GCE AS/A LEVEL

WJEC GCE AS/A Level in

BUILT ENVIRONMENT

APPROVED BY QUALIFICATIONS WALES

SPECIFICATION

Teaching from 2022

For AS award from 2023
For A level award from 2024

This Qualifications Wales regulated qualification is not available to centres in England.

WJEC GCE AS and A level in BUILT ENVIRONMENT

For teaching from 2022
For AS award from 2023
For A level award from 2024

This specification meets the requirements of the following regulatory documents published by Qualifications Wales:

- Approval Criteria for GCE AS and A level Qualifications which set out the requirements for all new or revised GCE specifications developed to be taught in Wales from September 2017.
- Approval Criteria for GCE AS and A level Built Environment which set out the requirements for all qualifications in this subject to be taught in Wales from September 2022.

GCE AS and A LEVEL BUILT ENVIRONMENT (Wales)

SUMMARY OF ASSESSMENT

This specification is divided into a total of 4 units, 2 AS units and 2 A2 units. Weightings noted below are expressed in terms of the full A level qualification.

AS Units

AS Unit 1: Our built environment Written examination: 2 hours 20% of qualification — 80 marks: 100 UMS
A written paper comprising a range of question types to assess specific content related to the built environment. The paper is presented as a question-and-answer booklet. All questions are compulsory.
AS Unit 2: Design and planning practices **Non-exam assessment (NEA): approximately 30 hours** **20% of qualification — 80 marks: 100 UMS**
This task assesses the learner's knowledge, understanding and skills in relation to design and planning practices. WJEC will set a contextualised brief each examinations series. In response to this brief, learners will undertake a practical project in which tangible outcomes are produced, including planning, practical and evaluative activities.

A level Units (the above plus a further 2 units)

A2 Unit 3: Materials, technologies and techniques Written examination: 2 hours 30 minutes 30% of qualification — 100 marks: 150 UMS
A written paper comprising a range of question types to assess specific content related to the use of materials, technologies and techniques in the built environment The paper is presented as a question-and-answer booklet. All questions are compulsory.
A2 Unit 4: Construction practices **Non-exam assessment (NEA): approximately 40 hours** **30% of qualification — 80 marks: 150 UMS**
Learners have a choice of two pathways within Unit 4: they either undertake a building survey or a land survey. This task assesses the learner's knowledge, understanding and skills in relation to construction practices. Learners are required to produce a development concept based on their survey findings. They are also required to produce subsequent construction management information, purchasing and financial management information and a programme of activities based on their development concept.

This is a unitised specification which allows for an element of staged assessment. Assessment opportunities will be available in the summer assessment period each year, until the end of the life of the specification.

Unit 1 and Unit 2 will be available in 2023 (and each year thereafter) and the AS qualification will be awarded for the first time in summer 2023.

Unit 3 and Unit 4 will be available in 2024 (and each year thereafter) and the A level qualification will be awarded for the first time in summer 2024.

The table below shows the two routes to a GCE Built Environment qualification.

Qualification	Unit 1 from 2023	Unit 2 from 2023	Unit 3 from 2024	Unit 4[1] from 2024
AS Built Environment	✓	✓	-	-
A level Built Environment	✓	✓	✓	✓

Qualification Approval Numbers
GCE AS: C00/4243/2
GCE A level: C00/3982/6

[1] There are two pathways in Unit 4, one based on building surveying of commercial or residential properties and one based on surveying land. Learners select one of these pathways.

GCE AS and A LEVEL BUILT ENVIRONMENT

1 INTRODUCTION

1.1 Aims and objectives

The WJEC GCE AS and A level qualification in Built Environment advances learners' understanding of the built environment, including the professional and technical roles within it and the range of buildings, assets and structures that comprise it.

The qualification allows learners to develop a deep understanding of the interrelated practices involved at each stage in the building life cycle, as well as of the scientific and mathematic principles required to understand the composition of the built environment. Learners will develop a wide range of technical and practical skills involved in the design, construction, use and maintenance of the built environment, considering the way that the built environment meets the needs of users, clients and stakeholders.

The qualification may be taken by those who have previously studied WJEC GCSE Built Environment or those that are interested in developing new skills in this subject area. The qualification will be of particular value to those with an interest in entering a technical or professional role in the built environment or continuing their studies in this subject area in higher education. It is, nonetheless, designed to appeal to a broad range of learners with different interests and may complement the study of a wide range of other subjects, including mathematics, physics, geography, design and technology, economics, business studies, art and design, history and geology.

This WJEC GCE specification in Built Environment will enable learners to develop knowledge and understanding of:

- the stages and processes involved in the built environment life cycle
- the professional and technical roles involved in the built environment
- the built environment needs of clients and stakeholders
- Building Information Modelling (BIM) practices and the role of BIM software in all stages of the built environment life cycle
- sustainability issues and sustainable practices in the built environment life cycle
- the changing nature of practice in the built environment sector over time and during different periods.

The specification will also enable learners to develop skills in:

- planning, developing, managing and evaluating built environment projects
- designing built environment concepts that meet client and stakeholder needs.

1.2 Prior learning and progression

This specification builds on the knowledge, understanding and skills established at GCSE. Some learners may have already gained knowledge, understanding and skills through their study of Built Environment at GCSE. However, there are no prior learning requirements for this specification. Any requirements set for entry to a course following this specification are at the discretion of centres.

It is reasonable to assume that many learners will have achieved qualifications equivalent to Level 2 at KS4. Skills in Numeracy/Mathematics, Literacy/English and Information Communication Technology will provide a good basis for progression to this Level 3 qualification, as will knowledge and understanding gained through the study of Level 2 sector/subject related qualifications.

This specification provides a suitable foundation for the study of Built Environment or a related area through a range of higher education courses, progression to the next level of vocational qualifications or employment. In addition, the specification provides a coherent, satisfying and worthwhile course of study for learners who do not progress to further study in this subject.

This specification is not age specific and, as such, provides opportunities for learners to extend their life-long learning.

1.3 Equality and fair access

This specification may be followed by any learner, irrespective of gender, ethnic, religious or cultural background. It has been designed to avoid, where possible, features that could, without justification, make it more difficult for a learner to achieve because they have a particular protected characteristic.

The protected characteristics under the Equality Act 2010 are age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation, marriage and civil partnership.

The specification has been discussed with groups who represent the interests of a diverse range of learners, and the specification will be kept under review.

Reasonable adjustments are made for certain learners in order to enable them to access the assessments (for example, candidates are allowed access to a Sign Language Interpreter, using British Sign Language). Information on reasonable adjustments is found in the following document from the Joint Council for Qualifications (JCQ): *Access Arrangements and Reasonable Adjustments: General and Vocational Qualifications.*

This document is available on the JCQ website (www.jcq.org.uk). As a consequence of provision for reasonable adjustments, very few learners will have a complete barrier to any part of the assessment.

1.4 Welsh Baccalaureate

In following this specification, learners should be given opportunities, where appropriate, to develop the skills that are being assessed through the Skills Challenge Certificate within the Welsh Baccalaureate:

- Literacy
- Numeracy
- Digital literacy
- Critical thinking and problem solving
- Planning and organisation
- Creativity and innovation
- Personal effectiveness.

1.5 Welsh perspective

In following this specification, learners must consider a Welsh perspective if the opportunity arises naturally from the subject matter and if its inclusion would enrich learners' understanding of the world around them as citizens of Wales as well as the UK, Europe and the world.

The built environment in Wales offers a broad range of contexts for the delivery of subject content in all four units. For example, the topics of planning legislation, sustainable construction, the sourcing of materials and contractors can all be considered within a Welsh context. Additionally, the land survey or building survey in the unit 4 NEA task should be undertaken in a Welsh context unless there are compelling reasons to base this work on a different context.

2 SUBJECT CONTENT

The subject content and assessment requirements are designed to ensure learners develop an appropriate breadth and depth of knowledge, understanding and skills in the built environment.

The subject content is presented in four units, each sub-divided into clear and distinct topic areas. Within each topic area the knowledge, understanding and skills are set out with an initial overview and then in two columns. The left hand column identifies the content to be studied. The right hand column provides amplification of the knowledge, understanding and skills that learners should develop in this area.

The amplification is designed to be exhaustive and clarify the breadth and depth of study required. *'Such as…'* or *'for example…*' are used only where it is helpful to place an aspect of the amplification in context. *'Including…'* is used to help clarify the breadth of an aspect of amplification or topic. Learners may choose to study the topic in greater breadth (i.e. beyond the scope of exemplification included in the amplification), as all relevant information may gain credit in the assessments. However, the focus of questions will always be on the amplification provided within the specification. Together, the content and the amplification columns give the full content of the specification.

There is no hierarchy implied by the order in which the content is presented. However, as Units 1 and 2 are at AS level and Units 3 and 4 are at A2 level, it is recommended that Units 1 and 2 are covered before Units 3 and 4.

Whilst the assessment for each unit focuses on the content specific to that unit, candidates may make relevant reference to content from other units.

The content of the two AS units (Unit 1 and Unit 2) helps develop learners' breadth of knowledge and understanding of the built environment.

At A2 learners complete a further two units (Unit 3 and Unit 4). Learners make a choice in one aspect of their work within Unit 4, focussing on either:

- *building surveying of commercial or residential properties,* or
- *surveying land*.

