

You can use a variety of delivery methods for these units, such as:

- Discussions at both whole class and small group level on planning processes and reviews of online planning applications and appeals available through local authority websites.
- Individual and group research and presentations, e.g. conservation areas and listed buildings.
- Simulation, e.g. staging mock planning appeals or public information sessions.

Delivering the learning aims

Learning aim A

To introduce learning aim A, you could begin with an initial presentation on the planning framework, how the plan making process operates and how a planning application is prepared and submitted. You could invite a guest speaker from a local or regional planning authority so that learners can hear how plans are developed and used to determine planning applications. Learners could also carry out online research into different planning frameworks and present their findings to peers for discussion on their structure and content.

You can use online planning application portals to provide examples of live local planning applications and the associated documents. This could be followed by discussions on the requirements for a new application to help learners prepare to develop their own draft planning applications.

Learning aim B

For learning aim B, introduce this area by using real examples of existing planning decisions available online. Learners could work in groups and prepare and undertake a mock planning appeal, using a local example where permission has been refused or has conditions attached. They could then identify the evidence and arguments that a developer could use to gain planning permission. Learners could then be encouraged to act as the appeal panel and ask questions.

You could invite guest speakers from a local construction business to discuss submitting planning applications, or perhaps their experience in implementing or appealing planning decisions. You could use case studies to look at what happens when development has taken place unlawfully and the resulting action taken by local authorities.

Learning aim C

You could introduce learning aim C by undertaking a site visit to a local listed building or conservation area, allowing learners to review how construction activities can be used to enhance significant buildings or areas. Learners could carry out website research as a small group activity on an allocated topic from the range of environmental measures available to protect land, vegetation and wildlife. Learners should also consider the impact of these measures on construction projects and present their findings to their peers.

Learning aim D

For learning aim D, you could introduce the topic by asking learners to share their knowledge of different organisations and groups working locally to protect buildings and the environment. Learners can also review the information provided by planning authorities on how the public can participate in planning processes. You could then provide case studies on how the public – whether as individuals or as organised groups – can participate in the planning process, at both the plan making and planning application stage. Learners can access online planning applications to review the type of objections lodged for current applications.

Assessment model (in internally assessed units)

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 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	Presentation or report evaluating how the public as individuals, groups or organisations can influence the outcome of planning decisions

Assessment guidance

The specification for this unit suggests three assignments, one covering learning aims A and B, one covering learning aim C and another covering learning aim D.

Case studies or scenarios are a useful way for learners to apply their knowledge and understanding by identifying the relevant planning documents, processes and outcomes for a planning application. Real applications and supporting documents could be used without sharing the outcome with learners for assignment 1.

As an alternative to a written report, learners may prefer to produce presentations for assignments 2 and 3, supplying a range of evidence including slides, research notes and scripts.

All learners must independently generate evidence that can be authenticated. All learners should independently undertake in-depth research to generate evidence for each assignment and ensure that is validated through inclusion of a fully referenced bibliography.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 24: Planning Application Procedures in Construction

Introduction

After explaining the unit content and assessment requirements, you could generate a class discussion to gauge learners' prior knowledge of planning processes, how applications are decided, how planning law protects the environment and how the public can engage in planning activities.

Throughout this unit, learners will need to develop a comprehensive knowledge of the legislation and processes that planning applications are subject to. Case-study activities will be a useful way to contextualise these. Learners should also be encouraged to complete a table or compile an ongoing glossary of planning terms as they progress through the unit, which will support their understanding of new concepts and terms.

You may use the following activities to give learners formative feedback in preparation for the formal assignment, as could the feedback from guest speakers or mentors from local businesses.

Learning aim A – Examine statutory frameworks and administrative processes for obtaining planning permission

- Following the initial class discussion on the unit content, you could move on to a tutor presentation looking at planning law and legal frameworks applicable to the construction industry. You could check learner understanding with an informal Q and A, considering when planning permission is, or is not, required for a range of development scenarios.
- Undertake a tutor-led activity to create a spider diagram/process map showing the different processes and interdependencies between them in determining planning applications. This class-generated spider diagram/process map can be photographed or saved if using an interactive whiteboard and shared electronically with learners.
- Visit planning departments or invite guest speakers so that learners are able to identify who is involved in planning activities, what their roles are and what are the processes. A tutor-led discussion following this visit/speaker could gather feedback from learners to compile a list of key decision makers involved at the various levels of planning application.
- You could instruct learners to produce flow charts and diagrams on the legislation in operation to manage planning processes. Split the class into groups, each with a specific area of legislation to research and produce a key facts document.
- Devise a group activity in which different groups are allocated a different type of public authority planning development plan for which they must produce a contents table, along with a process map for the plan preparation and approval, including public consultation stages for that plan and report back to the other groups.
- Following on from the group activity, lead a review of the differences between the different types of plan and their content, preparation, approval and consultation processes.
- You could allocate a different planning application per group and ask each group to review and present on its content, the stages involved and to track its progress from submission to approval.
- Follow up this activity by asking learners to work in small groups to produce a briefing sheet for a local community group on how planning authorities assess plans

and how planning application decisions are made. Learners should collate information on where communities can access further advice on these processes. This will assist learners in understanding the interconnections between different planning processes.

