



Level 3 Advanced Technical Certificate in Constructing the Built Environment (6720-34)

June 2017 Version 1.2

Qualification Handbook

Qualification at a glance

Industry area	Construction
City & Guilds qualification number	6720-34
Age group	16-19 (Key Stage 5), 19+
Entry requirements	Centres must ensure that any pre-requisites stated in the <i>What is this qualification about?</i> section are met.
Assessment	To gain this qualification, candidates must successfully achieve the following assessments: <ul style="list-style-type: none"> • One externally set, externally moderated assignment • One externally set, externally marked exam, sat under examination conditions
Additional requirements to gain this qualification	Employer involvement in the delivery and/or assessment of this qualification is essential for all candidates and will be externally quality assured.
Grading	This qualification is graded Pass/Merit/Distinction/Distinction* For more information on grading, please see Section 7: Grading.
Approvals	This qualification requires full centre and qualification approval
Support materials	Sample assessments Guidance for delivery Guidance on use of marking grids
Registration and certification	Registration and certification of this qualification is through the Walled Garden, and is subject to end dates.
External quality assurance	This qualification is externally quality assured by City & Guilds, and its internally marked assignments are subject to external moderation. There is no direct claim status available for this qualification.

Title and level	Size (GLH)	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 3 Advanced Technical Certificate in Constructing the Built Environment	360	600	6720-34	601/4510/9

Version and date	Change detail	Section
1.2 June 2017	Addition of the examination paper based module number	1. Introduction – Assessment requirements and employer involvement 5. Assessment 5. Assessment – exam Specification 7. Grading – Awarding grades and reporting results
	Removal of AO 6-8 from Synoptic Assignments	5. Assessment – Assessment Objectives
	Revised Exam Specification, Exam Duration and AO weightings	5. Assessment – Exam Specification
	Addition of Provisional Grade Boundaries for the Synoptic Assignment	7. Grading
	Branding Changes	City and Guilds Logo
1.1 June 2016	Small typographical errors	Throughout
	TQT added for qualifications Assessment component titles amended	1. Introduction
	Employer involvement guidance updated throughout	4. Employer involvement
	Summary of assessment methods and conditions	5. Assessment
	Moderation and standardisation of assessment updated throughout	6. Moderation and standardisation of assessment
	Awarding individual assessments Awarding grades and reporting results	7. Grading
	Enquiries about results Re-sits and shelf-life of assessment results Malpractice Access arrangements and special consideration	8. Administration
	City & Guilds Group statement updated	Useful contacts

Contents

1	Introduction	6
	What is this qualification about?	6
	Qualification structure	8
	Total qualification time (TQT)	8
	Assessment requirements and employer involvement	9
2	Centre requirements	10
	Approval	10
	Resource requirements	10
	Learner entry requirements	10
3	Delivering technical qualifications	11
	Initial assessment and induction	11
	Employer involvement	11
	Support materials	11
4	Employer involvement	12
	Qualification approval	12
	Monitoring and reporting learner engagement	12
	Types of involvement	13
	Types of evidence	14
	Quality assurance process	14
	Sufficiency of involvement for each learner	14
	Live involvement	14
	Timing	14
5	Assessment	15
	Summary of assessment methods and conditions	15
	What is synoptic assessment?	16
	How the assignment is synoptic for this qualification	16
	External exam for stretch, challenge and integration	16
	Assessment objectives	17
	Exam specification	18
6	Moderation and standardisation of assessment	19
	Supervision and authentication of internally assessed work	19
	Internal standardisation	19
	Provision for reworking evidence after submission for marking by the tutor	19
	Internal appeal	20
	Moderation	20
	Post-moderation procedures	20
	Centres retaining evidence	21
7	Grading	22
	Grade descriptors	22
	Awarding grades and reporting results	23

8 Administration	25
External quality assurance	25
Enquiries about results	25
Re-sits and shelf-life of assessment results	26
Factors affecting individual learners	26
Malpractice	26
Access arrangements and special consideration	26
Unit 301 Domestic construction technology	28
What is this unit about?	28
Learning outcomes	28
Scope of content	29
Guidance for delivery	31
Unit 302 Industrial and commercial construction technology	32
What is this unit about?	32
Learning outcomes	32
Scope of content	33
Guidance for delivery	36
Unit 303 Health and safety in the built environment	38
What is this unit about?	38
Learning outcomes	38
Scope of content	39
Guidance for delivery	42
Unit 305 Construction science and materials	43
What is this unit about?	43
Learning outcomes	43
Scope of content	44
Guidance for delivery	47
Unit 317 Sustainability and new technologies	49
What is this unit about?	49
Learning outcomes	49
Scope of content	50
Guidance for delivery	52
Unit 319 Mathematics for the built environment	54
What is this unit about?	54
Learning outcomes	54
Scope of content	55
Guidance for delivery	58
Appendix 1 Sources of general information	60

1 Introduction

What is this qualification about?

The following purpose is for the **City & Guilds Level 3 Advanced Technical Certificate in Constructing the Built Environment**

Area	Description
OVERVIEW	
Who is this qualification for?	<p>This qualification is for you if you are 16 years or older and want to combine general education with learning theoretical aspects and practical activities related to the built environment sector. There are no entry requirements for this qualification.</p> <p>If you have ever wondered how the buildings, infrastructure and landscape around us come into existence, and would like to find out more, this qualification could be for you. This qualification could open up the world of the built environment sector, which covers all aspects of the creation of our towns and cities, and is fundamental to creating a sustainable future.</p>
What does this qualification cover?	<p>You will study theoretical aspects of the subject and apply them to practical tasks. Compulsory topics include:</p> <ul style="list-style-type: none">• domestic construction technology• industrial and commercial construction technology• health and safety in the built environment• construction science and materials• sustainability and new technologies• mathematics for the built environment <p>You will study both the practical use and knowledge of the subject, which may involve local employers providing real examples as part of the training. It is expected that you will visit or have visits from employers who can provide demonstrations and talks on the industry, which may also be a relevant work placement with an employer.</p>
WHAT COULD THIS QUALIFICATION LEAD TO?	
Will the qualification lead to employment, and if so, in which job role and at what level?	<p>The City & Guilds Level 3 Advanced Technical Certificate in Constructing the Built Environment could lead to employment opportunities for you as a:</p> <ul style="list-style-type: none">• Construction Design Technician• Construction Site Technician• Construction Work Supervisor.

Why choose this qualification over similar qualifications?	<p>City & Guilds offers four sizes of Level 3 qualification in Constructing the Built Environment: Certificate, Diploma (540), Extended Diploma (720) & Extended Diploma (1080).</p> <p>You would take the Certificate if you want an introductory qualification to develop skills and knowledge required by employers in the construction and built environment industry. The Certificate is likely to be taken alongside other programmes such as GCSEs or AS Levels over a one-year course of study.</p>
Will the qualification lead to further learning?	<p>When you have achieved this qualification you have a choice of seeking employment or going on to further learning, progressing on to qualifications such as:</p> <ul style="list-style-type: none"> • Construction Technician Apprenticeship • Higher Apprenticeship in Construction Operations Management • Foundation Degrees in the following areas: Construction and the Built Environment, Civil Engineering, Quantity Surveying, Building Surveying, Conservation and Restoration
WHO SUPPORTS THIS QUALIFICATION?	
Who supports this qualification?	This qualification is supported by the Chartered Institute of Building (CIOB).

Qualification structure

For the **Level 3 Advanced Technical Certificate in Constructing the Built Environment** the teaching programme must cover the content detailed in the structure below:

Unit number	Unit title	GLH
Mandatory		
301	Domestic construction technology	60
302	Industrial and commercial construction technology	60
303	Health and safety in the Built Environment	60
305	Construction science and materials	60
317	Sustainability and new technologies	60
319	Mathematics for the built environment	60

Total qualification time (TQT)

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

Title and level	GLH	TQT
Level 3 Advanced Technical Certificate in Constructing the Built Environment	360	600

Assessment requirements and employer involvement

To achieve the **Level 3 Advanced Technical Certificate in Constructing the Built Environment** candidates must successfully complete **all** the mandatory assessment components.

Component number	Title
Mandatory	
040/540	Constructing the Built Environment – Theory exam
041	Constructing the Built Environment – Synoptic assignment

In addition, candidates **must** achieve the mandatory employer involvement requirement for this qualification **before** they can be awarded a qualification grade. For more information, please see guidance in *Section 4: Employer involvement*.

Employer involvement

Component number	Title
Mandatory	
834	Employer involvement

2 Centre requirements

Approval

New centres will need to gain centre approval. Existing centres who wish to offer this qualification must go through City & Guilds' **full** Qualification Approval Process. There is no fast track approval for this qualification. Please refer to the City & Guilds website for further information on the approval process: www.cityandguilds.com

Resource requirements

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Centre staffing

Staff delivering this qualification must be able to demonstrate that they meet the following requirements:

- be technically competent in the areas in which they are delivering
- be able to deliver across the breadth and depth of the content of the qualification being taught
- have recent relevant teaching and assessment experience in the specific area they will be teaching, or be working towards this
- demonstrate continuing CPD.

Physical resources

Centres must be able to demonstrate that they have access to the equipment and technical resources required to deliver this qualification and its assessments.

Internal Quality Assurance

Internal quality assurance is key to ensuring accuracy and consistency of tutors and markers. Internal Quality Assurers (IQAs) monitor the work of all tutors involved with a qualification to ensure they are applying standards consistently throughout assessment activities. IQAs must have, and maintain, an appropriate level of technical competence and be qualified to make both marking and quality assurance decisions through a teaching qualification or recent, relevant experience.

Learner entry requirements

Centres must ensure that all learners have the opportunity to gain the qualification through appropriate study and training, and that any prerequisites stated in the *What is this qualification about?* section are met when registering on this qualification.

Age restrictions

This qualification is approved for learners aged 16 – 19, 19+.

3 Delivering technical qualifications

Initial assessment and induction

An initial assessment of each learner should be made before the start of their programme to identify:

- if the learner has any specific learning or training needs,
- support and guidance they may need when working towards their qualification,
- the appropriate type and level of qualification.

We recommend that centres provide an introduction so that learners fully understand the requirements of the qualification, their responsibilities as a learner, and the responsibilities of the centre. This information can be recorded on a learning contract.

Employer involvement

Employer involvement is essential to maximise the value of each learner's experience. Centres are required to involve employers in the delivery of technical qualifications at Key Stage 5 and/or their assessment, for every learner. This must be in place or planned before delivery programmes begin in order to gain qualification approval. See *Section 4: Employer involvement* for more detail.