Learners may apply knowledge, skills and understanding gained from Units 1 and 2 in their study of Units 3 and 4. Thus they are provided with the opportunity to make connections between, and demonstrate their knowledge and understating of, elements from across the full course of study.

Through their work in built environment, learners are required to apply mathematical knowledge, skills and understanding. Appendix C maps relevant mathematical techniques to areas of specification content within Unit 3 and Unit 4 where learners have an opportunity to apply them. As noted above, content amplification is designed to be exhaustive where possible. This is the case for mathematical techniques, and the amplification does not seek to provide examples to illustrate a broader range of contexts or techniques. The amplification clarifies exactly what learners need to know, understand and be able to do to fully address all assessment requirements related to mathematical techniques in Unit 3 and Unit 4.

2.1	**Unit 1:** AS & A level
	Our built environment
2.1.1	The life cycle of buildings and structures
2.1.2	Low-rise and high-rise structures in the built environment
2.1.3	Professional and technical careers and roles in the built environment
2.1.4	Organisations in the built environment
2.1.5	Structures of low-rise domestic and commercial buildings
2.1.6	Designing and constructing substructures (in contemporary practice)
2.1.7	Designing and constructing superstructures (in contemporary practice)
2.1.8	Designing the services requirements for buildings (in contemporary practice)
2.1.9	Change of use
2.1.10	External works

2.2	**Unit 2:** AS & A level
	Design and planning practices
2.2.1	Stages involved in the design process
2.2.2	Factors, including legislation and government policy, that influence the design process for buildings and assets
2.2.3	Initial project briefs
2.2.4	Producing designs
2.2.5	Virtual modelling design
2.2.6	Planning construction methods and techniques

2.3	**Unit 3:** A level
	Materials, technologies and techniques
2.3.1	Properties of materials
2.3.2	Properties of construction materials
2.3.3	Degradation of construction materials
2.3.4	Structural analysis and building comfort
2.3.5	Standards for measurements
2.3.6	Thermal comfort
2.3.7	Acoustic design of buildings and assets
2.3.8	Lighting in buildings and of assets
2.3.9	Building services systems

2.4	**Unit 4:** A level **Construction Practices**		
Pathway A **Building surveying of commercial or residential properties**		**Pathway B** **Surveying land**	
2.4.1a	Residential and commercial properties	**2.4.1b**	Linear, levelling and angular measurements
2.4.2a	Building deterioration and degradation	**2.4.2b**	Fieldwork surveys equipment
2.4.3a	Surveying equipment	**2.4.3b**	Errors
2.4.4a	Planning to conduct a building survey	**2.4.4b**	Undertaking fieldwork surveys
2.4.5a	Examining and recording findings	**2.4.5b**	Drawings of completed fieldwork surveying
2.4.6a	Completing a building survey and measured survey		

Development concepts	
2.4.7	Converting, adapting and changing the use of buildings or land
Construction management	
2.4.8	Effective management
2.4.9	Resource planning
2.4.10	Handover
2.4.11	Construction management techniques
Purchasing and financial management	
2.4.12	Purchasing methods
2.4.13	Costs and taking off quantities
2.4.14	Bill of quantities
Programme of activities	
2.4.15	Producing programmes of activities
2.4.16	Ensuring progress

2.1 AS Unit 1

Our built environment

Written examination 2 hours
50% of AS qualification
20% of A level qualification
80 marks

The examination must be conducted in accordance with *Instructions for Conducting Examinations*, available at www.jcq.org.uk.

Overview of unit

In this unit learners will develop knowledge and understanding of:

- buildings and structures
- careers, roles and organisations in the built environment
- designing and constructing substructures, superstructures and service requirements
- change of use
- external works.

Areas of content

Learners should be given the opportunity to develop their knowledge and understanding of the ten areas of content set out on pages 11 to 24.

2.1.1	The life cycle of buildings and structures
2.1.2	Low-rise and high-rise structures in the built environment
2.1.3	Professional and technical careers and roles in the built environment
2.1.4	Organisations in the built environment
2.1.5	Structures of low-rise domestic and commercial buildings
2.1.6	Designing and constructing substructures (in contemporary practice)
2.1.7	Designing and constructing superstructures (in contemporary practice)
2.1.8	Designing the services requirements for buildings (in contemporary practice)
2.1.9	Change of use
2.1.10	External works

2.1.1 The life cycle of buildings and structures

In this section learners will gain knowledge and understanding of the stages in the life cycle of buildings and structures from strategic definition to demolition/repurposing:

- design
- construction
- operation
- demolition/repurposing.

Content	Amplification
(a) The stages in the life cycle of buildings and structures, from strategic definition to demolition/ repurposing	The life cycle of a building covers the whole of its life. Learners should know the activities that take place within the following stages: Design: • strategic definition • preparation and brief • concept design • developed design • technical design. Construction: • appointment of contractors • supply of raw materials • manufacture of component parts • building of structure/assembly of prefabricated parts • installation and commissioning of services • handover to client. Operation: • occupation • use • maintenance and repair. Demolition/repurposing: • securing permissions • refurbishment, extension, alteration • removal of structure, product or waste resulting from demolition or dismantling of a structure • reuse, recovery and recycling of materials • brownfield development site opportunity and design of a new project.

2.1.2 Low-rise and high-rise structures in the built environment

In this section learners will gain knowledge and understanding of low-rise and high-rise structures in the built environment, specifically the:

- types of structures
- features of these structures
- uses and purposes of these structures.

Content	Amplification
(a) Types of structures	Learners should know the following types of structural frames: • portal frames • skeleton frames • cavity wall construction • timber framed construction • structural insulated panels and the materials used within the built environment: • structural grade timber • structural steel • precast concrete • insitu concrete • brickwork and blockwork.
(b) Features of these structures	Learners should have an understanding of the following features of each of the structural frames: Portal frames: • columns on base plates • rafters • apex and knee details • eaves beam • wind bracing • cold formed sections and connections. Skeleton frames: • columns on base plates • column to beam connection • wind bracing. Cavity wall construction: • cavity wall construction methods • Damp-proof course (DPC) • insulation • intermediate wall ties.

Content	Amplification
(b) Features of these structures (continued)	Timber framed construction: • storey height or balloon frames • binders • details of intermediate floors • cladding skin • details of insulation • vapour membranes. Structural insulated panels (SIPS): • detail cross section • jointing • cladding finishes • roof panels.
(c) Uses and purposes of these structures	Learners should understand which types of structural frame may be best suited for the following applications, and why: • residential housing • retail and commercial buildings • industrial buildings.

2.1.3 Professional and technical careers and roles in the built environment

In this section learners will gain knowledge and understanding of the professional and technical careers and roles in the built environment sector:

- architecture
- civil and structural engineering
- surveying
- site and project management
- quantity surveying
- town planning
- building services engineering.

Content	Amplification
(a) Architecture	Learners should understand: • the role of the architect • routes to professional status • the main benefits of membership of the Royal Institute of British Architects (RIBA)

(b) Civil and structural engineering	Learners should understand:
	• the role of the civil engineer
	• the role of the structural engineer
	• routes to professional status
	• the main benefits of membership of the professional institutions:
	  • Institution of Civil Engineers (ICE)
	  • Institution of Structural Engineers (IStructE)

Content	Amplification

(c) Surveying	Learners should understand:
	• the role of the surveyor:
	  • land surveyor
	  • building surveyor
	• routes to professional status
	• the main benefits of membership of the Royal Institution of Chartered Surveyors (RICS).

(d) Site and project management	Learners should understand:
	• the role of the site manager
	• additional responsibilities of the project manager
	• the main benefits of membership of the professional institutions:
	  • Chartered Institute of Building (CIOB)
	  • Association of Project Management (APM).

(e) Quantity surveying	Learners should understand: • the role of the quantity surveyor and the differences when employed on behalf of the client or the contractor • routes to professional status • the main benefits of membership of RICS.
(f) Town planning	Learners should understand: • the role of the town planner within a local authority • routes to professional status • the main benefits of membership of the Royal Town Planning Institute (RTPI).
(g) Building services engineering	Learners should understand: • the role of the building services engineer • routes to professional status • the main benefits of membership of the Chartered Institution of Building Services Engineers (CIBSE).

2.1.4 Organisations in the built environment

In this section learners will gain knowledge and understanding of organisations in the construction and built environment sector:

- small and medium-sized enterprises
- nationwide and global companies
- contracting and sub-contracting
- tendering processes and procurement exercises, and relevant rules and legislation, including the Modern Slavery Act 2015
- local authority planning departments
- trade and industry training bodies
- trade registration and development schemes.

Content	Amplification
(a) Small and medium-sized enterprises	Learners should understand that the following small and medium-sized enterprises (SMEs) operate within the built environment sector: • labour only contractors • domestic subcontractors • specialist contractors • main contractors • company groups and be aware of relevant examples of each.
(b) Nationwide and global companies	Learners should know that the following operate within the built environment sector: • nationwide companies with local offices located to serve the whole of the UK • global companies that can operate across several continents providing a range of services and be aware of relevant examples of each.
(c) Contracting and sub-contracting	Learners should know how the built environment supply chain operates and understand the role of: • domestic subcontractors • nominated subcontractors • nominated suppliers. Learners should know that the supply chain is procured through different types of contract and understand the advantages and disadvantages of the following types of contract: • traditional • negotiated • design and build.