Learning aim B – Understand the processes for approving and appealing planning decisions and enforcement

- To introduce this topic, you could lead a discussion on the possible outcomes and conditions of planning decisions, and the reasons that could have informed them. This could be followed by an independent research activity into the different options open to an applicant when a planning authority has refused planning permission. Learners could present their research in a poster format.
- To explore this further, you could allocate a different planning application and decision per group and task each group to review and present to the class their rationale of the decision and any conditions attached to the approval.
- Develop a group activity based on a case study where a planning authority has refused planning permission. Groups could represent the applicant and produce an outline of their appeal application to gain planning permission.
- Follow on from the above task and set up a mock appeal to enable learners to actively participate – either as applicants or appeal bodies – using the case study as the basis of the activity. Arrange for external panel members, such as a planner or architect, to attend the mock appeal and review the appeal evidence submitted and the quality of the arguments made by either party to secure or deny permission.
- Share video clips to introduce learners to planning disputes and invite guest speakers or use case studies so that learners are able to identify what happens when unlawful development takes place.
- For assessment purposes, learners should research two different construction projects looking at the planning framework and planning application approval processes at play in each project and reasons for successful or unsuccessful outcomes. You should encourage learners to research the planning policies and development plans as well as planning approval terms and conditions that shaped the final construction project size, design and layout. They should also be able to evaluate the reasons for the success of each project.

Learning aim C – Understand the measures to control, protect and enhance buildings and land

- You could begin by asking learners to share occasions when they have visited stately homes, historical areas and local areas of outstanding natural beauty, and lead a group discussion to consider how planning measures can protect important assets.
- Ask learners to research in small groups planning legislation that protects land, wildlife, property and vegetation and to consider how this can affect construction activities. Each group can present their results via a poster or PowerPoint presentation.
- As an extension to the above, you could instruct learners to independently research and produce flow charts and diagrams on the legislative process in place to protect listed buildings, conservation areas and wildlife.
- A group visit to listed building or conservation area could be arranged so that learners can identify how planning operates to control and protect land and buildings, but also enable development activities to ensure continued use. This could also be delivered with the insight from a guest speaker engaged in the development or renovation of such a site.
- Give learners the opportunity for group work by using case studies to enable learners to demonstrate how planning measures operate so that land and buildings

are protected or enhanced.

- Learners, working in small groups, learners could research a defined area and design a map of assets protected through planning measures. The maps should be annotated with descriptions of each measure and each presented to class for comparison and discussion.
- Encourage learners to update their table/glossary of planning terms and collate all their research to inform their assignments. You could conclude the session with an extended opportunity for a Q and A activity.

Learning aim D – Understand how the general public can engage in the planning process

- You could lead a discussion on the motivation and methods around public engagement in planning applications and the advantages and disadvantages of this for the construction industry.
- Ask learners to research and then present their findings on different organisations operating in the planning arena to determine their objectives for participation.
- Use case studies consisting of actual plans and planning applications for learners to identify the support for or objections to development from the general public.
- You could use a selection of news clips and documentaries that show positive and negative public engagement with planning procedures. Learners could then identify the causes for endorsement or concern, and the impact on the planned development activity.
- Develop a group activity where groups could represent an individual, local group or national pressure group, and produce an outline of their campaign to challenge a development plan or planning application.
- For assessment purposes, ask learners to work in pairs or small groups to record and summarise their learning in this area.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC Level 3 Construction and the Built Environment

- Unit 8: Building Regulations and Control in Construction
- Unit 25: Property Law
- Unit 26: Conversion, Adaptation and Maintenance of Buildings

Resources

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Textbooks

Cullingworth B, Nadin V, Hart T, Davoudi S, Pendlebury A, Vigar G, Webb D and Townshend T, *Town and Country Planning in the UK* (15th Edition), Routledge, 2014 ISBN 9780415492287

Greed C, *Planning in the UK: An Introduction*, (1st Edition), Palgrave Macmillan, 2014 ISBN 9780230303331

Websites

https://www.gov.uk/browse/housing-local-services/planning-permission – this government site details the processes involved in securing planning permission.

http://planningguidance.communities.gov.uk/blog/guidance/ – this site supports local communities to get involved in planning processes.

https://www.planningportal.co.uk/ – this site details the current planning legislation and policies in operation.

http://www.rtpi.org.uk/ – this site is the professional body for planners and details careers in planning and has educational resources on planning processes.

https://www.youtube.com/watch?v=avuHd7o6YRY – this video clip summarises the planning policies that apply to building in the countryside.

https://www.youtube.com/watch?v=gdVjqtMI8bY – this is a video clip to introduce planning permission requirements.

https://www.youtube.com/watch?v=vBIcomKDrLo – this video clip reviews when construction activities can take place legally without planning permission.

http://www.dailymail.co.uk/news/article-3310462/Farmer-hid-illegally-built-castle-haystack-claims-t-demolished-s-home-protected-bats-newts.html – this site gives another example of illegally built property and the use of planning processes and law to address it.

http://www.dailymail.co.uk/news/article-2114920/Family-built-secret-house-woods-telling-planners-evicted-because.html – this site gives an example of illegally built property and protections given to property owners.