Support materials

The following resources are available for this qualification:

Description	How to access
Sample assessments	
Guidance for delivery	Available 2016 on the qualification pages on the City & Guilds
Guidance on use of marking grids	Website: www.cityandguilds.com

4 Employer involvement

Employer involvement is a formal component of Key Stage 5 Technical qualifications. It does not contribute to the overall qualification grading, but is a mandatory requirement that all learners must meet. As such it is subject to external quality assurance by City & Guilds.

Department for Education (DfE) requirements state:

Employer involvement in the delivery and/or assessment of technical qualifications provides a clear 'line of sight' to work, enriches learning, raises the credibility of the qualification in the eyes of employers, parents and students and furthers collaboration between the learning and skills sector and industry.

[Technical qualifications] must:

- *require all students to undertake meaningful activity involving employers during their study; and*
- *be governed by quality assurance procedures run by the awarding organisation to confirm that education providers have secured employer involvement for every student.*

Extract from: **Vocational qualifications for 16 to 19 year olds 2017 and 2018 performance tables: technical guidance for awarding organisations**, DfE (2015) paragraphs 89-90.

City & Guilds will provide support guidance and quality assurance of employer involvement.

Qualification approval

To be approved to offer City & Guilds Technicals, centres must provide an Employer Involvement planner and tracker showing how every learner will be able to experience meaningful employer involvement, and from where sufficient and suitable employer representatives are expected to be sourced.

Centres must include in their planer a sufficient range of activities throughout the learning programme that provide a range of employer interactions for learners. Centres must also plan contingencies for learners who may be absent for employer involvement activities, so that they are not disadvantaged.

As part of the approval process, City & Guilds will review this planner and tracker. Centres which cannot show sufficient commitment from employers and/or a credible planner and tracker will be given an action for improvement with a realistic timescale for completion. **Approval will not be given** if employer involvement cannot be assured either at the start of the qualification, or through an appropriate plan of action to address this requirement before the learner is certificated.

Monitoring and reporting learner engagement

Employer involvement is a formal component of this qualification and is subject to quality assurance monitoring. Centres must record evidence that demonstrates that each learner has been involved in meaningful employer based activities against the mandatory content before claiming the employer involvement component for learners.

Centres must record the range and type of employer involvement each learner has experienced and submit confirmation that all learners have met the requirements to City & Guilds. If a centre cannot provide evidence that learners have met the requirements to achieve the component, then the learner will not be able to achieve the overall Technical Qualification.

Types of involvement

Centres should note that to be eligible, employer involvement activities **must** relate to one or more elements of the mandatory content of this qualification.

As the aim of employer involvement is to enrich learning and to give learners a taste of the expectations of employers in the industry area they are studying, centres are encouraged to work creatively with local employers.

Employers can identify the areas of skills and knowledge in their particular industry that they would wish to see emphasised for learners who may apply to work with them in the future. Centres and employers can then establish the type of input, and which employer representative might be able to best support these aims.

To be of most benefit this must add to, rather than replace the centre's programme of learning.

Some examples of meaningful employer involvement are listed below. Employer involvement not related to the mandatory element of the qualification, although valuable in other ways, does not count towards this element of the qualification.

The DfE has provided the following examples of what does and does not count as meaningful employer involvement, as follows^{1,2}:

The following activities meet the requirement for meaningful employer involvement:

- *students undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification³;*
- *students undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s);*
- *students take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures;*
- *industry practitioners operate as 'expert witnesses' that contribute to the assessment of a student's work or practice, operating within a specified assessment framework. This may be a specific project(s), exercise(s) or examination(s), or all assessments for a qualification.*

In all cases participating industry practitioners and employers must be relevant to the industry sector or occupation/occupational group to which the qualification relates.

The following activities, whilst valuable, do not meet the requirement for meaningful employer involvement:

- *employers' or industry practitioners' input to the initial design and content of a qualification;*
- *employers hosting visits, providing premises, facilities or equipment;*
- *employers or industry practitioners providing talks or contributing to delivery on employability, general careers advice, CV writing, interview training etc;*
- *student attendance at career fairs, events or other networking opportunities;*
- *simulated or provider-based working environments eg hairdressing salons, florists, restaurants, travel agents, small manufacturing units, car servicing facilities;*
- *employers providing students with job references.*

¹ As extracted from: Vocational qualifications for 16 to 19 year olds
2017 and 2018 performance tables: technical guidance for awarding organisations

²This list has been informed by a call for examples of good practice in employer involvement in the delivery and assessment of technical qualifications - **Employer involvement in the delivery and assessment of vocational qualifications**

³ **DfE work experience guidance**

Types of evidence

For each employer involvement activity, centres are required to provide evidence of which learners undertook it, e.g. a candidate attendance register. The types of additional evidence required to support a claim for this component will vary depending on the nature of the involvement. E.g. for a guest lecture it is expected that a synopsis of the lecture and register would be taken which each learner and the guest speaker will have signed; expert witnesses will be identified and will have signed the relevant assessment paperwork for each learner they have been involved in assessing; evidence of contribution from employers to the development of locally set or adapted assignments.

Quality assurance process

As the employer involvement component is a requirement for achieving the KS5 Technical qualifications, it is subject to external quality assurance by City & Guilds at the approval stage and when centres wish to claim certification for learners.

Evidence will be validated by City & Guilds before learners can achieve the employer involvement component. Where employer involvement is not judged to be sufficient, certificates cannot be claimed for learners.

Sufficiency of involvement for each learner

It is expected that the centre will plan a range of activities that provide sufficient opportunities for each learner to interact directly with a range of individuals employed in the related industry. Centres must also provide contingencies for learners who may be absent for part of their teaching, so they are not disadvantaged. Any absence that results in a learner missing arranged activities must be documented. Where learners are unable to undertake all employer involvement activities due to temporary illness, temporary injury or other indisposition, centres should contact City & Guilds for further guidance.

Live involvement

Learners will gain most benefit from direct interaction with employers and/or their staff; however the use of technology (e.g. the use of live webinars) is encouraged to maximise the range of interactions. Where learners are able to interact in real time with employers, including through the use of technology, this will be classed as 'live involvement'.

It is considered good practice to record learning activities, where possible, to allow learners to revisit their experience and to provide a contingency for absent learners. This is not classed as live involvement however, and any involvement of this type for a learner must be identified as contingency.

Timing

A learner who has not met the minimum requirements cannot be awarded the component, and will therefore not achieve the qualification. It is therefore important that centres give consideration to scheduling employer involvement activities, and that enough time is allotted throughout delivery and assessment of the qualification to ensure that requirements are fully met.

5 Assessment

Summary of assessment methods and conditions

Component numbers	Assessment method	Description and conditions
040/540	Externally marked exam	<p>The exam is externally set and externally marked, and will be taken either online (040) through City & Guilds' computer-based testing platform or by paper (540).</p> <p>The exam is designed to assess the candidate's depth and breadth of understanding across content in the qualification at the end of the period of learning, using a range of question types and will be sat under invigilated examination conditions. See JCQ requirements for details: http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations</p> <p>The exam specification shows the coverage of the exam across the qualification content.</p> <p>Candidates who fail the exam at the first sitting will have one opportunity to re-sit. If the re-sit is failed the candidate will fail the qualification. For exam dates, please refer to the Assessment and Examination timetable.</p>
041	Synoptic assignment	<p>The synoptic assignment is externally set, internally marked and externally moderated. The assignment requires candidates to identify and use effectively in an integrated way an appropriate selection of skills, techniques, concepts, theories, and knowledge from across the content area. Candidates will be judged against the assessment objectives.</p> <p>Assignments will be released to centres as per dates indicated in the Assessment and Examination timetable published on our website.</p> <p>Centres will be required to maintain the security of all live assessment materials. Assignments will be password protected and released to centres through a secure method.</p> <p>There will be one opportunity within each academic year to sit the assignment. Candidates who fail the assignment will have one re-sit opportunity. The re-sit opportunity will be in the next academic year, and will be the assignment set for that academic year once released to centres. If the re-sit is failed, the candidate will fail the qualification.</p> <p>Please note that for externally set assignments City & Guilds provides guidance and support to centres on the marking and moderation process.</p>

What is synoptic assessment?

Technical qualifications are based around the development of a toolkit of knowledge, understanding and skills that an individual needs in order to have the capability to work in a particular industry or occupational area. Individuals in all technical areas are expected to be able to apply their knowledge, understanding and skills in decision making to solve problems and achieve given outcomes independently and confidently.

City & Guilds technical qualifications require candidates to draw together their learning from across the qualification to solve problems or achieve specific outcomes by explicitly assessing this through the synoptic assignment component.

In this externally set, internally marked and externally moderated assessment the focus is on bringing together, selecting and applying learning from across the qualification rather than demonstrating achievement against units or subsets of the qualification content. The candidate will be given an appropriately levelled, substantial, occupationally relevant problem to solve or outcome to achieve. For example this might be in the form of a briefing from a client, leaving the candidate with the scope to select and carry out the processes required to achieve the client's wishes, as they would in the workplace.

Candidates will be marked against assessment objectives (AOs) such as their breadth and accuracy of knowledge, understanding of concepts, and the quality of their technical skills as well as their ability to use what they have learned in an integrated way to achieve a considered and high quality outcome.

How the assignment is synoptic for this qualification

The typical assignment brief could be to respond to a design problem for a new engineered product or adapting an existing product.

This will require the candidate to carry out experiments on a prototype to evaluate the suitability of different materials. Learners will produce a design specification, with drawings, for a design that meets the brief and produce a production plan for its manufacture. They will need to produce a report on developing the design into a commercial product.

External exam for stretch, challenge and integration

The external assessment will draw from across the mandatory content of the qualification, using a range of shorter questions to confirm breadth of knowledge and understanding. Extended response questions are included to go into more depth, giving candidates the opportunity to demonstrate higher level understanding and integration through discussion, analysis and evaluation, and ensuring the assessment can differentiate between 'just able' and higher achieving candidates.

Assessment objectives

The assessments for this qualification are set against a set of assessment objectives (AOs) which are used across all City & Guilds Technicals to promote consistency among qualifications of a similar purpose. They are designed to allow judgement of the candidate to be made across a number of different categories of performance.

Each assessment for the qualification has been allocated a set number of marks against these AOs based on weightings recommended by stakeholders of the qualification. This mark allocation remains the same for all versions of the assessments, ensuring consistency across assessment versions and over time.