Content	Amplification
(d) Tendering processes and procurement exercises, and relevant rules and legislation, including the Modern Slavery Act 2015	Learners should know the methods of procurement: • open tendering • select tendering from a rotated list • design and build negotiated tender • two stage tendering and understand how a tender is managed and delivered, adjudicated and awarded. Learners should be aware of procurement regulations and that public sector tenders above a certain financial threshold must be awarded using the Official Journal of the European Union (OJEU). Learners should understand the impact of the Modern Slavery Act 2015 with regards to: • requirements on organisations with respect to their business and supply chains • need for an annual slavery and human trafficking statement • organisations which have to comply.
(e) Local authority planning departments	Learners should know that the function and services of the local authority planning department involve: • planning applications • advice and guidance • enforcement • conservation, buildings and trees.
(f) Trade and industry training bodies	Learners should be aware of the following trade and industry training bodies, the types of training provided and the main benefits of membership: • Construction Industry Training Board (CITB) • Federation of Master Builders.
(g) Trade registration and development schemes	Learners should be aware of the following trade registration and development schemes: • International Organization for Standardization (ISO) registration for quality assurance design and construction systems • Considerate Constructors Scheme (CCS) • Construction Skills Certification Scheme (CSCS) • Competent Persons Register.

2.1.5 Structures of low-rise domestic and commercial buildings

In this section learners will gain knowledge and understanding of the features and characteristics of structures of low-rise domestic and commercial buildings:

- the structural forms created both on-site and off-site
- the advantages and disadvantages of different structure types
- traditional (pre-1919) structure types
- modular construction.

Content	Amplification
(a) The structural forms created both on-site and off-site	Learners should know the prefabrication techniques for primary structures using secondary components off-site: • structural steel • precast concrete • engineered timber. Learners should know the on-site structural forms of insitu concrete: • formwork and falsework • reinforcement • concrete.
(b) The advantages and disadvantages of different structure types	Learners should understand the advantages and disadvantages of the following structural forms: **Structural steel** Advantages: • off-site quality fabrication • large sections available • speed/efficiency of construction • high load capacity. Disadvantages: • specialist equipment may be required for assembly • transportation of long sections can be complex • fire protection required. **Precast concrete** Advantages: • off-site quality fabrication • large sections available • speed/efficiency of construction • fire protection is built in • elements can be pre-tensioned • floor slabs can be pre-formed. Disadvantages: • specialist equipment may be required for assembly • transportation of long sections can be complex • site jointing is more complex.

Content	Amplification
(b) The advantages and disadvantages of different structure types (continued)	**Engineered timber** Advantages: • off-site quality fabrication • large sections available • speed/efficiency of construction • sustainable resource. Disadvantages: • specialist equipment may be required for assembly • transportation of long sections can be complex • fire protection coating required • susceptible to moisture • aesthetics fade under ultraviolet (UV) light. **Insitu concrete structural forms** Advantages: • fire protection built in • can be post tensioned • high load bearing capacity • complex shapes can be formed • concrete can be pumped on site. Disadvantages: • slower process • concrete needs to hydrate • heavier structure.
(c) Traditional (pre-1919) structure types	Learners should understand the components of masonry structures: • stonework • solid brick walls • brick stepped foundations • rendered exteriors • plastered interiors • slate, lead DPC.
(d) Modular construction	Learners should understand the components of modular construction (MC): • off-site fabrication processes • on-site assembly processes • volumetric modules • steel channel framed modules • pre-finishes • serviced • advantages and disadvantages of MC.

2.1.6 Designing and constructing substructures (in contemporary practice)

In this section learners will gain knowledge and understanding of designing and constructing substructures in contemporary practice:

- methods for investigating subsoil
- producing information for foundation design
- methods for improving subsoil
- the types of building foundation
- principles for designing foundations
- basement excavation, retaining walls and damp-proof courses.

Content	Amplification
(a) Methods for investigating subsoil	Learners should understand the techniques available when undertaking a site investigation: • excavation of trial pits • borehole drilling • insitu sampling of soils, undisturbed samples and disturbed samples • soil testing and analysis.
(b) Producing information for foundation design	Learners should know that foundation design and selection relies upon accurate information regarding soil properties, and understand that the process of soil testing from laboratory or from field testing involves: • plate bearing test • penetration test • moisture content analysis • density of soils • soil classification per layer • ground water conditions and level • chemical analysis.
(c) Methods for improving subsoil	Learners should understand the methods that are available for improving the condition of the subsoil: • vibro compaction/floatation • soil mixing techniques • dynamic weight compaction • installation of drainage • grouting and injection • geotextiles and geomembranes • chemical stabilisation.
(d) The types of building foundation	Learners should understand the features of the following types of foundations: • strip • mass trench fill • raft • pad • pile • pile cap with ground beam.

Content	Amplification
(e) Principles for designing foundations	Learners should know that the design of foundations should include consideration of the following: • soil investigation report • loads to be supported • bearing capacity of soil • other soil parameters • suitable depth for the foundation • foundation area • check settlement.
(f) Basement excavation, retaining walls and damp-proof courses	Learners should know the processes included within the construction of: Basements: • excavation of basement • earth work support as work proceeds • control ground water • waterproofing method • basement construction. Retaining Walls: • types, open self-draining construction, closed solid construction • methods to resist over turning • draining of retained soil • jointing in solid walls. Damp-proof courses (DPC): • positioning above ground level • type of materials used • connection to membranes below floors.

2.1.7 Designing and constructing superstructures (in contemporary practice)

In this section learners will gain knowledge and understanding of designing and constructing superstructures in contemporary practice:

- types of ground floor construction
- types of intermediate floor construction
- designing stairs and open spaces
- types of internal wall and partitioning
- external walls and cladding
- designing openings in walls
- finishing floors and ceilings.

Content	Amplification
(a) Types of ground floor construction	Learners should know the following types of ground floor construction: • solid floor construction • traditional suspended timber floor • beam and block precast system • position of insulation within each type • position of damp-proof membrane within each type.

Content	Amplification
(b) Types of intermediate floor construction	Learners should know the following types of intermediate floor construction: • additional timber joists with herringbone strutting, tongue and grooved floorboards • precast concrete hollow core plank floors • precast concrete beam and block floors • engineered timber beams • completion of floor finish to each system.
(c) Designing stairs and open spaces	Learners should know that the design of stairs must be in accordance with the principles of the Building Regulations approved documents. Learners should understand the importance of considering: • total going, total rise required • tolerances for fitting pre-made staircases • handrails and balustrade.
(d) Types of internal wall and partitioning	Learners should know the following types of internal wall and partitioning: • solid load bearing partitions in blockwork • stud partitions installed using timber or metal studs • plastering and plasterboard finishes.
(e) External walls and cladding	Learners should know the following types of external wall and cladding: • traditional cavity wall construction • brick cladding to timber or SIPS panel frames • timber cladding • composite cladding • metal profiled cladding.
(f) Designing openings in walls	Learners should understand the following considerations when designing openings in walls: • installation and insulation of a lintel • insertion of cavity tray, stop ends and weep holes • insertion of insulated cavity closers to opening • completion of internal finishes.
(g) Finishing floors and ceilings.	Learners should know the following forms of a finished surface of floor or ceiling: • secondary floor finishes, timber floor boards, chipboard sheeting • insitu structural topping to precast flooring • installation of a screeded floor • final floor finishes, carpet, vinyl, laminate.

2.1.8 Designing the services requirements for buildings (in contemporary practice)

In this section learners will gain knowledge and understanding of designing the services requirements for buildings in contemporary practice:

- services requirements for different types of buildings
- the design of services at different points in the construction process.

Content	Amplification
(a) Services requirements for different types of buildings	Learners should understand the services requirements for different types of buildings: Commercial buildings: • movement vertically and horizontally using lifts and escalators • electrical supplies • gas supplies • water supply • communication services. Residential buildings: • electrical supplies • gas supplies • water supply • communication services. Industrial buildings: • 3 phase 400v supplies • gas supplies to boilers • water supply • communication services.
(b) The design of services at different points in the construction process	Learners should be aware that the design and requirements for services differ according to the stage of construction. Learners should be aware of: • temporary supplies required for construction, installation for water and electricity, including service protection • existing site services being retained from demolition and protected for reconnection • construction of permanent supply plantroom with service entries below ground rising into plant room, such as a consumer unit for a domestic application • construction of service distribution systems, such as cold water service distribution using pipework around a building • capacities required for each service, pipe sizing and electrical cable sizing varying.

2.1.9 Change of use

In this section learners will gain knowledge and understanding of change of use incorporating:

- altering, refurbishing and extending existing buildings
- issues of compatibility and using consistent materials
- pre-1919 buildings and structures.