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Unit 25: Property Law

Delivery guidance

Approaching the unit

This unit focuses on the essential areas of law that regulate how land can be owned, bought, sold and leased. Learners will explore how construction firms must ensure that they comply with a range of areas of law when undertaking building and refurbishment work.

This will probably be the first time that your learners will have come into contact with some of the concepts of property law. It is therefore important to use a range of delivery methods. These will include the development of presentations, discussion topics and case studies as examples of how the law operates in practice and research opportunities on the legislation and case law that exist for this area of law.

Arranging visits to courts or tribunals will give learners the chance to see the law applied in real life. Guest speakers can also provide an extra dimension to your delivery to relate the content to the world of work and demonstrate to the learner how they may encounter these areas of law in their future careers in the construction industry.

Group work as formative or summative assessment can also benefit learners in understanding how property law operates and applying law to construction-related scenarios, but it is important to ensure that learners produce individual evidence for assessment purposes in line with the assessment guidelines for the qualification.

Quizzes, question and answer sessions, mind mapping and role plays could be used throughout this unit to reinforce and recap on learning.

You can also engage with local employers in the delivery of this unit by inviting them to participate as guest speakers, panel members for learner presentations, as mentors for your learners or through the provision of case studies and materials for inclusion in your delivery or assignments.

Delivering the learning aims

Learning aim A

For learning aim A, you could commence by delivering an overview of the unit and initiating a discussion on what learners already know about property law and legal procedures and use this as an opportunity to dispel any myths or inaccuracies.

You could use diagrams illustrating the administration of the law and how areas of law can overlap. You should also show learners how to find legal resources, including legislation, case law and law books, and explaining how the legal process operates.

You will need to emphasise the importance of using up-to-date and credible resources, as well as using law relevant to the country in which they are located, rather than international examples. This will set the scene for learners to undertake research on the topics in learning aim A, including searches on case law. You may wish to set this up as group work, with different groups allocated a specific topic to research. By then delivering this research to the class, learners will gain the opportunity to develop their presentation skills.

Your learners will also need to know about the different types of ownership of land and the applicable legal duties and restrictions on land use that these may trigger. This gives you the opportunity to work with learners, through group work and discussions, to examine real-life examples of legal cases illustrating these conditions in practice.

Using case studies you have supplied, learners can draft a mock legal application and courtroom style presentation to consider how legal restrictions can be set aside through such processes. A visit to a court or tribunal or a guest speaker from a legal firm may be useful in delivering learning aim A to contextualise the content with real-life situations.

Learning aim B

For learning aim B, you could begin by asking learners to consider how leases are used to protect property, owners and occupants. This could be followed by the opportunity to examine a range of leases, and to compare and contrast the terms and conditions within them, which protect property owners and tenants. You could distribute different examples of leases to groups for review and feedback to the class, looking at the terms and conditions contained in each lease. You may wish to invite a legal or property professional in as a guest speaker to share their experiences in developing leases for residential and commercial property schemes or undertaking property management of residential and commercial property using leases.

Learning aim C

You could introduce the topics in learning aim C through a group discussion on the general nature of a contract and ask learners to research and present on case law from this important area of law. You could then share some exemplars with learners to review and feed back on through group activities. This then affords you the opportunity to relate this area of law to the transfer of property, explaining how contracts are used and then detailing the specific procedures and costs associated with the legal process. You may wish to invite a legal or property professional in as a guest speaker to share their experiences in buying and selling property and to detail the process using real-life examples.

Assessment model (in internally assessed units)

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

Assessment guidance

This unit is internally assessed through a maximum of three summative assignments, one for learning aim A, one for learning aim B and one for learning aim C.

Case studies are an excellent way for learners to apply their knowledge and understanding of property law by identifying the appropriate law, process, consequences and remedies. Learners should incorporate evidence of their research and include a fully referenced bibliography. The assignment for learning aim A could use actual cases relating to construction activities, with learners having access to the facts of the case, but not the final decision.

The assignments for learning aims B and C could both refer to the same completed construction project case study. This would need to show a variety of land-use types so that learners can draft lease terms and conditions for learning aim B, and sales contracts for learning aim C. You may wish to invite representatives from local legal or property practices and use an employer panel to assess the validity of the leases produced.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 25: Property Law

Introduction

You may wish to commence the unit with an overview of the unit content and assessment requirements and a class discussion to gauge prior knowledge. You could then lead a discussion on what is law, outline how law is made and implemented by legislation and the courts.