The following table explains all AOs in detail, including weightings for the synoptic assignments. Weightings for exams (AOs 1, 2 and 4 only) can be found with the exam specification.

Assessment objective	Level 3 Advanced Technical Certificate in Constructing the Built Environment Typical expected evidence of knowledge, understanding and skills	Approximate weighting (Assignment)
AO1 Recalls knowledge from across the breadth of the qualification.	Identification of construction forms, methods, techniques, materials and their properties, document requirements, information required to complete building regulations applications, factors relating to human comfort and related design values, drafting techniques, legislation and regulations, roles and responsibilities, use of terminology	20%
AO2 Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification.	Explanations/comparisons related to material and component specifications and performance, why and when different methods, techniques, materials are used, principles (eg design, risk management, electrical, building services provision)	35%
AO3 Demonstrates technical skills from across the breadth of the qualification.	Working with documentation (project, planning, building regulations, support), producing tender figures, using surveying instruments, production of plans and drawings (2D, 3D), use of CAD, undertaking surveys (building, measured), carrying out a risk assessment, production planning and control	10%
AO4 Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes.	Applying knowledge and understanding to a particular scenario/problem, justifying decisions/approaches taken (eg materials, techniques, appropriate attention to human comfort factors given stated requirements), adapting practice to meet contextual challenges (eg surveying difficult sites, finding cost reductions to win a tender)	20%
AO5 Demonstrates perseverance in achieving high standards and attention to detail while showing an understanding of wider impact of their actions.	Accuracy and detail of drawings, attention to accuracy during surveying, thinking about and attending to specific requirements of the client, completeness and attention to usability of documentation, attention to detail in risk assessment and risk reduction/method statements	15%

Exam specification

Assessment Objective weightings per exam.

Assessment Objective	Exam weighting (approx. %)
AO1 Recalls knowledge from across the breadth of the qualification.	37
AO2 Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification.	43
AO4 Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes.	20

The way the exam covers the content of the qualification is laid out in the table below:

Assessment type: Examiner marked, written exam*

Assessment conditions: Invigilated examination conditions

Grading: X/P/M/D

Exam 040/540	Duration: 120 minutes		
Unit number	Unit title	Number of marks	%
301	Domestic construction technology	18	30
302	Industrial and commercial construction technology	18	30
303	Health and safety in the Built Environment	12	20
N/A	Integration across units	12	20
Total		60	100

*These exams are sat under invigilated examination conditions, as defined by the JCQ:

<http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations>

Entry for exams can be made through the City & Guilds Walled Garden.

6 Moderation and standardisation of assessment

City & Guilds' externally set assignments for technical qualifications are designed to draw from across the qualifications' content, and to contribute a significant proportion towards the learner's final qualification grade. They are subject to a rigorous external quality assurance process known as external moderation. This process is outlined below. For more detailed information, please refer to 'Marking and moderation - Technicals centre guidance' available to download on the City & Guilds website.

It is vital that centres familiarise themselves with this process, and how it impacts on their delivery plan within the academic year.

Supervision and authentication of internally assessed work

The Head of Centre is responsible for ensuring that internally assessed work is conducted in accordance with City & Guilds' requirements.

City & Guilds requires both tutors and candidates to sign declarations of authenticity. If the tutor is unable to sign the authentication statement for a particular candidate, then the candidate's work cannot be accepted for assessment.

Internal standardisation

For internally marked work⁴ the centre is required to conduct internal standardisation to ensure that all work at the centre has been marked to the same standard. It is the Internal Quality Assurer's (IQA's) responsibility to ensure that standardisation has taken place, and that the training includes the use of reference and archive materials such as work from previous years as appropriate.

Provision for reworking evidence after submission for marking by the tutor

It is expected that in many cases a candidate who is struggling with a specific piece of work may themselves choose to restart and rectify the situation during their normal allocated time, and before it gets to the stage of it being handed in for final marking by the tutor.

In exceptional circumstances however, where a candidate has completed the assignment in the required timescales, and has handed it in for marking by the tutor but is judged to have significantly underperformed, may be allowed to rework or supplement their original evidence for remarking prior to submission for moderation. For this to be allowed, the centre must be confident that the candidate will be able to improve their performance without additional feedback from their tutor and within the required timescales ie the candidate has shown they can perform sufficiently better previously in formative assessments.

The reworked and/or supplemented original evidence must be remarked by the tutor in advance of the original moderation deadline and the moderator informed of any candidates who have been allowed to resubmit evidence.

The process must be managed through the IQA. The justification for allowing a resubmission should be recorded and made available on request. The use of this provision will be monitored by City & Guilds.

⁴ For any internally assessed optional unit assignments, the same process must be followed where assessors must standardise their interpretation of the assessment and grading criteria.

Internal appeal

Centres must have an internal process in place for candidates to appeal the marking of internally marked components, ie the synoptic assignment and any optional unit assignments. This must take place before the submission of marks for moderation. The internal process must include candidates being informed of the marks (or grades) the centre has given for internally assessed components, as they will need these to make the decision about whether or not to appeal.

Centres cannot appeal the outcome of moderation for individual candidates, only the moderation process itself. A request for a review of the moderation process should be made to **appeals@cityandguilds.com**.

Moderation

Moderation is the process where external markers are standardised to a national standard in order to review centre marking of internally marked assessments. These markers are referred to as 'moderators'. Moderators will mark a representative sample of candidates' work from every centre. Their marks act as a benchmark to inform City & Guilds whether centre marking is in line with City & Guilds' standard.

Where moderation shows that the centre is applying the marking criteria correctly, centre marks for the whole cohort will be accepted.

Where moderation shows that the centre is either consistently too lenient or consistently too harsh in comparison to the national standard, an appropriate adjustment will be made to the marks of the whole cohort, retaining the centre's rank ordering.

Where centre application of the marking criteria is inconsistent, an appropriate adjustment for the whole cohort may not be possible on the basis of the sample of candidate work. In these instances a complete remark of the candidate work may be necessary. This may be carried out by the centre based on feedback provided by the moderator, or carried out by the moderator directly.

Moderation applies to all internally marked assignments. Following standardisation and marking, the centre submits all marks and candidate work to City & Guilds via the moderation platform. The deadline for submission of evidence will be available on Walled Garden. See the *Marking and moderation - Technicals Centre Guidance* document for full details of the requirements and process.

In most cases candidate work will be submitted directly to the moderator for moderation. This includes written work, photographic and pictorial evidence, or video and audio evidence. For some qualifications there will be a requirement for moderators to visit centres to observe practical assessments being undertaken. This will be for qualifications where the assessment of essential learner skills can only be demonstrated through live observation. The purpose of these visits is to ensure that the centre is assessing the practical skills to the required standards, and to provide the moderators with additional evidence to be used during moderation. These visits will be planned in advance with the centre for all relevant qualifications.

Post-moderation procedures

Once the moderation process has been completed, the confirmed marks for the cohort are provided to the centre along with feedback from the moderator on the standard of marking at the centre, highlighting areas of good practice, and potential areas for improvement. This will inform future marking and internal standardisation activities.

City & Guilds will then carry out awarding, the process by which grade boundaries are set with reference to the candidate evidence available on the platform.

Centres retaining evidence

Centres must retain assessment records for each candidate for a minimum of three years. To help prevent plagiarism or unfair advantage in future versions, candidate work may not be returned to candidates. Samples may however be retained by the centre as examples for future standardisation of marking.

7 Grading

Awarding individual assessments

Individual assessments will be graded, by City & Guilds, as pass/merit/distinction where relevant. The grade boundaries for pass and distinction for each assessment will be set through a process of professional judgement by technical experts. Merit will usually be set at the midpoint between pass and distinction. The grade descriptors for pass and distinction, and other relevant information (eg archived samples of candidate work and statistical evidence) will be used to determine the mark at which candidate performance in the assessment best aligns with the grade descriptor in the context of the qualification's purpose. Boundaries will be set for each version of each assessment to take into account relative difficulty.

Please note that as the Merit grade will usually be set at the arithmetical midpoint between pass and distinction, there are no descriptors for the Merit grade for the qualification overall.

Grade descriptors

To achieve a pass, a candidate will be able to

- Demonstrate the knowledge and understanding required to work in the occupational area, its principles, practices and legislation.
- Describe some of the main factors impacting on the occupation to show good understanding of how work tasks are shaped by the broader social, environmental and business environment it operates within.
- Use the technical industry specific terminology used in the industry accurately.
- Demonstrate the application of relevant theory and understanding to solve non-routine problems.
- Interpret a brief for complex work related tasks, identifying the key aspects, and showing a secure understanding of the application of concepts to specific work related tasks.
- Carry out planning which shows an ability to identify and analyse the relevant information in the brief and use knowledge and understanding from across the qualification (including complex technical information) to interpret what a fit for purpose outcome would be and develop a plausible plan to achieve it.
- Achieve an outcome which successfully meets the key requirements of the brief.
- Identify and reflect on the most obvious measures of success for the task and evaluate how successful they have been in meeting the intentions of the plan.
- Work safely throughout, independently carrying out tasks and procedures, and having some confidence in attempting the more complex tasks.

To achieve a distinction, a candidate will be able to

- Demonstrate the excellent knowledge and understanding required to work to a high level in the occupational area, its principles, practices and legislation.
- Analyse the impact of different factors on the occupation to show deep understanding of how work tasks are shaped by the broader social, environmental, and business environment it operates within.
- Demonstrate the application of relevant theory and understanding to provide efficient and effective solutions to complex and non-routine problems.
- Analyse the brief in detail, showing confident understanding of concepts and themes from across the qualification content, bringing these together to develop a clear and stretching plan that would credibly achieve an outcome that is highly fit for purpose.
- Achieve an outcome which shows an attention to detail in its planning, development and completion, so that it completely meets or exceeds the expectations of the brief to a high standard.

- Carry out an evaluation in a systematic way, focussing on relevant quality points, identifying areas of development/ improvement as well as assessing the fitness for purpose of the outcome.

Awarding grades and reporting results

The overall qualification grade will be calculated based on aggregation of the candidate's achievement in each of the assessments for the mandatory units, taking into account the assessments' weighting. The **Level 3 Advanced Technical Certificate in Constructing the Built Environment** will be reported on a four grade scale: Pass, Merit, Distinction, Distinction*.

All assessments **must** be achieved at a minimum of Pass for the qualification to be awarded. Candidates who fail to reach the minimum standard for grade Pass for an assessment(s) will not have a qualification grade awarded and will not receive a qualification certificate.