Content	Amplification
(a) Altering, refurbishing and extending existing buildings	Learners should understand the issues involved in altering, refurbishing and extending existing buildings. Consideration should be given to the following: Altering existing buildings: • change in use and Planning Permissions that may be required along with Building Regulation approvals • the client/stakeholder's brief. Refurbishing existing buildings: • additional space requirements for upgrading technologies within existing building • Building Regulations approval • asbestos survey and removal • structural work required for increased loads • phasing of works, by floor, area. Extending existing buildings: • full plans application for Planning and Building Regulation approval • size of extension • connection to existing structure. Learners should be aware that changes in use can also have a significant effect on the services within buildings, such as: • incompatibility with electrical and/or heating systems • an increase or decrease in ventilation or drainage.
(b) Issues of compatibility and using consistent materials	Learners should know that the processes of altering, refurbishing and extending an existing building may cause the following issues during construction: • coordination of metric to imperial dimensions on materials such as brickwork • using modern structural frame against traditional construction • weatherproofing between structures • matching colour and texture of existing façade materials.
(c) pre-1919 buildings and structures	Learners should know that the alteration, refurbishment or extension of (traditional) buildings and structures constructed pre-1919 may raise the following issues: • coordination of metric to imperial dimensions • listed building consent and matching materials like for like, planning constraints • greater depth of foundations on new structure • matching floor levels • expansion and contraction joint between structures.

2.1.10 External works

In this section learners will gain knowledge and understanding of:

- foul and surface water drainage
- sustainable urban drainage systems
- installation/distribution of utility services
- methods for creating footpaths and roads.

Content	Amplification
(a) Foul and surface water drainage	Learners should have an understanding of foul and surface water drainage systems: • combined mains drainage systems • separate mains drainage systems • inspection chambers • manholes • connections to soil stacks • fittings, rodding eyes, gullies, pipe connectors, pipes • Part H Approved Document of the Building Regulations, drainage design, access points, falls required.
(b) Sustainable urban drainage systems	Learners should have an understanding of sustainable urban drainage systems (SuDS), including: • soakaway technology • swales • drainage ponds and basins • reed bed technology • filter strips and drains • wetland areas • rainwater harvesting • green roof technology.
(c) Installation/ distribution of utility services	Learners should understand the importance of the following in the installation and distribution of utility services: • colour coding of services • position within footpaths, depth, identification • trench construction • consumer service connection off main service.
(d) Methods for creating footpaths and roads	Learners should know the methods involved when creating footpaths and roads: • road kerbs and channels • foot path edgings • sub-bases • base courses • wearing courses • gully drainage • falls and cross falls.

2.2 AS Unit 2

Design and planning practices

Non-exam assessment (NEA): approximately 30 hours
50% of AS qualification
20% of A level qualification
80 marks

Overview of unit

In this unit learners will develop knowledge and understanding of, and skills in:

- the design process and factors that influence the design process
- developing initial project briefs
- producing designs and virtual modelling
- planning construction methods and techniques.

Learners are required to present their work for Unit 2 NEA in an appropriate manner. Typically, this might be an A4 or A3 sized document (or a document made up of a combination of both sizes, e.g. with drawings and plans on A3 and the remainder of the task on A4). However, we will accept varied forms of presentation for candidates' NEA work and centres considering alternative means of presentation should contact WJEC for advice.

Within the task, learners may include short and extended prose, digital images/photographs, annotated images/diagrams to suit the nature of the task and their interests. Whilst the form of presentation is flexible, teachers should ensure that learners' work has the potential to address all of the relevant assessment criteria.

This NEA is composed of a task based on a contextual brief set by WJEC each examinations series. WJEC will publish the contextual brief for Unit 2 of GCE Built Environment on the WJEC secure website on 01 December in the calendar year preceding the year in which the qualification is to be awarded.

Areas of content

Learners should be given the opportunity to develop their knowledge and understanding of, and skills in, the six areas of content set out on pages 26 to 38.

2.2.1	Stages involved in the design process
2.2.2	Factors, including legislation and government policy, that influence the design process for buildings and assets
2.2.3	Initial project briefs
2.2.4	Producing designs
2.2.5	Virtual modelling design
2.2.6	Planning construction methods and techniques

2.2.1 Stages involved in the design process

In this section learners will gain knowledge and understanding of the stages involved in the design process focusing on:

- stages 0–4 of the RIBA Plan of Work[2]
- the activities undertaken at each of these stages.

Content	Amplification
(a) Stages 0–4 of the RIBA Plan of Work	Learners should know the pre-construction stages of the RIBA Plan of Work: • Stage 0. Strategic definition • Stage 1. Preparation and brief • Stage 2. Concept design • Stage 3. Developed design • Stage 4. Technical design.

(b) The activities undertaken at each of these stages	Learners should be aware of the activities undertaken at each of the pre-construction stages of the RIBA Plan of Work:
	
	Stage 0. Strategic definition:
	• identify client's business case
	• establish project team
	• hold pre-application town planning discussions
	• review feedback from previous projects
	• sustainability review
	• produce strategic project brief.
	
	Stage 1. Preparation and brief:
	• develop project objectives, outcomes and budget
	• undertake feasibility studies, review site information and project programme
	• prepare project roles table and contractual tree
	• prepare handover strategy, risk assessments and project execution plan
	• confirm sustainability targets, environmental requirements and building lifespan
	• produce initial project brief.
	
	Stage 2. Concept design:
	• develop architectural concept design including:
	  • outline structural design
	  • initial building services design
	• prepare project strategies including strategies for:
	  • sustainability
	  • maintenance and operation
	  • handover
	  • construction
	  • Health and Safety
	• agree outline specifications and preliminary cost information
	• issue the final project brief.

[2] RIBA Plan of Work 2013, https://www.ribaplanofwork.com/PlanOfWork.aspx, or the most up to date version of this document.

Content	Amplification

(b) The activities undertaken at each of these stages (continued)	**Stage 3. Developed design:**
	• develop the concept design
	• coordinate architectural, structural and building services design
	• update cost information
	• submit application for planning permission.
	Stage 4. Technical design:
	• prepare technical design to include all:
	  • architectural details
	  • structural and building services information
	  • specialist subcontractor design
	• finalise material and performance specifications
	• agree procurement route
	• submit Building Regulation application
	• update project strategies and risk assessments.

2.2.2 Factors, including legislation and government policy, that influence the design process for buildings and assets

In this section learners will gain knowledge and understanding of:
- site information and constraints
- planning parameters and constraints
- statutory requirements and constraints
- environmental requirements and constraints
- social requirements and constraints
- budgetary and economic constraints
- Construction (Design and Management) regulations.

Content	Amplification
(a) Site information and constraints	Learners should know that the following information can be obtained from site: • boundaries and ground levels • ground conditions, soil types and contamination • site access, local highways and rights of way • adjoining/adjacent structures • underground services and structures • orientation and local climate • ecology and archaeological survey • gas, electrical and water infrastructures and capacity • foul sewers and drains infrastructure and capacity • flood risk, air quality and sources of noise. Learners should be aware of the constraints that site information may have on building design: • project feasibility • building location, exposure, aspect and orientation • foundation and type of substructures required • party wall legislation.

Content	Amplification
(b) Planning parameters and constraints	Learners should be aware of the parameters of the planning process: • compliance with the Local Plan and other government policies • impact on the local area • effect on trees and wildlife and the impact on any Site of Special Scientific Interest (SSSI) or Area of Outstanding Natural Beauty (AONB) • highway matters, traffic access, visibility and parking • scope of existing local facilities and local housing stock • potential loss of light or privacy to neighbouring properties • suitability for the local area, issues of conservation and listed buildings • over development • provision or retention of employment • issues concerning drainage and surface water runoff. Learners should be aware of the constraints that information gathered from the planning process may have on building design: • flood risk • contaminated land • Tree Preservation Orders (TPOs) • conservation areas • listed buildings.
(c) Statutory requirements and constraints	Learners should be aware that the National Building Regulations and Building Standards can constrain the design process, and that these Standards define: • what qualifies as 'building work' • the notification procedures that must be followed • requirements for building design and construction (Approved documents A – R). Learners should be aware that building regulations are national statutory requirements, but understand that the Welsh Government has responsibility for setting building regulations in Wales. Learners should be aware that there are other requirements arising from public bodies: • police, concerning security arrangements and lighting of public spaces • fire service, regarding means of escape, access and water supplies for fire fighting • highway authority, regarding road layouts and access • National House Building Council (NHBC) regarding standards for new housing.

Content	Amplification
(d) Environmental requirements and constraints	Learners should be aware that the following environmental parameters can constrain the design process: • the use of sustainable or hazardous materials • energy consumption and carbon emissions • air, water or ground pollution or contamination • waste and water management • noise, vibration, and dust • traffic and transport • preservation of ecology • resilience to climate change • design for deconstruction and disposal. Learners should be aware of the constraints that this information may have on building design: • project feasibility • building location • specification of sustainable materials • requirement for active and passive heating and ventilation systems • selection of energy sources • rainwater harvesting and use of grey water.
(e) Social requirements and constraints	Learners should be aware that the following social requirements can constrain the design process: • consultation with stakeholders, including the local community regarding development proposals • affordable housing provision • recreational open space • local vernacular. Learners should be aware of the constraints that this information may have on building design: • limitation on development arising from public opposition and media pressure.
(f) Budgetary and economic constraints	Learners should be aware of the impact of economic constraints on the project budget and the allocation of resources in terms of: • quality • safety • functionality • performance.

Content	Amplification
(g) Construction (Design and Management) regulations	Learners should understand that the Construction (Design and Management) Regulations (CDM) are the main set of regulations for managing the health, safety and welfare of construction projects Learners should know that CDM regulations apply to: • all building and construction work • the design phase. Learners should be aware that CDM regulations place responsibility for planning, managing, monitoring and coordinating health and safety in the pre-construction and construction phases of a project on the following duty holders: • client • principal designer • principal contractor • workers. Learners should be aware that CDM regulations require the identification, elimination or control of foreseeable risks and understand how this may be undertaken on site.