It is always of interest to include local and national current legal issues using newspaper and TV clips when reviewing how the different areas of law impact on the use of land and property.

Throughout this unit, work with learners to devise a glossary of legal terms and processes.

Learning aim A – Understand different types of land ownership and responsibilities

These activities support tutor and peer formative feedback on learner engagement in class discussion, group work and research.

- Lead a group discussion, questioning learners on how they would define 'land' and 'land ownership'. Ask them to consider how the UK legal system operates to protect and enforce land and property ownership laws, and dispel any myths or misunderstandings. This activity could continue with a paired activity to support learners to define new legal terms and map how these processes operate for freehold and leasehold land.
- Following this, you could instruct learners on how to locate sources of law and determine its relevancy and appropriateness in terms of origin and age.
- Set up learner groups to research the different courts and their areas of responsibility, and other learner groups to investigate how law is made through parliamentary processes and support a peer review of their findings.
- Visit courts or invite guest speakers in so that learners can determine how the law operates and the personnel involved.
- Introduce learners to judge-made law providing a range of examples for group review and feedback on how legal decisions were made and their impact on construction activities. Resources may include case law, newspaper and TV clips and websites.
- Introduce the wider legal framework impacting on the construction industry with a tutor-led presentation using examples of a property moving through construction, and use phases to explain how a range of laws impact on the use of land and building.
- Instruct learners to then undertake small group research activities on allocated areas to produce and present flow charts, diagrams and posters on the different areas of law within the property and construction industry.
- Introduce learners to land law, and use a case study to illustrate how different interests can operate at the same time. Detail how some interests can be set aside, and invite learners to prepare arguments to present to a court to apply for the removal of rights.
- In a tutor-led discussion, learners should engage and suggest how the land, property and ownership laws can impact on the construction industry's projects and

developments. Refer to case studies used during delivery as required.

- To conclude, you should encourage learners to update their glossary of legal terms and processes before restating the requirements of the initial assignment and issuing briefs.

Learning aim B – Examine the law of landlord and tenant

The following activities may be used in preparation for the formal assessment. These provide opportunities to give formative feedback by the tutor, or through peer or guest speaker feedback.

- Lead a discussion on why rules and regulations are needed to protect the rights of landlords and tenants. You could follow this with a review of a few news stories and documentaries covering landlord and tenant disputes which learners could read and then share their thoughts with peers.
- Task learners to independently study and research examples of lease agreements to identify standard content and use of legal terms to govern landlord and tenant obligations. Following this activity, the class could reconvene in a tutor-led discussion on the purpose of restrictions and covenants in lease agreements.
- Give learners a small group activity to produce sample leases for a range of case studies. Lease agreements could then be swapped between the groups for peer assessment and feedback.
- Devise a group activity in which learners produce a table of the advantages and disadvantages of the different lease terms and conditions. Some groups will consider the terms as applicable to landlords, and some groups will look at the terms for tenants. Groups representing each party could pair up to share feedback and collate their results, before class discussion to consolidate outcomes.
- Ask learners to produce leaflets or posters for property owners or tenants explaining their duties and responsibilities.
- Invite guest speakers so that learners can identify the roles and responsibilities of property or legal professionals in drafting leases and the consequences of errors or omissions.

Learning aim C – Examine the system for buying and selling property

- Introduce the topic by asking learners to share their personal experiences in buying goods and services and their awareness of consumer law in this area. With learner input, you could then compile a list of what the class perceive as key requirements of contract law concerning the buying and selling of property.
- You could present case studies of actual conveyancing examples for learners to identify the terms and conditions and procedures. You could follow this with an interactive quiz or matching game linking term to definition and encourage learners to update and expand upon their legal term glossary.
- Lead a group research activity examining the leading case law that deals with the law of contract. Allocate different cases per group, with each group then informing the other groups of their findings.
- Continue the topic by asking learners to share their knowledge of property sales and processes and then undertake group activities to research and present on the typical requirements and process for the legal transfer of property through conveyancing. Groups could present their findings as process maps, identifying the responsibilities of the different parties involved, and the supporting documentation required, such as land registry and indemnity policies, and estimate the fees involved for given property value.
- Instruct learners to prepare a leaflet or poster to inform construction firms on the legal stages and their responsibilities and input to the transfer of property.
- Finally, you could invite guest speakers to enable learners to understand how property contracts are created and how legal transactions take place to dispose of property.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson NQF Level 3 National in Construction

- 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, Adaption and Maintenance of Buildings

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC Nationals in Construction and the Built Environment. Check the Pearson website (http://qualifications.pearson.com/endorsed-resources) for more information as titles achieve endorsement.

Textbooks

Elliott C and Quinn F, *English Legal System* (17th Edition), Pearson, 2016 ISBN 9781292089140

Wilson S, Rutherford H, Storey T and Wortley N, *English Legal System* (Second Edition), OUP Oxford, 2016 ISBN 9780198747949

Videos

This is a UK Citizens Advice video clip on landlord and tenant expectations (https://www.youtube.com/watch?v=RHqJd9Anj8c).