The approximate pass grade boundary for the synoptic assignment in this qualification is:

Synoptic Assignment	Pass Mark (%)
041	42

Please note that each synoptic assignment is subject to an awarding process before final grade boundaries are confirmed.

The contribution of assessments towards the overall qualification grade is as follows:

Assessment method	Grade scale	% contribution
Theory exam (040/540)	X/P/M/D	40%
Synoptic assignment (041)	X/P/M/D	60%

Both synoptic assignments and exams are awarded (see 'Awarding individual assessments', at the start of Section 7, above), and candidates' grades converted to points. The minimum points available for each assessment grade is listed in the table below. A range of points between the Pass, Merit and Distinction boundaries will be accessible to candidates. For example a candidate that achieves a middle to high Pass in an assessment will receive between 8 and 10 points, a candidate that achieves a low to middle Merit in an assessment will receive between 12 and 14 points. The points above the minimum for the grade for each assessment are calculated based on the candidate's score in that assessment.

	Pass	Merit	Distinction
Theory exam: 40%	6	12	18
Synoptic assignment: 60%	6	12	18

The candidate's points for each assessment are multiplied by the % contribution of the assessment and then aggregated. The minimum points required for each qualification grade are as follows:

Qualification Grade	Points
Distinction*	20.5
Distinction	17
Merit	11
Pass	6

Candidates achieving Distinction* will be the highest achieving of the Distinction candidates.

8 Administration

Approved centres must have effective quality assurance systems to ensure valid and reliable delivery and assessment of qualifications. Quality assurance includes initial centre registration by City & Guilds and the centre's own internal procedures for monitoring quality assurance procedures.

Consistent quality assurance requires City & Guilds and its associated centres to work together closely; our Quality Assurance Model encompasses both internal quality assurance (activities and processes undertaken within centres) and external quality assurance (activities and processes undertaken by City & Guilds).

For this qualification, standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external moderation.

In order to carry out the quality assurance role, Internal Quality Assurers (IQAs) must have and maintain an appropriate level of technical competence and have recent relevant assessment experience. For more information on the requirements, refer to *Section 2: Centre requirements* in this handbook.

To meet the quality assurance criteria for this qualification, the centre must ensure that the following procedures are followed:

- suitable training of staff involved in the assessment of the qualification to ensure they understand the process of marking and standardisation
- completion by the person responsible for internal standardisation of the Centre Declaration Sheet to confirm that internal standardisation has taken place
- the completion by candidates and supervisors/tutors of the record form for each candidate's work.

External quality assurance

City & Guilds will undertake external moderation activities to ensure that the quality assurance criteria for this qualification are being met. Centres must ensure that they co-operate with City & Guilds staff and representatives when undertaking these activities.

City & Guilds requires the Head of Centre to

- facilitate any inspection of the centre which is undertaken on behalf of City & Guilds
- make secure arrangements to receive, check and keep assessment material secure at all times, maintain the security of City & Guilds confidential material from receipt to the time when it is no longer confidential and keep completed assignment work and examination scripts secure from the time they are collected from the candidates to their dispatch to City & Guilds.

Enquiries about results

The services available for enquiries about results include a review of marking for exam results and review of moderation for internally marked assessments.

For further details on enquiries and appeals process and for copies of the application forms, please visit the **appeals page** of the City & Guilds website at **www.cityandguilds.com**.

Re-sits and shelf-life of assessment results

Candidates who have failed an assessment or wish to re-take it in an attempt to improve their grade, can re-sit assessments **once only**. The best result will count towards the final qualification. See guidance on individual assessment types in Section 5.

Factors affecting individual learners

If work is lost, City & Guilds should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. Centres should use the JCQ form, JCQ/LCW, to inform City & Guilds Customer Services of the circumstances.

Learners who move from one centre to another during the course may require individual attention. Possible courses of action depend on the stage at which the move takes place. Centres should contact City & Guilds at the earliest possible stage for advice about appropriate arrangements in individual cases.

Malpractice

Please refer to the City & Guilds guidance notes *Managing cases of suspected malpractice in examinations and assessments*. This document sets out the procedures to be followed in identifying and reporting malpractice by candidates and/or centre staff and the actions which City & Guilds may subsequently take. The document includes examples of candidate and centre malpractice and explains the responsibilities of centre staff to report actual or suspected malpractice. Centres can access this document on the City & Guilds website.

Examples of candidate malpractice are detailed below (please note that this is not an exhaustive list):

- falsification of assessment evidence or results documentation
- plagiarism of any nature
- collusion with others
- copying from another candidate (including the use of ICT to aid copying), or allowing work to be copied
- deliberate destruction of another's work
- false declaration of authenticity in relation to assessments
- impersonation.

These actions constitute malpractice, for which a penalty (eg disqualification from the assessment) will be applied.

Where suspected malpractice is identified by a centre after the candidate has signed the declaration of authentication, the Head of Centre must submit full details of the case to City & Guilds at the earliest opportunity. Please refer to the form in the document *Managing cases of suspected malpractice in examinations and assessments*.

Access arrangements and special consideration

Access arrangements are adjustments that allow candidates with disabilities, special educational needs and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

It is the responsibility of the centre to ensure at the start of a programme of learning that candidates will be able to access the requirements of the qualification.

Please refer to the *JCQ access arrangements and reasonable adjustments* and *Access arrangements - when and how applications need to be made to City & Guilds* for more information. Both are available on the City & Guilds website: <http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/access-arrangements-reasonable-adjustments>

Special consideration

We can give special consideration to candidates who have had a temporary illness, injury or indisposition at the time of the examination. Where we do this, it is given after the examination.

Applications for either access arrangements or special consideration should be submitted to City & Guilds by the Examinations Officer at the centre. For more information please consult the current version of the JCQ document, *A guide to the special consideration process*. This document is available on the City & Guilds website: <http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/access-arrangements-reasonable-adjustments>

Unit 301

Domestic construction technology

UAN:	J/506/5399
Level:	3
GLH:	60

What is this unit about?

The purpose of this unit is for learners to develop an understanding of the technology used in the construction of low-rise domestic buildings. Learners will explore the processes, techniques and technologies used to create such buildings, and will investigate construction projects in terms of the important stages, using detailed construction drawings, specifications and schedules of work.

The unit compares modern methods of construction with traditional methods and investigates the advantages of modern methods of construction such as lower costs, shorter project durations, enhanced health and safety and reduced environmental concerns.

The unit also explores the environmental impact of low-rise domestic buildings and the methods used to monitor and control that impact.

Learning outcomes

In this unit, learners will be able to

1. identify the different forms, elements, components and materials used in domestic construction
2. recognise traditional and modern methods of domestic construction
3. understand how domestic buildings perform in use.

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved. Learners do not need any prior knowledge of domestic construction technology in order to understand this unit, but it is anticipated that learners will possess basic literacy and numeracy skills.

Learning outcome:

1. Identify the different forms, elements, components and materials used in domestic construction

Topics

- 1.1 Substructure and superstructure forms
- 1.2 Primary and secondary elements
- 1.3 Components and materials

Topic 1.1

Substructure

Learners must understand and use appropriate technical terminology to describe domestic buildings. They must be able to determine which materials are to be used for substructure development. They must also understand why such materials are used in specific places, both for their properties and the quality of their finish. Learners must understand that substructure work is work carried out below damp-proof course level. This includes the structure on which the building stands, including foundations such as:

- strip
- raft
- pile
- pad and beam

There is no requirement for the learners to understand how building services are distributed inside low-rise domestic buildings at this stage. However, learners must understand how the following building services are incorporated into the substructure:

- electricity
- gas
- cold water
- drainage
- telecoms

Learners will also need to understand the construction of basements including:

- methods of construction
- excavations, external and internal support systems
- tanking

Superstructure

Learners must understand and use appropriate technical terminology to describe domestic buildings. They must be able to determine the materials used for superstructures. They must be aware of why materials are used in specific places, both for their properties and the quality of their finish. Learners must understand that superstructure is that part of the building above the damp-proof course.

- Traditional on-site methods (brick and block, concrete, stone)
- Modern pre-fabricated methods (timber frame, steel frame, cladding, trussed rafters, pods)

Topic 1.2

Learners must be able to differentiate between primary and secondary elements of buildings and explain the function of each.

- Primary elements (walls, floors, roofs)
- Secondary elements (doors, windows, partitions, staircases, fixtures and fittings)

Topic 1.3

Learners must be able to describe how components and materials are incorporated into buildings

- Components (cladding, roof systems, internal partitions, raised floors, suspended ceilings)
- Materials (concrete, metals, timber, masonry, plastic, glass)

Learning outcome:

2. Recognise traditional and modern methods of domestic construction

Topics

2.1 Methods used in traditional and modern construction

2.2 Characteristics of traditional and modern methods of construction

Topic 2.1

Learners must build upon Topic 1.2 to develop an understanding of the traditional methods used to construct low-rise domestic buildings using the following materials:

- brick and block
- stone
- timber

Learners must build upon Topic 1.2 to develop an understanding of the modern methods used to construct low-rise domestic buildings using the following techniques:

- timber frame
- panelised
- mass concrete
- thin joint
- volumetric (pod/modular)

Topic 2.2

Learners must understand the characteristics of traditional and modern methods of construction and be able to specify the advantages and disadvantages of each method.

- Traditional methods (all work done on-site, labour intensive, longer build times, more waste generated, low levels of mechanisation, weather dependent)
- Modern methods (off-site prefabrication, modularisation, greater use of construction plant, better quality control, shorter build times, reduced labour requirement)

Learning outcome:

3. Understand how domestic buildings perform in use

Topics

3.1 Performance expectations

3.2 Environmental issues

Topic 3.1

Learners must understand what low-rise domestic buildings are required to do in order to achieve their design function. They must be able to link the following functions of domestic buildings to the form of construction chosen, and the methods used in their construction:

- weather exclusion
- durability
- structural performance
- fire resistance
- thermal performance
- sound insulation
- security
- access and egress

Topic 3.2

Learners must understand that even low-rise domestic buildings can have an environmental impact, both during construction and in use, and must understand how each of the following are used to monitor and control that environmental impact.