2.2.3 Initial project briefs

In this section learners will gain knowledge, understanding and skills in the process involved in creating initial project briefs:

- setting parameters of projects in relation to the factors that influence the design of buildings and assets
- setting project outcomes
- outlining possible design ideas and specifications
- writing briefs for a specific and intended audience.

Content	Amplification
(a) Setting parameters of projects in relation to the factors that influence the design of buildings and assets	Learners should understand the importance of setting project parameters based upon the following factors that influence building design: • owner or end user functional requirements • aesthetic requirements • implications arising from the physical environment • planning constraints and building regulations • resources.

(b) Setting project outcomes	Learners should understand the importance of project outcomes in terms of building function and performance:
	• outcomes for function will involve defining processes to be carried out and type of accommodation required
	• setting outcomes for performance to include owner or end user satisfaction and other aspects such as:
	  • the internal environment
	  • energy consumption and operational cost targets
	  • construction cost and sustainability targets
	  • project programme.

Content	Amplification
(c) Outlining possible design ideas and specifications	Learners should be aware that: • design ideas and specifications can be presented using drawings, plans, specifications and models: • design process is an iterative process of inputs, refinement and outputs • models are representations of a concept/design for client in consultation with stakeholders • specifications describe the materials and workmanship required.
(d) Writing briefs for a specific and intended audience	Learners should understand that the project brief is the key document upon which the design for the building will be based, including technical details intended for the professional design team and specialist contractors. The project brief may include: • a description of the client • site information • spatial requirements, including schedules of accommodation and adjacencies • technical requirements and performance standards • component requirements including lead in times • other issues, including planning requirements, budget and programme.

2.2.4 Producing designs

In this section learners will gain knowledge, understanding and skills in producing different types of designs using the practices of:

- a range of 2D and 3D sketches and drawings
- the techniques, principles and conventions of manual drawing
- technical, component and material annotations.

Content	Amplification
(a) A range of 2D and 3D sketches and drawings	Learners should be aware that original ideas are usually represented in the following forms: • 2D Sketches (these are freehand design drawings of spatial relationships, floor plans, elevational forms and site arrangements, prepared in reasonable proportion, often as overlays on scaled grids). • 3D Sketches (these are freehand design drawings of 3D forms often prepared as overlays on isometric or axonometric grids or using approximate two point perspective). Learners should be aware that design drawings are usually represented in the following forms: • 2D Drawings (these are orthographic drawings accurately prepared to scale including location plans, site plans, floor plans, construction details, elevations and sections). • 3D Drawings (these are isographic drawings accurately prepared to scale, including site layouts, construction details and perspectives).
(b) The techniques, principles and conventions of manual drawing	Learners should understand the techniques of manual drawing; the use of a drawing board with parallel motion and adjustable set square to produce outline pencil drawings and finished detailed drawings using technical drawing pens. Learners should understand the principles and conventions of manual drawing, intended to aid drafting and promote collaboration within the design team including: • sheet layout, title block and recording of revisions • dimensioning • line thickness, weight and line types • indication of elevational and sectional views.
(c) Technical, component and material annotations	Learners should understand the types of annotations which may be applied to drawings: • technical annotations – recommended minimum text sizes for notes and dimensions, headings and titles, according to sheet size • component annotations – architectural symbols for doors, windows and associated motion. Symbols for electrical and security fittings, heating equipment and sanitary ware • material annotations – cross referencing to schedules. Materials hatching, covering concrete, masonry, timber, insulation and groundworks.

2.2.5 Virtual modelling design

In this section learners will gain knowledge, understanding and skills in the use and practices of virtual modelling design:

- use of 2D and 3D virtual modelling outputs to produce different project information
- setting up virtual modelling projects and using common methodologies
- producing virtual models and rendering.

Content	Amplification

(a) Use of 2D and 3D virtual modelling outputs to produce different project information	Learners should understand the use of 2D and 3D virtual modelling to represent project information.
	
	2D virtual modelling:
	• The initial model developed is likely to include massing diagrams and 2D symbols to represent elements of the design, including:
	  • architectural form and spatial arrangements
	  • outline structural and services designs
	  • outline site and landscape design.
	• The 2D model is used to generate associated outputs, such as:
	  • outline specifications
	  • preliminary construction and phasing information
	  • general programme information and an initial elemental cost plan.
	
	3D virtual modelling:
	• A complete 3D virtualisation developed from the 2D model to include objects with specifications and method statements attached.
	• The final 3D model will include all information necessary to allow the objects in the model to be manufactured and installed or constructed.

(b) Setting up virtual modelling projects and using common methodologies	Learners should be aware of the importance of setting up modelling projects, using common methodologies with the aim of being fully collaborative. This allows early engagement of the supply chain and the introduction of sub-contractor and supplier design: • set up – the scope and nature of virtual modelling required and associated working practices are defined at the outset to enable informed procurement of consultants and specialists • common methodologies – consistency across the design and construction team in terms of compatibility of computer systems and the adoption of common standards and file formats for documents, drawings and information exchanges.

Content	Amplification
(c) Producing virtual models and rendering	Learners should be able to produce virtual modelling and rendering for projects: • producing virtual models – use of CAD software for the input and processing of building design information to output 2D and 3D images of the proposed building, that can be rotated and viewed through 360^0 • rendering – generating a photorealistic digital image from a model. The model will contain objects in a strictly defined data structure; with details on geometry, viewpoint, textures, lighting, and shading.

2.2.6 Planning construction methods and techniques

In this section learners will gain knowledge, understanding and skills of the methods and techniques used in planning construction of the built environment:

- the primary and secondary requirements of low-rise and medium-rise buildings
- the requirements for working with buildings from different periods
- contemporary construction methods for substructures and superstructures
- sustainable construction methods, techniques and considerations
- water and waste water systems design and construction
- landscape design
- site design.

Content	Amplification
(a) The primary and secondary requirements of low-rise and medium-rise buildings	Learners should be aware of the primary requirements of a low-rise building and the components typically used in the superstructure of such a building. Learners should be aware of the primary requirements of a medium-rise building and the components typically used in the superstructure of such a building. Learners should be aware of the secondary requirements of low-rise and medium-rise buildings: that common construction methods are used for the doors, windows, internal walls, staircases and internal finishes.

Content	Amplification
(b) The requirements for working with buildings from different periods	Learners should be aware that buildings may be from different periods and may include historic and listed buildings that require conservation, sustainable care and appropriate renewal. Learners should be aware that conservation may involve: • renovation – the process of improving or modernising an old, damaged or defective building • restoration – repair involving a high level of authenticity, replicating materials and techniques as closely as possible • refurbishment – the process of improvement by cleaning, decorating and re-equipping. Learners should be aware that conservation skills and workmanship may involve the following materials: • wood – use of traditional methods, craft skills, carving and materials to conserve, repair, or replace timbers that have decayed or been damaged • masonry – refurbishment and repair, including fixing, carving, pointing, grouting, cleaning, stone sourcing and matching • plasterwork – plaster matching and repair carried out in the correct material, including pure lime plasters and renders, solid run and fibrous work, free hand modelling, pattern and mould making, pargetting and other specialist finishes • brickwork – matching existing building materials, such as reproduction bricks and terracotta, and carrying out works including; structural repair, anchoring, tying, pointing and grouting to ensure the integrity and aesthetic of the building is maintained • ferrous and non-ferrous metals – including specialist leadwork in sheeting and flashings and replacement of cast iron, wrought iron and brass features.

Content	Amplification

(c) Contemporary construction methods for substructures and superstructures	Learners should be aware of the main components of the following construction methods:
	
	Substructures:
	• structural foundations, designed to suit ground conditions and to transfer building loads to the supporting ground foundation:
	  • strip footings and trench fill concrete foundations
	  • raft and pad foundations
	  • load bearing piles, friction piles and ground compactor piles
	  • ground beams and foundation walls
	• retaining walls, designed to resist pressure from retained ground and hydrostatic forces, including sheet piles, reinforced masonry/concrete walls, and gabions
	• basements, below ground level accommodation constructed using tanked floor slab and retaining walls
	• ground bearing floors – reinforced concrete slabs, with power float or screed finish and incorporating insulation and damp-proof membrane.
	
	Superstructures:
	• structural walls – solid masonry and cavity constructions, dense concrete blocks, insulating blocks and reinforced concrete cast insitu
	• frames – skeleton frames and portal frames constructed in standard or laminated timber, steel and reinforced concrete, both precast and insitu
	• traditional external cladding – brick, stone, rendered blockwork, tile hanging, brick slips, timber boarding and profiled steel sheeting on secondary steel rails
	• contemporary external cladding – including structural insulated panels (SIPs), glazed curtain walling systems and composite cladding panels
	• intermediate floors – timber joist, beam and block, reinforced concrete both precast and insitu
	• vertical circulation – timber and concrete staircases, trimming of stairwells, construction of shafts for lifts, escalators and services within primary structures
	• rooves – traditional flat and pitched roof constructions, including roof joists, rafter and purlin, trussed rafter, secondary structures between frames, insulations and finishes
	• rooves – alternative structures, vaults, domes, shell constructions and green rooves.