This is a video clip on the residential property conveyancing process (https://www.youtube.com/watch?v=iNg281x46pQ).

Websites

http://www.bbc.co.uk/programmes/b00vmvcv – This is a BBC documentary on landlord and tenant disputes.

http://www.channel5.com/show/nightmare-tenants-slum-landlords – This is a Channel 5 documentary on landlord and tenant disputes.

https://europa.eu/european-union/documents-publications/slide-presentations – The European Union website. It has a range of useful slides for use as tutor resources showing the current role of the EU in the legal system.

https://www.gov.uk/browse/business/premises-rates – The UK Government's website for information for business tenants.

https://www.gov.uk/government/topics/law-and-the-justice-system – The UK Government's website for information on administration of the law. It contains useful links to the organisations involved in the legal and justice systems.

https://www.gov.uk/private-renting-tenancy-agreements/overview – This website outlines good practice in developing leases for the housing sector.

https://www.judiciary.gov.uk/ – This is the UK court system website. It includes information on the structure and hierarchy of the courts and recent cases.

http://www.parliament.uk/ – The UK House of Commons and House of Lords website. It contains information on how parliament drafts, approves and amends legislation.

https://www.supremecourt.uk/index.html – This is the UK Supreme Court site. It is the final court of appeal in the UK for civil cases and for criminal cases from England, Wales and Northern Ireland.

http://www.telegraph.co.uk/finance/personalfinance/investing/buy-to-let/11837218/Nightmare-landlords-The-rent-on-our-decrepit-home-went-up-75-and-then-we-were-evicted.html – This newspaper article describes examples of landlord and tenant disputes.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.

Unit 26: Conversion, Adaptation and Maintenance of Buildings

Delivery guidance

Approaching the unit

The UK has millions of existing properties that require ongoing maintenance, alterations, changes and upgrades, and this optional unit focuses on such properties and how we can ensure their suitability for continued use, both now and for future generations.

Learners will explore 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. They will develop a maintenance plan for a property, learn the processes involved and the methods employed to develop a successful project before applying this to their own design scheme. They should be encouraged to draw on their own wider experience of construction from other units to present suitable solutions.

Delivery of this unit is likely to use a range of different methods, including tutor presentations, individual and group work along with paired investigations. There is also opportunity for a range of practical investigations of existing building projects. Learners would also greatly benefit from the involvement of local employers in the delivery of this unit if there are opportunities to do so.

Delivering the learning aims

Learning aim A

Learning aim A investigates the needs driving the conversion and adaptation of properties, introducing learners to the different levels of intervention and approaches available. The difference between the conversion and adaptation of a building should be clarified at an early stage. Learners can investigate the reasons why existing properties can become old and dilapidated, such as lack of maintenance, properties no longer fit for their intended purpose, listed and historic buildings and government requirements for increased brownfield development due to limited greenfield sites.

Research could be carried out in the context of existing buildings in your area that have become dilapidated, or focus on high profile buildings, such as The Houses of Parliament. From investigation and class discussion, learners should be able to identify the reasons why buildings have been neglected, or why older buildings have been converted or adapted in recent years. This analysis can direct learners to carry out their own further independent study into why there is a need for conversion and adaptation of a property. Learners should research all the possible reasons why a building may need to converted or adapted, including changes in social needs, financial costs of maintaining the building, improving energy efficiency and technological advancements. The learners could continue their independent research to look at examples of different levels of intervention – from general maintenance to prevent deterioration of the fabric of the building, to the complete refurbishment of the whole property – and create a list of the type of work carried out.

Learning aim B

In learning aim B, you should make sure that learners develop their understanding of the need for maintenance and how to develop a maintenance plan for a property. Learners could link with *Unit 1: Construction Principles* to identify the range of construction materials used in construction projects and research the defects associated with each material. Learners could be given a range of case studies that feature properties with problems, and they could investigate the possible causes, such as inappropriate specification, poor construction, structural failure, human impact or lack of maintenance. There are a number of popular television programmes that look at problems that may occur with properties (suggestions are included in the Resources section), and these may be a good prompt for class discussion.

You could give learners a research task so that they gain an understanding of cyclical maintenance requirements for a building (such as their school or college). This could then be complemented by further paired or group activities where learners investigate a range of maintenance approaches that can be utilised by building owners, each offering advantages and disadvantages when looking to extend the life of a property. Finally, you could give learners a range of buildings and ask them to use the knowledge they have gained to create a maintenance plan for the building they have been allocated.