- Environmental Impact Assessment (EIA)
- Energy Performance Certificates (EPC)
- Code for Sustainable Homes
- Waste management plans
- Building Regulations (Part L)

Guidance for delivery

Staff delivering this unit will have an opportunity to use a wide range of techniques, lectures, guest speakers, industry experts, discussions, case studies, DVDs and video footage. Tutors are advised to use seminar presentations, site visits, supervised practical activities, research using internet and/or library resources and the use of personal and/or industrial experiences as appropriate. Site visits are the most important of the many learning tools and learners should be provided with the opportunity to visit as many housing sites as possible, preferably at different stages of construction, in order to see the process in real life, as it happens.

Visiting guest speakers could also add to the relevance of the subject to bring the learning to life. This can be combined with site visits where time is short, and where it is more convenient for those providing the learners with the benefit of their on-site experience.

An understanding and demonstration of health and safety must be integrated at all times into the lessons. Centres would benefit from links with local construction companies or the building department of a local authority who will carry out a selection of work that can be related and applied to lessons. Staff should apply learning within real-life working environments, as this is vital for learner engagement, motivation and development.

Unit 302

Industrial and commercial construction technology

UAN:	M/506/5400
Level:	3
GLH:	60

What is this unit about?

The purpose of this unit is to develop the learners' knowledge and understanding of industrial and commercial construction technology.

Learners will investigate the technology and construction techniques used to construct industrial and commercial buildings and will study alternative types of structure and the materials and processes used. Learners will also be given the opportunity to investigate the use of alternative technologies and materials for sustainable buildings.

The unit compares the alternative forms of construction used for industrial and commercial buildings including, where appropriate, the inclusion of modern methods of construction and the need to ensure buildings are energy-efficient in both construction and use. Learners should be able to describe construction techniques and compare different types of structure, building fabrics, techniques, application methods and appropriate terminology, to produce solutions for a range of building designs and client requirements.

The learner will be given the opportunity to identify and describe the most suitable construction to bring a construction project to a successful conclusion in terms of groundwork, substructure and superstructure.

Learning outcomes

In this unit, learners will be able to

1. recognise the methods used in industrial and commercial construction
2. understand site preparation and substructure work in industrial and commercial construction
3. understand superstructure work in industrial and commercial construction
4. identify roofing work in industrial and commercial construction

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Recognise the methods used in industrial and commercial construction

Topics

- 1.1 Types of industrial and commercial buildings Primary and secondary elements
- 1.2 Common construction forms
- 1.3 Materials used to construct common forms

Topic 1.1

Learners must understand and use appropriate technical terminology to describe the following industrial and commercial buildings.

- Factories
- Stores
- Petrol stations
- Hotels
- Supermarkets
- Warehouses
- Garages
- Breweries
- Foundries
- Power stations

Topic 1.2

Learners must be able to determine the most appropriate form of structure for a given project. They must be aware of the uses and limitations of the various construction techniques available to them and understand the function of a building and how this influences the specification of the building.

- Concrete and steel framed buildings
- Timber, concrete and steel portal frames
- Cross wall
- Fin wall
- Diaphragm walling
- Panelised

Topic 1.3

Learners must understand the materials used to construct common forms of industrial and commercial buildings and the reasons for their specification.

- Precast concrete
- Cast in situ concrete
- Pre-stressing and post-tensioning techniques
- Steel
- Laminated timber
- Brick and block

Learning outcome:

2. Understand site preparation and substructure work in industrial and commercial construction

Topics

- 2.1 Site and soil investigations
- 2.2 Site preparation techniques
- 2.3 Types and uses of foundations

Learners must understand that before construction work commences it is necessary to collect information on previous and current uses of the site. This is done to ensure that correct decisions are made when planning the site layout. Learners must be able to explain the various methods of soil investigation and be able to interpret borehole logs.

Using the information from site investigation and borehole logs learners must be able to choose and sketch the most appropriate form of foundation for a given situation.

Topic 2.1

Learners must understand that the objective of site investigation is to collect and record the information needed to help with the design and construction processes including:

- site boundaries
- access to site
- local roads
- trees, hedges and fences
- topography
- existing structures
- position of existing services
- wildlife and habitat.

Learners must understand the factors to be ascertained by soil investigations including:

- shear strength
- compressive strength
- plasticity
- permeability
- density (bulk and solid)
- porosity
- liquid limit
- moisture content
- position of water table
- chemical composition

Learners must understand the methods used to obtain both disturbed and undisturbed soil samples including:

- trial pits
- hand and mechanical augers
- bore hole logs
- interpretation of results of above.

Topic 2.2

Learners must understand the various forms of work that must be undertaken before construction can commence, including:

- dewatering – temporary and permanent
- contamination and remediation

- ground improvement techniques (consolidation, compaction).

Topic 2.3

Learners must be able to specify the most appropriate foundation types for industrial and commercial buildings in given situations and given soil conditions.

They should be able to sketch foundation details for:

- deep strip, wide strip, trench fill
- reinforced raft
- piles
- pad.

Learning outcome:

3. Understand superstructure work in industrial and commercial construction

Topics

3.1 Forming connections to construction elements

3.2 Wall construction

3.3 Floor construction

Topic 3.1

Learners must be able to explain the various methods of forming beam and column connections in steel and concrete. Learners must also be able to identify and sketch portal frame design using rigid two-pin or three-pin frames.

- Precast and cast in situ concrete frame connections
- Steel frame connections
- Timber, concrete and steel portal frame connections

Topic 3.2

Learners must identify and sketch alternative forms of wall construction and recommend the most appropriate construction to be used in given situations. Consideration should also be given to thermal and sound insulation of the walls.

- Rainscreen cladding
- Panel and curtain walls
- Infill panels
- Metal profile sheeting

Topic 3.3

Learners must identify and sketch alternative forms of floor construction and recommend the most appropriate construction to be used in given situations. Consideration should also be given to thermal and sound insulation of the roofs.

- Floor construction techniques
- Precast concrete
 - Cast in-situ concrete
 - Pot and beam
 - Beam and block
- Provision for openings in floors
- Floor finishes

Learning outcome:

4. Identify roofing work in industrial and commercial construction

Topics

4.1 Roof construction techniques

4.2 Roof coverings

Topic 4.1

Learners must be able to select and justify appropriate roof construction techniques for use with industrial and commercial building, and be able to sketch construction details and recommend appropriate types of roof covering. They must ensure that they have taken into account the need to provide roof structures that contribute to energy conservation in buildings. Learners must consider requirements of roof structures including the need to provide natural light using patent glazing, roof lights, lantern lights and light tunnels and the space requirements for plant rooms for lifts, heat pumps, air-conditioning and water tanks.

The following roofs should be investigated:

- pitched roof trusses
- northlight roofs
- monitor roofs
- flat roofs
- shell roofs
- space decks/frames.

Topic 4.2

The following forms of roof covering must be considered:

- metal roof covering
- plastic
- glass
- built-up felt
- asphalt
- EPDM (membrane)
- Glass Reinforced Plastic (GRP)
- green roofs
- slates and tiles.

Guidance for delivery

Staff delivering this unit will have an opportunity to use a wide range of techniques, lectures, guest speakers/industry experts, discussions, case studies, use of DVD and video footage.

Centres should cover a wide range of technical detail relating to Industrial and commercial buildings encouraging learners to investigate alternative solutions to construction problems. Real-life industry visits to encourage debate, discussion and allow learners to appreciate the way in which buildings are required to perform in use would be very useful.

Staff are advised to use seminar presentations, site visits, supervised practical activities, research using internet and/or library resources and the use of personal and or industrial experiences are suitable.

Delivery of this unit should stimulate, motivate, educate and enthuse the learner. Visiting guest speakers could also add to the relevance of the subject to bring the learning to life.

An understanding and demonstration of the alternative uses for industrial and commercial buildings should be included.

Centres would benefit from links with local construction companies and local industry or commercial partners, many colleges, particularly those delivering construction and engineering disciplines, will have examples of various forms of construction suitable for study. Learners would benefit from educational visits to industrial and commercial premises including, leisure centres, schools, shopping centres and industrial premises to experience the range of structures and uses of the buildings. Staff should apply learning with real-life working environments and workshops, as this is vital for learner engagement, motivation and development.

Visits to construction sites will help to motivate learners and illustrate to them the importance and complexity of the construction industry.

UAN:	T/506/5401
Level:	3
GLH:	60

What is this unit about?

The purpose of this unit is for learners to develop knowledge and understanding of health and safety in the built environment.

The construction industry remains one of the largest in Great Britain, bringing employment to over two million people. It remains extremely hazardous, and therefore a cause for significant concern. The health and safety challenge for the industry is huge, and construction companies regularly hit the headlines for all the wrong reasons. The accident rate for construction industry workers is a cause for concern and companies must look to continually improve the health, safety and welfare of employees, sub-contractors, visitors and the general public, as far as is reasonably practicable.

Accidents remain at an unacceptable level despite all the legislation, regulations and preventative measures that have been introduced. The industry must continue to reduce the accident rate together with the associated injuries and incidences of ill-health.

In this unit learners must investigate the procedures associated with hazard identification and risk management. This must involve determining potential hazards in and around the workplace, considering who is at risk and deciding what control measures should be used.

Learners must also familiarise themselves with health and safety law, and what the legal responsibilities are for the various parties to the construction process.

Learning outcomes

In this unit, learners will be able to

1. determine how and where accidents occur in the construction industry
2. apply the principles of risk management
3. understand health and safety legislation relevant to the construction industry
4. develop training materials for use in the construction industry

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

In order to fully understand this unit, learners need not have any prior knowledge of health and safety. It is however anticipated that learners hold GCSE Grades at Grade C or above in Mathematics and English Language and have the necessary literacy and numeracy skills to analyse data and complete the report aspects of the unit.