Content	Amplification
(d) Sustainable construction methods, techniques and considerations	Learners should be aware of the main components of sustainable construction methods: • reuse materials or components in situ, such as the structural frame, masonry façade or foundations • use reclaimed materials or components with little processing such as steel beams and columns salvaged during demolition • use materials manufactured with significant and known recycled content, for example, concrete using cement replacement materials such as Pulverised Fuel Ash (PFA) • use natural materials that have low embodied energy and/or environmental impact, such as timber in preference to steel; materials that are accredited as being responsibly sourced, for example, Forest Stewardship Council (FSC) timber. Learners should be aware that the following sustainable techniques are available for selecting construction materials less damaging to the environment: • environmental preference methods, which use star-ratings to substitute 'normal' materials with more sustainable alternatives • calculation of EcoPoints, a measure of the impact of each material according to the quantities required • carbon accounting methods, which use embodied energy or carbon dioxide emissions as the measure of impact. Learners should be aware that there are other sustainable considerations: • sourcing materials and labour locally – reducing transport of materials and associated fuel, emissions and road congestion • improving energy efficiency – use of renewable sources of energy (solar, wind, heat pumps), increasing standards of insulation and use of re-circulating ventilation/heating systems • reduce water usage – grey water systems and rainwater harvesting.

Content	Amplification
(e) Water and waste water systems design and construction	Learners should be aware of the regulations and considerations around different water and waste water systems: • rainwater and waste water removal – Building Regulations Approved Document H sets out the rules for the removal of wastewater and rainwater • waste water – regulations state that, where possible foul water should be removed via connection to the public sewer system • greywater – waste water can be treated and reused onsite for toilet flushing and irrigation, reducing the demand for fresh clean water • rainwater harvesting – the collection and storage of rainwater for reuse on-site. Rainwater can be collected from rooves and hardstanding areas, stored in underground tanks and used for irrigation • sustainable drainage systems (SuDS) – using techniques to deal with surface water runoff locally, through collection, storage, and cleaning before allowing it to be released slowly back into the environment. This alleviates peak flows to storm drains that result in flooding of urban areas and associated pollution.
(f) Landscape design	Learners should know that landscape design involves the composition, layout and specification of trees, other planting and hard landscaping features as part of a construction project on a specific site. Learners should be aware that landscape design can be applied on a wider scale, with regards to urban planning, location, layout and content of parks and civic landscapes.
(g) Site design	Learners should know that site design will involve the layout and specification of vehicular and pedestrian access routes, including roads and footpaths, parking, bicycles, delivery spaces, external seating and soft landscaping areas. Learners should be aware that building location and orientation on the site will be determined with consideration of site conditions, available views and the local climate.

2.3 A Level Unit 3

Materials, technologies and techniques
Written examination: 2 hours 30 minutes
30% of A level qualification
100 marks

The examination must be conducted in accordance with *Instructions for Conducting Examinations*, available at www.jcq.org.uk

Learners will need access to a calculator in this examination.

Overview of unit

In this unit learners will develop knowledge and understanding of, and skills in:

- properties of and degradation of materials
- structural analysis and building comfort
- standards for measurements
- thermal, acoustic and lighting considerations
- building services systems.

Areas of content
Learners should be given the opportunity to develop their knowledge and understanding of, and skills in, the nine areas of content set out on pages 40 to 57.

2.3.1	Properties of materials
2.3.2	Properties of construction materials
2.3.3	Degradation of construction materials
2.3.4	Structural analysis and building comfort
2.3.5	Standards for measurements
2.3.6	Thermal comfort
2.3.7	Acoustic design of buildings and assets
2.3.8	Lighting in buildings and of assets
2.3.9	Building services systems

The content amplification for Unit 3 includes details of how relevant mathematical techniques listed in Appendix C should be integrated into learners' study of *materials, technologies and techniques* in the built environment. The amplification includes details of all relevant mathematical techniques which learners may be asked to apply, in context, within the Unit 3 assessment.

2.3.1 Properties of materials

In this section learners will gain knowledge and understanding of:

- the properties that define the uses and purposes of materials
- the ways that materials may respond to changing conditions and situations
- the factors that cause material degradation.

Content	Amplification
(a) The properties that define the uses and purposes of materials	Learners should understand the following properties of building construction materials: • strength • toughness • hardness • brittleness • malleability • ductility • resilience • resistance to creep and slip • resistance to fatigue.
(b) The ways that materials may respond to changing conditions and situations	Learners should understand how materials respond to changes in: • air temperature, causing expansion or contraction • humidity, causing condensation, mould growth, mildew staining, damage to equipment, corrosion, decay of the building fabric and poor performance of insulation • precipitation, causing reduction in concrete compressive strength, reduction of stiffness and strength in timber and corrosion in steel.
(c) The factors that cause material degradation	Learners should know that material degradation can be caused by: • corrosion • salt crystallisation • frost damage • water damage • pollution • solar radiation • vandalism.

2.3.2 Properties of construction materials

In this section learners will gain knowledge and understanding of:

- the properties of common materials used in construction processes
- the ways in which common materials are manufactured/processed before use
- the ways in which changing temperatures affect construction materials
- the load-bearing properties of construction materials.

Content	Amplification
(a) The properties of common materials used in construction processes	Learners should understand the main properties of the following construction materials: **Concrete** Properties of concrete and their influence on durability: • high compressive strength • low tensile strength • shrinkage (due to loss of moisture by evaporation) • porosity and density • fire resistance • thermal and acoustic insulation. Properties of reinforced concrete and their influence on durability: • tolerance of tensile strain • thermal compatibility of concrete and steel. Properties of prestressed concrete and their influence on durability: • combines the compressive strength of concrete with the tensile strength of steel • versatility as a mass produced material. **Steel** Properties of steel as a construction material: • high compressive strength • high tensile strength • ductility • durability • thermal conductivity. **Stainless steel** Properties of stainless steel (as compared with steel) as a construction material: • higher corrosion resistance • higher compressive and tensile strength • higher ductility. **Timber** Properties of timber as a construction material: • aesthetics • hardness (varies according to type of wood) • light weight in comparison with some other construction materials • durability • strength along and across grain • shrinkage and swelling.

Content	Amplification
(a) The properties of common materials used in construction processes (continued)	**Bricks** Properties of brick as a construction material: • hardness • high compressive strength • flexural tensile strength • durability • frost resistance • efflorescence.
(b) The ways in which common materials are manufactured/ processed before use	Learners should understand how the following construction materials are manufactured and processed: Cement: • cement: raw materials such as limestone are crushed to provide a fine material for blending. • mortar: a paste used to bind and point building blocks typically made on-site from a mixture of sand, cement and water • concrete: a composite material, consisting mainly of cement, water and aggregate • reinforced concrete: reinforcement with steel bars or mesh for additional tensile strength • prestressed concrete: reinforcing steel bars are stretched and anchored to compress it Steel: • iron ore is mined, smelted and carbon is added (stainless steel has chromium, silicon and nickel added) • structural steel: standard column and beam sections • lightweight mild steel sections: lintels, purlins and rails • profiled sheeting: wall and roof cladding Timber: • felled logs are cut into ‘boards’ and then seasoned to remove excess water • engineered wood products (EWP) designed to overcome limitations on size and lengths of sawn timber: trussed rafters, structural sections and manufactured boards such as plywood and oriented strand board (OSB) Brick: • natural clay minerals are crushed, and additives blended to produce different shades. The mix is shaped, dried and then fired.

Content	Amplification
(c) The ways in which changing temperatures affect construction materials	Learners should know that temperature can affect the properties of construction materials. They should understand the impact on the following materials: Concrete: • abrupt temperature changes can cause cracking and spalling • aggregate expansion can produce distress within the material • high temperatures can affect compressive strength. Steel: • length, surface area and volume increase with temperature • high temperatures can cause reduction in strength and stiffness • becomes more brittle at low temperatures. Timber: • high temperatures can cause thermal expansion, warping, swelling and shrinkage • low temperatures can cause thermal contraction and warping. Brick: • high temperatures can cause bricks to absorb more water from the mortar resulting in lower bond strength • low temperatures can slow the rate of hydration in mortar leading to cracking.
(d) The load-bearing properties of construction materials	Learners should know the load bearing properties of the following construction materials: Concrete: • high compressive strength • strength increases over time. Steel: • high strength capacity in both tension and compression • high strength-to-weight ratio. Timber: • potential for good strength capacity in both tension and compression, depending on the type and shape of the timber. Brick: • high compressive strength, depending on the strength of the bricks or blocks used and the mortar.

2.3.3 Degradation of construction materials

In this section learners will gain knowledge and understanding of:

- the causes of material degradation
- measures involved in preventing and reducing degradation
- solving issues caused by material degradation
- impact on the environment.