Learning aim C

The delivery of learning aim C will link closely with *Unit 2: Construction Design* and optional *Unit 25: Property Law*. Learners could work in small groups alongside an industrial partner to investigate the different stages of the RIBA Plan of Work 2013 for a range of case studies, identifying the direct impact the Plan of Work would have on a conversion or adaptation of a building. Learners could then progress to investigate planning legislation, which may impact on a conversion and adaptation project. Case studies could be introduced and discussed as a group. This would again be an excellent opportunity to work with an industry partner to engage learners further with real-life examples that have encountered different legislative constraints, such as Planning Permission, Listed Building Consent or building in an Area of Outstanding Natural Beauty.

With the legislative requirements understood, the group could then be challenged to research the range of options for the conversion and adaptation of properties. This research could be supplemented by looking at existing projects, identifying and justifying how they have been converted or adapted. These examples could be the same case studies as investigated in learning aim A. Working in small groups, the learners could suggest the most suitable form of conversion or adaptation. This should include assessing the client's requirements, such as structural alterations or lateral or vertical extensions, and then deciding how best to meet these.

Finally, the learners should be able to create proposals for conversion and adaptation schemes. You could use a local or national example of a conversion, adaptation or maintenance project that learners are familiar with, and they could then work in pairs to identify the different types of building survey reports available, building confidence in their analytical skills as they interpret the information.

Learners will again call on these skills when analysing and interpret plans, elevations and sectional details for proposed schemes, and may draw on knowledge from optional *Unit 10: Building Surveying in Construction*. Learners could produce maintenance plans for these projects specifying how often the various elements will need attention. You could work in partnership with a local design or construction organisation to give learners the opportunity to present and discuss their proposals for the different schemes.

Assessment model (in internally assessed units)

Learning aim	Key content areas	Recommended assessment approach
A Examine the need for conversion and adaptation of a property	**A1** Conversion and adaptation **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 and adaptation of a property	**C1** Process of conversion and adaptation **C2** Legislative requirements **C3** Options for conversion and adaptation **C4** Proposals for conversion and adaptation schemes	A written report, annotated drawings and specification for a conversion and adaptation project for a given scenario

Assessment guidance

There is a maximum of three summative assessments for this unit. You should set the assignment briefs within the context of an existing property.

For assignment 1, which will cover learning aim A, you should provide adequate details about the existing state of the property so that learners can evaluate the needs and intervention options for the conversion and adaptation.

Learning aim B will be addressed in assignment 2, and learners will need to include an evaluation of the maintenance requirements and critical analysis of their proposed maintenance plan, justifying their rationale of how to preserve and extend the life of a given property.

Learning aim C will be addressed in assignment 3, and learners must justify a proposed scheme design and specification for a conversion and adaptation project for a given property. This should include evidence how it meets legislative requirements.

You could ask for assessment evidence in the form of a project report and a portfolio containing drawings and specifications. As part of the assignment brief, you could ask learners to include sketches, illustrations and a list of information sources used.

Getting started

This provides you with a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 26: Conversion, Adaptation and Maintenance of Buildings

Introduction

In the delivery of this unit, there is the opportunity for you to develop links with local construction and design companies who may be able to give learners suitable conversion or adaptation challenges or scenarios that could be used to help develop their skills.

Once the underpinning knowledge and understanding from learning aims A, B and C have been addressed, a more holistic approach could be employed, which would give learners the opportunity to develop a scheme design and specification for the conversion and adaptation of a property.

Learning aim A – Examine the need for conversion and adaptation of a property

- This learning aim could be introduced with a class discussion on a range of conversion, adaptation or maintenance projects. You may wish to look at well-known examples with learners, such as The Houses of Parliament or the Olympic Stadium, or choose a more local example, such as a new hotel or residential apartment block within a listed building.
- The learners can then go on to research, independently or in pairs, all the reasons why existing properties need to be adapted or converted. Research could be captured in a number of formats, such as a brief report or presentation. This should include reasons why old buildings have become dilapidated, increased brownfield development, legislative changes, historic preservation, architectural trends, changes in societal needs, financial, improving energy efficiency and increased human comfort requirements.
- One example case study could be to review the energy efficiency of old versus new properties; various data exist, e.g. through EPCs (available for any house for sale online), or even illustration of thermal losses for two given buildings (old versus new). This could then include a discussion on potential remedies, from basic methods, such as insulation, to installation of renewable technologies to improve cost efficiency of a building. This could take into account any consents or permissions required for older buildings in particular.
- When ready to move on to explore levels of intervention, learners could investigate the different levels of intervention that may be required, e.g. general maintenance to prevent deterioration of the fabric of the building, or refurbishment of the whole property.
- Learners could work in small groups to visit and research buildings in their local area – perhaps their school, college or local houses - and create a list of the type of work that has been carried out. They will assess levels of general maintenance and any alterations or extensions that may have been added to the buildings to ensure they are suitable to meet modern living standards. The research of all the groups can be shared through group discussions.
- Learners also need to research the examples of retaining a façade and elevation, with a new building behind it. Often examples can be found in town and city centres. You should also consider other types of historic buildings, such as old factories.
- Within their groups, learners should collate the reasons for the intervention options studied, summarising their clear rationale for the need for the conversion and adaptation of a range of properties. This can be shared with peers through tutor-led discussion or learner presentations.