Learning outcome:

1. Determine how and where accidents occur in the construction industry

Topics

- 1.1 Accident statistics
- 1.2 Causes of accidents
- 1.3 Recording and reporting accidents

Topic 1.1

Learners must be able to explain what the typical causes of accidents are and they must be able to identify potential hazards in and around the workplace. Definition of accident

- Hazard identification
- HSE data
- Current trends
- Company statistics (fatalities, near misses, major accidents, minor injuries)

Topic 1.2

There are many causes of accidents and these should be considered in cognate groups such as:

- slips, trips and falls
- hazardous materials
- use of electricity
- falling objects
- negligence and/or tiredness
- weather conditions
- hygiene and site housekeeping
- manual handling
- working in confined spaces
- on-site traffic

Topic 1.3

Learners must be able to explain the procedures for reporting accidents, incidents and dangerous occurrences. The following should be considered:

- accident procedures
- employee duties (recording and reporting)
- HSE notification
- prevention of re-occurrence by ensuring safe working practices
RIDDOR

Learning outcome:

2. Apply the principles of risk management

Topics

- 2.1 Hazard analysis
- 2.2 Risk management techniques

Topic 2.1

Learners must be able to identify the persons who could be harmed in the workplace and the steps to be taken to reduce or eliminate the risks of accidents. The following must be considered:

- people at risk
- common hazards
- site conditions
- asbestosis
- faulty tools and equipment
- poor site welfare
- poor hygiene
- weather conditions
- access and egress
- working at height or below ground
- confined spaces

Topic 2.2

Learners must also be able to apply appropriate techniques to prepare risk assessments for given scenarios. The following must be considered:

- risk assessments – 5 steps
- method statements
- human and workplace factors
- company policies and procedures

Learning outcome:

3. Understand health and safety legislation relevant to the construction industry

Topics

- 3.1 Legislation and regulations
- 3.2 Practical implementation of regulations

Topic 3.1

Learners will need to have knowledge of the different pieces of legislation that are used within the construction industry and why they are in place. Learners need to have an overview of the different legislation that is used to govern and protect workers and public whilst carrying out a range of construction duties and differentiate between the various forms of regulations. Most importantly, learners must have a basic understanding of the Health and Safety at Work Act 1974, and any regulations made under the Act. Other considerations must include reference to:

- Construction Design and Management Regulations 2007
- Control of Substances Hazardous to Health Regulations 2002
- Lifting Operations and Lifting Equipment regulations 1998
- Work at Height Regulations 2005
- Confined Spaces Regulations 1997
- Provision and Use of Work Equipment Regulations 1998
- Management of Health and Safety at Work Regulations 1999
- Personal Protective Equipment Regulations 1992

- Noise at Work Regulations 2005
- Reporting of Injuries Diseases and Dangerous Occurrences Regulations 2013.

Topic 3.2

Learners must understand the corporate and human consequences of failing to comply with the practical implementation of health and safety legislation. Examples include:

- investigation
- improvement notice
- prohibition notice
- fines
- imprisonment
- confiscation of equipment
- seizure of assets
- death or injury
- emotional impact
- reputational damage
- contractual implications
- stoppage of work
- loss of income.

Learning outcome:

4. Develop training materials for use in the construction industry

Topics

4.1 Training needs

4.2 Development of training material

Topic 4.1

Learners must have an understanding of the methods used on construction sites to make people aware of the dangers inherent in the industry. This can be achieved in a variety of ways including rigorous site inductions, mandatory training and regular toolbox talks. Learners must be able to contribute to the preparation and delivery of a range of toolbox talks. Factors to consider include:

- roles and responsibilities of everyone involved in and around a construction site
- industry-awarded qualifications
- competence schemes (e.g. CSCS cards, Green cards)
- permits to work
- induction checklists

Topic 4.2

Learners must be able to contribute to the preparation and delivery of a range of development materials. These could include:

- toolbox talks (for a range of work)
 - manual handling/safe lifting procedures
 - use of mechanical lifting aids
 - asbestos
 - COSHH (Chemicals and combustibles)
 - working at height and hazards associated
 - plant and machinery hazards
 - drug and alcohol abuse in the workplace

- risks in the workplace such as hand arm vibration, noise, respiratory illness, dermatitis, muscular skeletal problems, falling from height, struck by moving plant machinery
- signage
- enforcement of PPE (safety boots, hard hat, high visibility jacket, hand-protection, goggles, other PPE as appropriate
- use PPE to minimise risks from dangers

Guidance for delivery

Staff delivering this unit will have an opportunity to use a wide range of techniques, lectures, guest speakers/industry experts, discussions, case studies, use of DVD and video footage.

Centres should cover a wide range of health and safety activities to show and demonstrate potential hazards in and around the workplace. Real life industry visits to encourage debate, discussion, and to allow learners to experience the environment and what the potential dangers are.

The staff are advised to use seminar presentations, site visits, supervised practical activities, research using internet and/or library resources and the use of personal and or industrial experience. Delivery of this unit should stimulate, motivate, educate and enthuse the learner. Visiting guest speakers could also add to the relevance of the subject, bringing the learning to life.

An understanding and demonstration of health and safety must be integrated at all times into the lessons for all units. Centres would benefit from links with local construction companies, or the building department of a local authority, who will carry out a selection of work that can be related and applied to lessons.

Health and safety is always of paramount importance. Visits to college workshops, training providers and construction sites will help to motivate learners and illustrate to them the importance and complexity of the construction industry.

There is a comprehensive range of legislation that underpins health, safety and welfare in the construction industry and this must be obeyed at all times on-site and during delivery.

UAN:	T/506/5415
Level:	3
GLH:	60

What is this unit about?

People have limited control over the external environment, and the provision of human comfort in the internal environment is therefore of critical importance in modern construction. This has obvious implications for energy efficiency and sustainability, and it therefore follows that these issues require careful consideration at an early stage of design and construction.

Electricity is vital to the way we work and live today, and has been for a very long time. The distribution of electrical power within buildings will be covered in **Unit 310: Building Services Technology**. The generation of electrical power, and the distribution of that power to buildings, is dealt with here. This unit covers the processes used to generate electricity in power stations, using a source of heat to produce steam to drive turbines. The production of electricity by alternative sources such as wind, water and the tides is covered in Unit 318: Sustainability and new technologies.

Construction materials are used for a wide variety of purposes. Some are structural, others are decorative, others provide a smooth, clean, hygienic finish, some conduct electricity well and others provide thermal insulation. These are only a few of the uses to which construction materials can be put. The unit identifies the construction materials in general use and explains the important properties of each. The use to which materials are put depends upon their fitness-for-purpose, and this in turn depends upon their physical and chemical properties. The link between the intended purposes of the materials, the environment in which they will be used, their properties, and their final specification as both sustainable and fit-for-purpose, will be emphasised throughout.

Despite all of this, materials can deteriorate in use and may eventually fail. This unit identifies how and where this can happen, and explains the methods and techniques used to reduce, prevent and, where necessary, remediate, such deterioration

Learning outcomes

In this unit, learners will be able to

1. identify the factors that affect human comfort in buildings
2. understand the safe generation, transmission and distribution of electrical power
3. determine the properties and uses of construction materials
4. recognise how construction materials fail and how such failures can be prevented

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Identify the factors that affect human comfort in buildings

Topics

- 1.1 Thermal comfort
- 1.2 Lighting
- 1.3 Noise and vibration

Topic 1.1

Learners must be aware that human comfort varies from person-to-person but that the factors that affect the perception of comfort can be considered systematically. They must understand the effect of each factor and be able to state acceptable values for each of the factors. There is no requirement for the learners to understand combined thermal comfort scales or calculate standard design temperatures.

- Environmental factors (air temperature, mean radiant temperature relative humidity, air velocity)
- Individual factors (age, gender, health, activity, clothing)
- Acceptable range of values and appropriate units for above
- Measurement of factors (thermometers, hygrometers, anemometers)
- U values and their relevance to human comfort
- Calculations relating to above.

Topic 1.2

Learners must be aware of the different properties of natural and artificial lighting, and must be able to specify both in qualitative and quantitative terms. They must be able to recognise different types of luminaire, but there is no requirement for them to demonstrate an understanding of how the different types of luminaires work, or the nature of the light distribution provided by each, at this stage.

- Artificial lighting (types of luminaires)
- Natural lighting (daylight)
- Acceptable range of values and appropriate units for above
- Glare
- Measurement of factors (light meter, daylight meter)
- Calculations relating to above.

Topic 1.3

Learners must demonstrate an understanding of the effect of noise and vibration on human comfort and be able to state acceptable values for each and explain how loudness and frequency interact. They must understand the difference between the insulation and absorption of sound, but there is no requirement for an in-depth understanding of the techniques used to control sound transmission or reverberation.

- Loudness and frequency
- Absorption and insulation
- Acceptable range of values and appropriate units for above
- Measurement of factors (sound level meter)
- Calculations relating to above.

Learning outcome:

2. Understand the safe generation, transmission and distribution of electrical power

Topics

- 2.1 Principles of electricity
- 2.2 Generation of electrical power
- 2.3 Transformation and distribution of electrical power

Topic 2.1

Learners must be aware of what is meant by the term 'electric current' and must understand the relationship between voltage, current, resistance, electrical power and the work done by an electric current. They must understand the basic principles of electromagnetic induction, and how this can be used to generate electrical power for large-scale use. They must be able to develop this understanding to demonstrate why alternating current is the inevitable outcome of standard practical methods of generating power.

- Electric current as a flow of electrons
- Relationship between volts, amperes, ohms, joules and watts.
- Electro-magnetic induction
- Reason why current alternates in direction
- Alternating current wave form (characteristics, peak values, root-mean square values)
- Calculations related to above.

Topic 2.2

Learners must understand practical methods of generating electricity in terms of what goes on in power stations. There is no requirement at this stage for an understanding of alternative or renewable forms of generating energy, although they should be aware that they exist.

- Sources of heat energy (coal, oil, gas, nuclear, biomass)
- Awareness of renewable energy sources
- Process of generating electrical power
- Calculations related to above.

Topic 2.3

Learners should understand that the distribution of electrical power at high voltages implies high power losses and that the distribution of electrical power to buildings at high voltages is unsafe and will create practical problems. This should be reinforced by calculation of power losses at a variety of voltages. Learners must understand the consequent need for transformers and be able to explain how they work. This too should be reinforced by calculations. They must understand the advantages of three-phase distribution over single-phase distribution and be able to draw simple combinations of live and neutral phases to demonstrate how both 230/240 V and 415 V supplies can be provided.

- Power losses during transmission
- Transformation of electrical power (step-up and step-down transformers)
- Single-phase and three-phase distribution
- Calculations related to above

Learning outcome:

3. Determine the properties and uses of construction materials

Topics

- 3.1 Materials
- 3.2 Properties

3.3 Uses

Topic 3.1

Learners must be able to recognise the common materials used in construction and be able to explain where each is generally used and for what purpose. There are many other materials that can be used, but the following are the most common.

- Timber
- Bricks and blocks
- Cement, aggregates and concrete
- Metals and alloys (steel, copper, lead, aluminium)
- Limes and gypsum plasters
- Plastics

Topic 3.2

Learners must understand the important properties of construction materials and be able to explain why and where each is important. They must develop a qualitative understanding of these properties (for example, that steel has a greater density than aluminium, or that the thermal expansion of plastics is greater than that of timber) but there is no need for an exact quantitative knowledge of the value of each.