Content	Amplification
(a) The causes of material degradation	Learners should know the following causes of material degradation, and understand how the process occurs. Corrosion: • reinforced concrete degradation can occur through corrosion of reinforcement bars • degradation of steel requires moisture and oxygen and can occur when protective coatings are damaged. Frost damage: • concrete degrades due to the cumulative effect of successive freeze-thaw cycles • spalling caused by moisture inside a brick expanding and contracting due to changes in temperature. Water damage: • water damage can cause rotting of wood, rusting of steel and de-laminating of materials such as plywood. Pollution: • acid gases such as sulphur dioxide (SO2) in the presence of moisture can accelerate the corrosion of iron and steel. Solar radiation: • plastics and wood degrade under prolonged exposure to solar radiation.
(b) Measures involved in preventing and reducing degradation	Learners should know the measures available to prevent and reduce degradation in the following materials: Reinforced concrete: • ensuring adequate concrete cover to the reinforcement bars in order to reduce moisture or salt penetration • use of an impermeable concrete mix • use of corrosion-inhibiting coatings and sealers. Steel: • use of a paint or powder coating • reduce exposure to rain or seawater • use of corrosion inhibiting chemicals.

Content	Amplification
(b) Measures involved in preventing and reducing degradation (continued)	Timber: • use of preservative treatments against decay and insect attack to coat the timber • pressure treating timber forcing preservatives into the timber. Brick: • brickwork designed to prevent the intrusion of rain and snow • use of masonry sealant designed to allow bricks to breathe.
(c) Solving issues caused by material degradation	Learners should understand how to minimise the impact of material degradation and solve issues caused in the following materials: Reinforced concrete: • stopping and preventing further degradation • treating exposed steel reinforcement • filling fissures or holes caused by cracking • strengthening concrete structures to increase the load-carrying capacity, i.e. increasing the concrete cross-section and adding material such as steel plate or fibre composites. Steel: • chemically removing corrosion • protecting from further corrosion by galvanizing, applying protective paints or coatings • replacing defective and/or loose fixings. Timber: • dry rot: reducing moisture content down to sufficiently low levels • wet rot: treating the timber with a fungicide or replacing affected timbers. Brick: • replacing broken or spalled bricks • repairing mortar joints • face grouting of hairline cracks • installing Damp-Proof Course (DPC) proof course • installing additional wall ties where the existing anchors have failed.
(d) Impact on the environment	Learners should know that air, soil and water pollution can arise as a result of material degradation. Learners should understand the potential impact of material degradation on the environment: • aesthetics • dust • vibration • noise • greater use of scarce resources and increased production of Carbon Dioxide (CO^2) as a result of increased maintenance, production or design.

2.3.4 Structural analysis and building comfort

In this section learners will gain knowledge and understanding of the application of the following techniques:

- structural analysis of buildings/assets
- impact of temperature changes on building users
- impacts of material properties on building acoustics and sounds
- determining the designs required for lighting in buildings/assets.

Content	Amplification

(a) Structural analysis of buildings/assets	Learners should understand:
	• structural loads are forces than can cause stress, deformation and displacement
	• loads that act upon a structure will vary according to the design, use, location and materials being used
	• loads are classified as either:
	  • dead loads – the structure's self-weight which generally remains constant
	  • live loads – or imposed loads are temporary or moving loads that will vary, such as traffic loads on a bridge.
	
	Learners should understand the following categories of loads:
	• concentrated (or point) loads
	• line loads
	• distributed (or surface) loads.
	
	Learners should be able to apply given formulae to calculate the maximum bending moment of:
	• simply supported beams:
	  • point load in centre WL/4
	  • point load, off centre Wab/L
	  • uniformly distributed load $wL^2/8$
	• cantilever beams:
	  • point load WL
	  • uniformly distributed load $wL^2/2$
	
	Learners should know that the maximum bending moment occurs:
	• at the mid-point in a simply supported beam carrying:
	  • a point load in the centre of the beam
	  • a uniformly distributed load
	• at the support in a cantilever beam carrying:
	  • a point load anywhere along the beam
	  • a uniformly distributed load.

Content	Amplification

(b) Impact of temperature changes on building users	Learners should understand:
	• the impact of temperature change on building users and how it varies with different building types, different building constructions and in response to how buildings are used
	• that buildings should provide thermal comfort to users and that the tendency of some buildings to increase the exposure of users to temperature changes can be compounded by other factors:
	  • social or economic factors which affect how well people are able to adapt, including the age or health of users, being on a low income or socially isolated.
	  • the availability of green space and shading surrounding the building.

(c) Impacts of material properties on building acoustics and sounds	Learners should know that building acoustics is the controlling of noise in a building and includes: • the minimisation of noise transmission from one space to another • the control of the characteristics of sound within spaces themselves. Learners should understand how building acoustics may be influenced by: • the geometry and volume of a space • the sound absorption, transmission and reflection characteristics of surfaces enclosing the space and/or within the space • the sound absorption, transmission and reflection characteristics of materials separating spaces • airborne sound transmission.
(d) Determining the designs required for lighting in buildings/assets.	Learners should understand the requirements of lighting design, including that it should enable users to see clearly and without discomfort and that careful consideration should be paid towards the selection of the appropriate lighting system, equipment, control systems and the use of daylight. Learners should know that the design process for lighting in building/assets takes account of: • the kind of human activity for which lighting is to be provided • the amount of light required • the colour of the light • the distribution of light within the space to be lit.

2.3.5 Standards for measurements

In this section learners will gain knowledge and understanding of the following:

- the rules of measurement affecting the planning of construction, installation and maintenance projects
- the rules of measurement for civil engineering projects
- producing quantities for substructures and superstructures
- producing quantities for civil engineering projects
- producing bills of quantities for building/asset projects.

Content	Amplification
(a) The rules of measurement affecting the planning of construction, installation and maintenance projects	Learners should be aware of the New Rules of Measurement (NRM) and understand that they provide a standard set of measurement rules for: • estimating • cost planning • procurement • whole-life costing for construction projects.
(b) The rules of measurement for civil engineering projects	Learners should be aware that the Civil Engineering Standard Method of Measurement (CESMM) for civil engineering projects sets out: • the procedures to which a bill of quantities should be prepared and priced • the quantities of work expressed and measured.

(c) Producing quantities for substructures and superstructures	Learners should be able to apply the appropriate rules of measurement and the mathematical techniques of:
	• addition, subtraction, multiplication and division
	• sequences
	• properties of circles
	• area and perimeter formulae of 2D shapes
	• volume and surface area formulae of 3D objects
	• area and volume of irregular or compound shapes
	• centre line calculations
	• powers, indices and roots
	• calculating averages
	to undertake the production of quantities for:
	• substructures up to and including the damp-proof course (DPC):
	  • clearing site
	  • topsoil removing
	  • excavation
	  • concrete work
	  • masonry works

Content	Amplification

(c) Producing quantities for substructures and superstructures (continued)	• superstructures above the DPC:
	  • reinforced concrete
	  • steelwork
	  • blockwork
	  • floors
	  • roof
	  • finishing
	  • windows, and doors
	  • electrical and plumbing installation.

(d) Producing quantities for civil engineering projects	Learners should be able to apply knowledge and the mathematical techniques of: • addition, subtraction, multiplication and division • sequences • properties of circles • area and perimeter formulae of 2D shapes • volume and surface area formulae of 3D objects • area and volume of irregular or compound shapes to undertake the production of quantities for civil engineering projects. This involves calculating project specific measured quantities of the items of work identified by the drawings and specifications in the tender documentation in line with the CESMM.
(e) Producing bills of quantities for building/asset projects	Learners should know that preparing a bill of quantities must be undertaken in line with the relevant rules of measurement and requires that the design is complete, and a specification has been prepared. Learners should be able to produce a bill of quantities which provides project specific measured quantities of the items of work identified by the drawings and specifications in the tender documentation. The quantities may be measured in: • number • length • area • volume • weight • time.

2.3.6 Thermal comfort

In this section learners will gain knowledge and understanding of the principles, risks affecting thermal comfort:

- the scientific principles required to understand the factors affecting the thermal comfort of buildings
- controlling and managing heat
- moisture risks to buildings, including condensation and approaches to moisture management.

Content	Amplification
(a) The scientific principles required to understand the factors affecting the thermal comfort of buildings	Learners should know that heat transfers by: • conduction • convection • radiation. Learners should understand how the mode of heat transfer can change. For example, solar radiation (heat) can be absorbed by a brick wall. The heat is then transferred by conduction through the brick, to the indoor air by convection and to indoor surfaces by radiation. Learners should understand the environmental factors that affect thermal comfort, including: • air temperature • radiant temperature • air velocity • relative humidity.
(b) Controlling and managing heat	Learners should understand the factors that should be considered when controlling the heat flow in buildings: • insulation • thermal bridges • air leakage • solar radiation • interior heat gains. Learners should know that heating and cooling systems need the following controls to regulate the operation of equipment: • a sensing device to compare actual state with target state • a control system to process input data to determine what action is required. Learners should understand how heat can be managed via a Building Management System (BMS) which can control a building's mechanical and electrical equipment: • ventilation • lighting • power systems • fire systems • security systems.

Content	Amplification
(c) Moisture risks to buildings, including condensation and approaches to moisture management	Learners should know that a building is at risk of being affected by moisture and that the risks may occur in the following forms: • damp patches and mould growth • damage to surface finishes • corrosion and decay of the building fabric • frost damage • poor performance of insulation. Learners should know the common forms of moisture risk: • surface condensation • interstitial condensation • penetrating damp. Learners should understand how moisture can be managed by: • limiting sources of moisture and increasing temperatures (air and surface) • dehumidification • natural ventilation • vapour barriers. Learners should understand how penetrating damp can be prevented by: • maintenance and repair • external treatments.