Learning aim B – Develop a maintenance plan for a property

- The focus of learning aim B is to consider the reasons why properties need ongoing maintenance to preserve their fabric and ensure their longevity. You could ask your learners to suggest a possible impact that a defect can have on a construction project and highlight that such defects are one of the major causes of disputes within construction projects.
- Learners could then work in pairs to research the different materials used in construction projects and the common defects to which they are susceptible. Learners should also research design defects and poor specifications and the impact that these can have on the structure. Looking at the example of The Rana Plaza disaster would be a shocking eye-opener for many.
- Another possible reason why a building may require maintenance is through poor workmanship (you may wish to link to content in *Unit 20: Quality Control Management in Construction*). To address this, you could task learners to look at a range of images of case studies of poor workmanship and as a class discuss the possible causes and consequences.
- During your presentations, you may find it useful to refer to clips from television programmes such as 'Cowboy Builders', 'Homes Under the Hammer' or 'Restoration Man' to look at problems that may occur with properties.
- You could give learners a research task so that they gain an understanding of cyclical maintenance requirements for a building such as their school or college. This could then be complemented by further paired or group activities, where learners investigate a range of maintenance approaches that can be utilised by building owners. Learners would need to identify the advantages and disadvantages of each in extending the life of a property.
- Finally, you could give learners a range of buildings and ask them to use the knowledge they have gained to create a maintenance plan for the building they have been given.
- Maintenance of buildings is a vital part of the whole life cycle of a building, and learners should investigate the range of different approaches to building maintenance. In a small group exercise, learners could discuss the advantages and disadvantages of unplanned and planned maintenance, listing the possible outcomes of an unplanned maintenance approach. Acknowledging the major part of planned maintenance as the asset management plan, the groups could then research the local council and identify the different properties it is responsible for maintaining, researching the annual maintenance costs of the buildings. You could conclude with a class discussion on what may happen to maintenance plans as budgets are cut.
- Learners should also research other forms of maintenance approaches, such as scheduled and condition-based, to identify the advantages and disadvantages of each approach and look at possible situations where each approach may be most suitable. They could work individually or in pairs to do this.
- Moving on to the levels of maintenance intervention and repair, learners could work in small groups to assess case studies such as local schools, colleges, houses, council buildings, hospitals etc identifying emergency repairs (repairs that need to be carried imminently as there is a risk to human life or major damage to the building) and describe the actions that need to be taken to rectify the situation. Learners can then research different forms of repairs – such as temporary, targeted and planned – and suggest situations where they are applicable and be aware of the advantages and disadvantages of each. Research from this task could be shared in class discussion, with tutor guidance to clarify or correct learner understanding.
- Learners will need knowledge of the regular inspections and reports that accompany planned preventative maintenance (PPM) or cyclical maintenance and repairs. This is an opportunity to link with an industrial partner to look at PPM for council buildings, and also private companies. This will demonstrate to learners real examples of how

PPM can prevent unwanted and unexpected expensive repairs. It should also highlight the suitable approach of the PPM, whether it be scheduled on time or on the condition.

- Learners must be aware of the point when it is not economically viable to repair and when a replacement plan may be necessary. This can happen with equipment, the building fabric or building services. Learners should make a list of building fabric and services that may need to be replaced and estimate the expected life span of each.
- As a revision exercise for this learning aim, learners could use their own home as an example and come up with two changes or upgrades they would carry out to make improvements. This could be new windows, a new roof, converting the attic or replacing the old bathroom suite with a new one. They may present their ideas in the form of sketch drawings, showing both the existing and the new layouts. When presenting to the rest of the class, learners should demonstrate their understanding of the impact of the work, e.g. will you need to move out or will you be able to remain in the house? These investigations and sketches could then be presented to the rest of the class.

Learning aim C – Develop a scheme design and specification for the conversion and adaptation of a property