- Strength (compressive, tensile, shear, bending)
- Modulus of elasticity (stiffness)
- Density (solid and bulk)
- Durability (resistance to chemical, physical and biological attack)
- Workability
- Porosity and water absorption
- Thermal and moisture movement
- Thermal and electrical conductivity

Topic 3.3

Learners must develop an understanding of how the properties of materials directly influence the way in which materials are used and how specification follows upon fitness-for-purpose in every case. Costs should be considered only in relative terms.

- Fitness for purpose (structural, water-exclusion, thermal and sound insulation; electrical conduction and resistance),
- Aesthetics (visual appearance), resistance to degradation, contribution to sustainability
- Costs, ease of handling and working, health and safety issues
- Specification to reflect properties in use

Learning outcome:

4. Recognise how construction materials fail and how such failures can be prevented

Topics

- 4.1 Causes of failure
- 4.2 Failure mechanisms
- 4.3 Preventive techniques

Topic 4.1

Learners must be able to recognise the agents that lead to the failures of construction materials and must be able to explain which materials they will most affect.

- Water

- Sunlight
- Insect attack
- Fungal attack
- Chemical attack
- Fire
- Temperature (degradation by heat, frost attack)

Topic 4.2

Learners must understand how the agents identified above are instrumental in the deterioration and failure of construction materials. They must be able to explain the scientific principles underpinning such deterioration (for example, corrosion of metals is an electro-chemical process, fungi attack timber because they contain no chlorophyll, frost attack on porous materials is the result of water expanding as it freezes, and so on) but only at a level commensurate with a general understanding of the hazards to which materials are exposed.

- Corrosion of metals
- Fungal and insect attack on timber
- Warps, splits and shakes in timber
- Frost attack on brickwork and concrete
- Sulphate attack on cements
- Efflorescence in brickwork
- Ultra-violet attack on paints and plastics.

Topic 4.3

Learners must build upon the above to understand that all materials deteriorate in use and that great care must be taken in the specification of materials, and that this must be backed up with preventive measures and remediation as necessary.

- General (provide physical barrier, painting, coating)
- Corrosion (exclude water and air, sacrificial coating, cathodic protection, anodisation)
- Fungal and insect attack (apply preservatives, control moisture content)
- Warps, splits and shakes in timber (appropriate form of conversion, air or kiln seasoning)
- Frost attack (exclusion of water, specification of low porosity materials)
- Sulphate attack on cements (specify sulphate-resisting cements, exclusion of groundwater)
- Efflorescence (exclude water, use bricks with low soluble salt content)
- Ultra-violet attack (incorporate UV stabilisers in plastics)

Guidance for delivery

Tutors have opportunities to use a wide range of techniques. These should include lectures, small and large group discussions, case studies, demonstrations, supervised laboratory practical work, research using the internet and/or other library resources and presentations by guest speakers. Delivery should stimulate, motivate, educate and enthuse learners.

Centres would benefit from visits to building sites, power stations and materials testing centres. The use of case studies, DVDs, videos and photographic material will be useful as a secondary source of data, should first-hand experience of testing procedures prove difficult.

Learning outcomes 3 and 4 are, although separate, linked in a fairly obvious way and it is recommended that they be taught in the obvious order, so that the content of L3 can be fully utilised in the delivery of LO4.

Teaching and learning strategies should take an integrated approach and must combine learner-centred investigative techniques with supervised, hands-on, experiential learning that involves taking measurements, making observations, consulting reference documents and forming conclusions. Practical demonstrations and laboratory work should be used to underpin the

measurement of the factors that affect human comfort and the generation and distribution of electrical power. The latter should be small in scale and should concentrate on the principles. Centres should use power packs, rather than mains supplies, to reduce the risk to learners. Materials testing procedures are useful, where the centre possesses the relevant equipment, but experiments can be simulated without recourse to specialist equipment. Health and safety risk assessments should, of course, be undertaken before each testing procedure.

Calculations are unavoidable in science-based units and are explicitly included in learning outcomes 1 and 2. The use of calculations to support the other learning must not however be seen as an exercise in its own right. This content of this unit underpins that of many other units and the unit should generally be undertaken at an early stage of the programme. Group activities are permissible, and indeed encouraged, but tutors must ensure that learners are able to provide individual evidence of understanding.

UAN:	A/506/5450
Level:	3
GLH:	60

What is this unit about?

Changes in the environment, resulting from natural phenomena, are a continuing challenge to us all, and especially to the construction and built environment sector. There are many new sustainability initiatives and improved technologies intended to reduce our carbon input to the environment. This unit will look at the ways we can reduce our carbon footprint by looking at renewable energy, the ways in which we can reduce pollution and waste, and the implications of all this for new methods of construction. A failure to address these issues will almost certainly lead to an increase in the unpredictable weather patterns we have seen across the globe in recent years.

Learning outcomes

In this unit, learners will be able to

1. understand renewable energy technology
2. understand pollution control
3. understand waste management
4. understand sustainable construction techniques

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Understand renewable energy technology

Topics

- 1.1 New technologies for renewable energy
- 1.2 Benefits of renewable energy and efficient technology

Topic 1.1

Learners must understand the different types of new technologies available.

- Ground source heat pumps
- Air source heat pumps
- Hydro electricity
- Solar PV
- Solar water
- Geothermal
- Biomass (wood, crops)
- Wind turbines
- Tidal

Topic 1.2:

Learners must be able to explain the benefits of new technologies, both by retro-fitting and by use in new build, and they must be able to evaluate the efficiencies each will bring.

- Renewable source of energy
- Reduced emissions (carbon and others)
- Financial incentives
- Reduced environmental impact (carbon neutrality)

Learning outcome:

2. Understand pollution control

Topics

- 2.1 Impact of global pollution
- 2.2 Pollution generated by non-renewable sources

Topic 2.1

Learners should understand how global and local pollution impacts on humans and the environment in each of the following ways.

- Air
 - CO2
 - Acid rain
 - CFCs
 - Smoke
 - Photochemical smog
 - Indoor air quality (Sick Building Syndrome)
- Water
 - Over-extraction
 - Pollution by communities, industry, agriculture
 - Eutrophication

- Land
 - Contamination by communities, industry, agriculture
 - Remediation techniques
 - Over-development
 - Destruction of habitat and biodiversity

Topic 2.2

Learners should understand how pollution is generated by non-renewable sources such as the following.

- Fossil fuels
- Nuclear fuel
- Fracking

Learning outcome:

3. Understand waste management

Topics

- 3.1 Waste management techniques
- 3.2 Legal implications
- 3.3 Financial implications

Topic 3.1

Learners must understand the different types of waste generated on a construction site, how waste is categorised, where the waste is produced and how to manage its disposal. Learners must understand the importance of waste audits and how they are carried out.

Waste materials will include the following.

- Timber
- Plastic
- Paper
- Stone/concrete/clay
- Metals
- Gypsum
- Chemicals (paints, adhesives, solvents, gases)
- Architectural salvage
- Glass

Topic 3.2

Learners will need to evaluate the impact of ineffective working methods of waste control. Learners will evaluate construction materials and products to minimise the waste potential.

- Regulations
- Volatile organic compounds
- SWMPs
- Storage, transportation and disposal

Topic 3.3

Learners must explain financial impact of disposing materials locally and segregating materials.

- Landfill tax
- Cost of disposal
- Penalties

Learning outcome:

4. Understand sustainable construction techniques

Topics

- 4.1 Embodied energy
- 4.2 Reducing energy consumption
- 4.3 Sustainable construction methods

Topic 4.1

Learners must understand embodied (embedded) energy and how this is dependent upon the energy dissipated in the location, extraction, manufacture and transport of materials such as the following.

- Types of glass
- Timber
- Insulation materials (rigid/flexible, natural/synthetic)
- Plastic goods
- Cladding
- Concrete (cement, aggregates)
- Metals
- Gypsum and limes
- Bitumens
- Composite materials

Topic 4.2

Learners must understand how the appropriate specification of materials in the construction process can improve human comfort in buildings. Examples should include the following.

- Reduction of heat losses
- Reduction of energy consumption
- Improvement of air quality

Topic 4.3

Learners must understand the different construction techniques currently used to increase efficiency in terms of reducing heat loss. Learners must compare:

- traditional and modern methods
- masonry v framed structures (concrete, timber, steel)
- forms of external enclosure (e.g. brick, composites, metal, plastic, glass).

Guidance for delivery

Tutors have opportunities to use a wide range of techniques. These should include lectures, small and large group discussions, case studies, demonstrations, supervised laboratory practical work, research using the internet and/or other library resources and presentations by guest speakers. Delivery should stimulate, motivate, educate and enthuse learners.

Centres would benefit from visits to building sites, power & nuclear stations and materials testing centres. The use of case studies, DVDs, videos and photographic material will be useful as a secondary source of data, should first-hand experience of testing procedures prove difficult.

Teaching and learning strategies should take an integrated approach and must combine learner-centred investigative techniques with supervised, hands-on, experiential learning that involves, making observations, consulting reference documents and forming conclusions. Group activities

are permissible, and indeed encouraged, but tutors must ensure that learners are able to provide individual evidence of understanding.

UAN:	L/506/5453
Level:	3
GLH:	60

What is this unit about?

The purpose of this unit is for learners to use formulae and apply mathematical techniques in algebra, geometry, mensuration and statistics for solving a range of practical problems in construction. Technicians, working in the field of construction and civil engineering, will apply mathematics to do their job successfully regardless of their particular area of expertise.

The teaching/learning of this unit starts with the use of a scientific calculator and other basic techniques such as rounding and estimation. These are followed by the transposition and evaluation of formulae. The use of these techniques is not limited to mathematics for its own sake and the content is used in other units such as Science and Materials, Structural Mechanics, Site Surveying and Measurement, Tendering and Estimating. For instance, learning the solution of linear and quadratic equations is not just academic - both are used in several practical applications in construction and civil engineering.

In construction projects it is necessary to calculate areas and volumes. These include the area of land, volume of earthworks and area/volume of building finishes/materials. Their quantities have to be determined accurately using established techniques, because the cost of the project is dependent on these calculations. We will encounter both regular and irregular surfaces and components and this unit deals with the basic techniques of finding areas/volumes for both.

The land acquired for construction work has to be levelled before the setting out can commence. Setting out involves the measurement of angles and distances, and the use of formulae involving the trigonometrical ratios, so that the relevant calculations can be performed. Although many of these tasks are done by modern surveying instruments, learners need to understand the basics of the trigonometry used.