- The focus here is for learners to be able to examine a client's requirement for a conversion or adaptation project, taking into consideration external factors, such as planning, statutory, environmental, social and economic constraints to create a possible solution.
- This section also offers you the opportunity to develop links with an industry partner who could identify possible projects that your learners could investigate. The learners could work in pairs to recommend and justify solutions that meet the client's vision and work within the constraints. These recommendations could be presented to the industry partner who could critic the solutions.
- Learners could work in groups to investigate the different stages of the RIBA Plan of Work 2013 for a range of case studies. This is an opportunity to work with an industrial partner to look at case studies and identify the work involved at each stage of the Plan of Works. Learners could work in small groups, tackling tutor-provided scenarios and explain how each stage of the conversion or adaptation of a building would be impacted by the RIBA Plan of Works 2013.
- Following this, learners could again work in small groups to first list buildings in the local area that have become redundant or obsolete. Using the knowledge gained from learning aim A, they should identify the reasons why the buildings became redundant or obsolete before coming together for class discussion to debate the possible uses of the buildings following adaption or conversion. To help generate ideas, you could view the BBC series 'Inside the Merchant'. This is about the 5-star Merchant Hotel in Belfast (opened in 2006) and is an excellent example of how vacant buildings can be converted and help to regenerate rundown parts of a city. The Grade A listed buildings were originally the headquarters of the Ulster Bank (1867).
- Linking with *Unit 2: Construction Design*, learners could identify the range of planning legislation that may impact on a conversion and adaptation project. Case studies could be introduced and discussed as a group. This would be an excellent opportunity to work with an industry partner, such as the local planning authority, or a designer, who may have a range of projects that have encountered different legislative constraints, such as Planning Permission, Listed Building Consent or building in an Area of Outstanding Natural Beauty.
- Learners could then research other legislation that may impact on the conversion or adaptation of a building, such as Building Regulations, Health and Safety and other property-related legislation. You could extend this understanding with an activity that challenges your learners to consider your school or college fire risk assessment, and task them to list all of the items that should be included in the Fire Risk

Assessment report.

- Learners can then be challenged to research the range of options for conversion and adaptation of properties. This research could be supplemented by looking at existing projects and identifying and justifying how they have been converted or adapted. These examples could be the same case studies as investigated in learning aim A. Working in small groups, the learners could suggest the most suitable form of conversion or adaptation. This should include assessing the client's requirements and then deciding how best to meet these, such as structural alterations or lateral or vertical extensions.
- Finally, the learners should be able to create proposals for conversion and adaptation schemes. This will link with *Unit 2: Construction Design*. You could use a conversion, adaptation or maintenance project that learners are familiar with, such as the Buckingham Palace refurbishment or the Albert Dock Regeneration scheme in Liverpool, or a local example, perhaps a new hotel or residential apartment block that may have been built within a listed building. Learners could work in pairs to identify the different types of building survey reports available and analyse and interpret information from each type of survey.
- Learners need to be able to analyse and interpret plans, elevations and sectional details for proposed schemes. In a tutor-led discussion, learners could collaborate in small groups to assess the content of specifications that should be provided for the learners (representing relevant projects and linked to plans, elevations and sections).
- Following this, learners could work in pairs to produce detailed maintenance plans for the projects, looking at the different elements that need maintenance to then provide recommendations on how often they should be maintained.
- Learner proposals could then be presented to and discussed with local industry partners, such as design or construction firms.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit has links to:

- Unit 1: Construction Principles
- Unit 2: Construction Design
- Unit 4: Construction Technology
- Unit 7: Graphical Detailing in Construction
- Unit 8: Building Regulations and Control in Construction
- Unit 10: Building Surveying in Construction
- Unit 18: Building Information Modelling
- Unit 24: Planning Application Procedures in Construction
- Unit 25: Property Law

Resources

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Textbooks

Doran D, Douglas J and Pratley R, *Refurbishment and Repair in Construction*, Whittles Publishing, 2009 ISBN 9781904445555 – This book provides information on the refurbishment of existing constructions, with minimal alterations, and how this is a more sustainable and preferable approach than demolition and reconstruction.

Douglas J, *Building Adaptation*, (Second Edition), Butterworth-Heinemann, 2006 ISBN 9780750666671 – This book provides a general introduction to the conversion, extension and refurbishment of property.

Wood B, *Building Maintenance*, Wiley-Blackwell, 2009 ISBN 9781405179676 – The book provides information on building maintenance processes.

Videos

Cowboy Builders – a series looking at some of the disasters left by disreputable workmen (http://www.channel5.com/show/cowboy-builders/)

Following the progress of properties purchased up at auction (http://www.bbc.co.uk/programmes/b006v5kb)

The Rana Plaza disaster (https://www.youtube.com/watch?v=pEbFnAMHHps)

Restoration Man – focusing on historically and architecturally significant buildings (http://www.channel4.com/programmes/the-restoration-man)

Websites

https://www.gov.uk/browse/housing-local-services/planning-permission – This government site details the processes involved in securing planning permission.

https://www.gov.uk/government/publications/national-planning-policy-framework--2 – National Planning Policy framework 2012

https://historicengland.org.uk/advice/technical-advice/energy-efficiency-and-historic-buildings/ – Improving energy efficiency in older properties

https://www.historicengland.org.uk/listing/what-is-designation/listed-buildings/ – Historic England Listed Buildings

http://planningguidance.communities.gov.uk/blog/guidance/ – This site supports local communities to get involved in planning processes.

https://www.planningportal.co.uk/ – This site details the current planning legislation and policies in operation.

https://www.ribaplanofwork.com/ – Royal Institute of British Architects Plan of Work 2013

http://www.rics.org/uk/ – Professional Body including information, research, standards and guidance on property conversion, heritage conservation and adaptation

http://www.rics.org/uk/knowledge/research/conference-papers/building-resilience-in-urban-settlements-through-conversion-adaptation/ – Scholarly article on property conversion

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