Many publications have statistical information on issues such as waste and recycling, road traffic accidents and falls from heights that are of interest to learners as well as engineers in the construction industry. Learners need the basic skills in statistics to understand and evaluate the published information. Learners also need to collect, analyse, present and interpret data. The topics included in this unit will enable learners to undertake these activities.

Learning outcomes

In this unit, learners will be able to

1. use basic mathematics, methods and techniques to solve equations
2. use geometric and trigonometric techniques
3. use techniques to calculate perimeters, areas and volumes
4. use graphical and statistical techniques

Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved.

Learning outcome:

1. Use basic mathematics, methods and techniques to solve equations

Topics

- 1.1 Use of scientific calculator, rounding and approximation techniques
- 1.2 Indices and transposition
- 1.3 Linear and quadratic equations

Topic 1.1

Learners must be able to recognise the function of the keys of a scientific calculator. They must be able to use the main keys for performing a range of calculations. They should be able to present the answer to a given accuracy and be able to use estimation for checking their answers. They must understand how this relates to the following.

- Add, subtract, divide, multiply; exponents, logarithms; sin, cos, tan; arc sin, arc cos, arc tan; degrees, radians
- Decimal places and significant figures
- Standard form
- Estimation of an answer

Topic 1.2

Learners must understand the addition, subtraction, division and multiplication of algebraic expressions, and the laws of indices. They must be able to manipulate a range of formulae to change the subject of the formulae.

- Add, subtract, multiply and divide simple algebraic expressions
- Laws of indices
- Transposition of formulae (including formulae that involve squares, square roots, cubes and cube roots)
- Evaluation of formulae

Topic 1.3

Learners must be able to differentiate between linear and quadratic equations. They should recognise that the number of roots of an equation depend on the power of the unknown. They must be able to use a range of methods for solving linear, linear simultaneous and quadratic equations.

- Linear equations
- Linear simultaneous equations (solution by substitution and elimination methods)
- Quadratic equations (solution by factorization and simultaneous formula techniques)
- Checking answers by re-substitution

Learning outcome:

2. Use geometric and trigonometric techniques

Topics

- 2.1 Geometric techniques
- 2.2 Basic trigonometric techniques
- 2.3 Sine rule and cosine rule

Topic 2.1

Learners must recognise different types of angles made by intersecting lines and geometric shapes. They must understand the concept of similar triangles, recognise different types of triangles and be able to apply Pythagoras' theorem to right-angled triangles. They must understand the properties of quadrilaterals and circles and apply them to solve practical problems involving the following.

- Properties of angles, units of measurement (degrees and radians)
- Properties of triangles
- Pythagoras' theorem and its application
- Properties of rectangles, trapeziums, parallelograms
- Properties of the circle and their practical application.

Topic 2.2

Learners must understand the trigonometrical ratios of sine, cosine and tangent, as applied to a right-angled triangle. They must be able to identify the hypotenuse, adjacent and opposite sides of a right-angled triangle. They must be able to determine the angle from the given trigonometrical ratio and vice-versa. They should be able to differentiate between the angles of elevation and depression and apply all these concepts to solve practical construction problems.

- Trigonometrical ratios (sine, cosine and tangent)
- Angles of elevation and depression
- Calculations involving angles in degrees/radians
- 2D/3D problems in construction.

Topic 2.3

Learners must understand that the trigonometrical ratios can only be applied to right-angled triangles, and that for determining the angles and sides of other triangles, different techniques need to be used. For a given triangle, they should be able to identify which rule to use and be able to recognise the ambiguous case.

- The sine rule
- The cosine rule
- Ambiguous case of the sine rule
- Area of a triangle (two sides and the enclosed angle known).

Learning outcome:

3. Use techniques to calculate perimeters, areas and volumes

Topics

- 3.1 Perimeters and areas of regular shapes
- 3.2 Areas of irregular shapes
- 3.3 Volumes of regular and irregular objects

Topic 3.1

Learners must be able to calculate the perimeter of regular shapes. They should be able to identify triangles, quadrilaterals (rectangles, trapeziums, parallelograms) and circles, and be able to calculate their areas. They should understand the techniques used for calculating the surface area of regular objects, and identify the right units for perimeters and areas.

- Perimeters of regular shapes
- Area of triangles and quadrilaterals
- Area of circles, segments and sectors
- Surface area of regular objects (cylinders, spheres, pyramids and cones)
- Application of the above to construction problems

Topic 3.2

Learners must be aware that numerical integration methods can be used to calculate the area of irregular shapes such as building plots. They should be able to divide the irregular shape into appropriate number of strips and calculate its area. They should be able to compare the results obtained from different methods.

- Numerical integration methods (mid-ordinate, trapezoidal and Simpson's rule)
- Comparison of the results obtained from these methods
- Application to find the area of simple and compound shapes

Topic 3.3

Learners must be able to understand the methods used to calculate the volume of regular objects and be able to use the right units. Learners must be able to extend Simpson's rule and the trapezoidal rule (covered in Topic 3.2) to calculate the volume of irregular objects. They should also recognise that the Prismoidal rule, that can be used to find the volume of large excavations, is basically Simpson's rule applied to two strips.

- Volume of regular solids (prisms, cuboids, cylinders, cones, pyramids and spheres)
- Volume of irregular solids (Simpson's rule and trapezoidal rule)
- Volume of trenches/embankments.
- Prismoidal rule

Learning outcome:

4. Use graphical and statistical techniques

Topics

- 4.1 Graphical techniques
- 4.2 Data processing and presentation
- 4.3 Dispersion of data

Topic 4.1

Learners must understand the selection of scales for the x-axis and y-axis. They must be able to identify the x and y co-ordinates from given data and be able to plot experimental data. If the data exhibits linear correlation, they should be able to produce best-fit straight lines (approximately). They should be able to plot graphs of equations, and be able to find their solution. Learner must understand the technique to determine the gradients of straight lines and be able to find the equation of a straight-line graph.

- Cartesian and polar co-ordinates
- Linear and linear simultaneous equations
- Quadratic equations
- Gradient of straight lines
- Equation of straight-line graphs

Topic 4.2

Learners should be able to process raw data and produce frequency tables and grouped data. They must understand that the number of classes of a grouped data depends on the size of the data set. They must be able to determine the central tendency of data from grouped and ungrouped data and be able to compare the results. Learners should be able to produce a range of statistical diagrams from their analysis of data. These should include the following.

- Frequency tables
- Grouped data
- Mean, mode and median
- Statistical diagrams (bar charts, pie charts, frequency polygons and cumulative frequency polygons)

Topic 4.3

Learners must recognise the importance of the consistency of data. They must be able to apply a range of numerical measures of dispersion, and understand the limitation of these methods.

- Range
- Quartiles
- Inter-quartile range
- Variance
- Standard deviation

Guidance for delivery

Tutors can use a range of teaching and learning methods to deliver this unit. These include lectures, demonstrations, discussions, group work, individual work and research using internet/library resources. The tutors should make sure that the learners spend enough time on practising the solution of problems covering all the topics. Learners must be given opportunities to apply the fundamental concepts to solve practical construction problems; the emphasis must be on practice - in the classroom as well as at home. Group work should be encouraged for students' interaction, but it is important that individual learners must have equal learning and assessment opportunities.

Learning outcome 1 should be covered first as it includes some basic techniques that underpin work in the other learning outcomes. Learning outcome 2 should be covered next as it deals with the properties of geometrical shapes and elementary trigonometry. Learners need to know these before learning to calculate perimeters, areas and volumes (learning outcome 3). For some tasks in learning outcome 3 students should be encouraged to measure up a room and use the measurements to determine area, volume and other quantities. For delivering learning outcome 4, secondary data may be used rather than primary data. Learners should be encouraged to use spreadsheet for producing the statistical diagrams.

Tutors should go through as many examples as possible so that the basic concepts are clear to the learners. The examples should be based on construction activities, wherever possible. Tutors must encourage learners to produce solutions in a systematic way that includes all steps of calculations.

This unit should be undertaken at an early stage of the programme as the content of the unit underpins that of many other analytical units.

Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on www.cityandguilds.com.

City & Guilds Centre Manual

This document provides guidance for organisations wishing to become City & Guilds approved centres, as well as information for approved centres delivering City & Guilds qualifications. It covers the centre and qualification approval process as well as providing guidance on delivery, assessment and quality assurance for approved centres.

It also details the City & Guilds requirements for ongoing centre and qualification approval, and provides examples of best practice for centres. Specifically, the document includes sections on:

- the centre and qualification approval process
- assessment, internal quality assurance and examination roles at the centre
- registration and certification of candidates
- non-compliance and malpractice
- complaints and appeals
- equal opportunities
- data protection
- management systems
- maintaining records
- internal quality assurance
- external quality assurance.

Our Quality Assurance Requirements

This document explains the requirements for the delivery, assessment and awarding of our qualifications. All centres working with City & Guilds must adopt and implement these requirements across all of their qualification provision. Specifically, this document:

- specifies the quality assurance and control requirements that apply to all centres
- sets out the basis for securing high standards, for all our qualifications and/or assessments
- details the impact on centres of non-compliance

The **centre homepage** section of the City & Guilds website also contains useful information on

- **Walled Garden:** how to register and certificate candidates on line
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for e-assessments.

Useful contacts

UK learners General qualification information	E: learnersupport@cityandguilds.com
International learners General qualification information	E: intcg@cityandguilds.com
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	E: centresupport@cityandguilds.com
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	E: singlesubjects@cityandguilds.com
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	E: intops@cityandguilds.com
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	E: walledgarden@cityandguilds.com
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: business@cityandguilds.com

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds' products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: **feedbackandcomplaints@cityandguilds.com**

About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people and organisations to develop their skills for personal and economic growth. Made up of City & Guilds, City & Guilds Kineo, The Oxford Group and ILM, we work with education providers, businesses and governments in over 100 countries.

Copyright

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute and may not be copied, reproduced or distributed without prior written consent. However, approved City & Guilds centres and candidates studying for City & Guilds qualifications may photocopy this document free of charge and/or include a PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching candidates working towards a City & Guilds qualification, or for internal administration purposes
- candidates may copy the material only for their own use when working towards a City & Guilds qualification

The Standard Copying Conditions (see the City & Guilds website) also apply.

City & Guilds

1 Giltspur Street

London EC1A 9DD

www.cityandguilds.com