2.3.7 Acoustic design of buildings and assets

In this section learners will gain knowledge and understanding of the principles and implications of how sound is managed in the design of buildings and assets:

- the scientific/mathematic principles required to understand the way that sound is measured
- how sound is managed throughout the life cycle of buildings/assets
- the implications of sound design on building users and others.

Content	Amplification
(a) The scientific/ mathematic principles required to understand the way that sound is measured	Learners should understand the following scientific and mathematic principles that measure sound: Frequency: • cycles per second of a sound is expressed in hertz (Hz): Wavelength: • the distance between two successive sound waves. Amplitude: • the height of the sound wave. Loudness: • if the amplitude is large, the sound is said to be loud • if the amplitude doubles, the loudness is quadrupled • loudness is expressed in decibel (dB). Measurement: • energy in a sound wave is measured in dB • pitch describes its frequency and is measured in Hz: • a sound level meter is used to measure sound.
(b) How sound is managed throughout the life cycle of buildings/assets	Learners should be aware that there are relevant Building Regulations and know that: • approved Document E sets out standards for the resistance to the passage of sound in domestic buildings, in schools and flats • the standards apply to new buildings, to alterations to pre-existing premises and to buildings being converted to flats • the approved document also provides guidance on sound proofing and control of unwanted sound travel within and in-between connecting buildings • owners are responsible for ensuring buildings are compliant with relevant regulations. Learners should know that: • separating walls rely on mass or density to achieve suitable levels of acoustic insulation • separating floors typically include acoustic insulation and are overlaid with a resilient layer as a protection against impact noise • conversion projects may require additional independent panel walls and ceiling structures with absorbent materials and double boarded finish for increased mass.

Content	Amplification
(c) The implications of sound design on building users and others	Learners should know that noise pollution is an important consideration in the location, design and construction of new developments and understand that this can have negative effects on health, wellbeing and general quality of life. Learners should know that noise pollution includes: • environmental noise, such as noise from transportation sources • neighbour noise, such as noise from inside and outside adjacent buildings • noise arising from industrial, entertainment and business premises. Learners should understand how the design of building acoustics can: • help to mitigate the effects of noise pollution by providing protection against impact and airborne noise • also be significant in spaces such as concert halls, recording studios, lecture theatres, where the quality of sound is important.

2.3.8 Lighting in buildings and of assets

In this section learners will gain knowledge and understanding of:
- the types of light, both natural and artificial, which affect building/asset users
- the methods of measuring light in buildings and of assets.

Content	Amplification
(a) The types of light, both natural and artificial, which affect building/asset users	Learners should understand the use of different types of light: Natural light: • provided by vertical glazing and rooflights. Artificial lighting: • overhead lights used to provide uniform illumination throughout a space • ambient lighting, gentle illumination of an area • accent lighting, as provided by spotlights to draw attention to items • task lighting, focused local lighting such as desk lamps • emergency lighting, to provide sufficient illumination for safe evacuation • security lighting, to illuminate an area such as main entrances and external pathways. Lamps: • filament lamps - incandescent and halogen • discharge lamps - lamps and xenon arc • light-emitting diodes (LEDs). Learners should be aware that the colour temperature can change appearance related to the ‘warmth’ or ‘coolness’ of the light emitted by a lamp, expressed in Kelvin (K).

Content	Amplification
(b) The methods of measuring light in buildings and of assets	Learners should know that the following methods are used to measure light within a building: Daylight factor (DF) - the percentage of daylight available inside a room. Lux - the SI unit of illuminance, equal to one lumen per m^2. Illuminance - the amount of light received on the surface. Luminance - the amount of light reflected or emitted from a surface. Candela (cd) - the SI unit of luminous intensity. Learners should be aware that the Chartered Institution of Building Services Engineers (CIBSE) produces a series of guides about optimum lighting requirements.

2.3.9 Building services systems

In this section learners will gain knowledge and understanding of the following principles in service systems:

- the nature of energy and its use in building services systems
- the energy forms used in electrical, air conditioning, refrigeration and heating systems
- the units, calculations and methods of calculating energy use and requirements
- the links between structural design and energy consumption
- active and passive building services engineering design
- the benefits of collaborative use of Building Information Modelling (BIM) when designing structures and building services systems.

Content	Amplification
(a) The nature of energy and its use in building services systems	Learners should understand the nature of energy: • energy is the capacity to do work • when energy is converted from one form into another, it is neither created nor destroyed. Learners should know that there are several forms of energy: • kinetic • potential • heat • light • electrical • sound. Learners should understand that the use of energy in building services includes the conversion of energy from sources into outputs in the following building services systems: • building management systems • energy generation, distribution and supply • escalators and lifts • fire safety, detection and protection • heating, ventilation and air conditioning (HVAC) • ICT networks • lighting • security and alarm systems • water, drainage and plumbing.

Content	Amplification
(b) The energy forms used in electrical, air conditioning, refrigeration and heating systems	Learners should know the difference between renewable and non-renewable forms of energy and be able to categorise various forms of energy: Non-renewable forms of energy: • coal • oil • gas. Renewable forms of energy: • solar energy, converted into electricity (photovoltaics) or used to heat air or water (solar thermal) • wind energy, converted into electricity using turbines • hydroelectric power, converting the potential energy of moving water to generate electricity • geothermal power, using ground source heat energy • bioenergy, from burning biomass to generate electricity and heat.
(c) The units, calculations and methods of calculating energy use and requirements	Learners should know that energy consumption of an appliance or item of plant can be calculated as: Power (P) in watts (W) = 1000 x Energy (E) in kilowatt-hours (kWh) / consumption time period t in hours (hr) Learners should be able to apply given formulae based on P=1000E/t to calculate energy use requirements. Learners should understand how U values (thermal transmittances) are used to measure how effective elements of a building's fabric are as insulators. Learners should be aware that SAP (Standard Assessment Procedure) calculations are based on: • energy cost rating adjusted for floor area on a scale of 1 to 100 (lower ratings indicate higher running costs) • CO2 emissions adjusted for floor area (Environmental Impact rating or EI rating) • the Building Emission Rate (BER) expressed in kg/m²/year • the Target Fabric Energy Efficiency (TFEE) - the minimum energy performance requirement (kWh/(m^2.year). Learners should know that the SAP calculations consider a wide range of factors, including: • construction materials and thermal insulation of the building fabric (U values) • air leakage and ventilation equipment • efficiency and control of heating systems • solar gains • choice of fuel for space and water heating, ventilation and lighting • space cooling • renewable energy technologies.

Content	Amplification
(d) The links between structural design and energy consumption	Learners should understand how energy consumption varies according to the structural design of a building: Learners should know that: • thermal mass is the ability of a building structure to absorb and store heat and can reduce the energy required for cooling and heating • solid masonry structures and concrete provide good thermal mass • steel frames structures are not good at storing heat because of the high conductivity of steel • timber frame structures provide low thermal mass due to their lightweight structure. Learners should understand: • the concept of passive structures and how the design results in ultra-low energy consumption • the potential drivers for and barriers to the adoption of passive house design in Wales.
(e) Active and passive building services engineering design	Learners should know that the design of a building can include either active or passive services systems: Active services engineering design makes use of active building services systems, including: • boilers and chillers • mechanical ventilation • electric lighting. Passive services engineering design makes use of natural sources of heating, cooling and ventilation, including: • solar radiation • cool night air • air pressure differences. Learners should know that the main elements of integrated passive design are: • orientation • glazing • thermal mass • insulation • natural ventilation • control of air flows • zoning Learners should understand how hybrid services systems can also be utilised which use the following active systems to assist passive measures: • heat recovery ventilation • solar thermal systems • ground source heat pumps.

Content	Amplification
(f) The benefits of collaborative use of BIM when designing structures and building services systems	Learners should understand the main benefits of using BIM in a collaborative approach: • stakeholder understanding of projects because images and visualisations can be created at early stages of projects prior to any construction being undertaken • coordination between consultants on a project by drawing together all information to check that differing elements do not clash • conflict resolution because conflicts can be resolved before construction, reducing construction site conflicts • timeline sequencing to determine project key milestones and dates • support for Lean Construction Techniques • accuracy of mensuration and standardised Bill of Quantities for cost control because it allows calculation of values based on a virtual prototype of the building prior to its completion • facilities management to provide a building that meets the end users' needs including handover documents are accurate and digitally available.

2.4 A Level Unit 4

Construction practices

Non-exam assessment (NEA): approximately 40 hours
30% of A level qualification
80 marks

Overview of unit

In this unit learners will develop knowledge and understanding of, and skills in:

- surveying (properties or land)
- development concepts
- management of construction, purchasing and finance
- programmes of activities.

Learners follow one pathway through the initial section of this unit; either *building surveying of commercial or residential properties* or *surveying land.*

Learners must choose either Pathway A (sections 2.4.1a – 2.4.6a) or Pathway B (sections 2.4.1b – 2.4.5b). In addition, all learners must complete sections 2.4.7 – 2.4.16.

Learners are required to present their work for Unit 4 NEA in an appropriate manner. Typically, this might be an A4 or A3 sized document (or a document made up of a combination of both sizes). However, we will accept varied forms of presentation for candidates' NEA work and centres considering alternative means of presentation should contact WJEC for advice.

This NEA is composed of a task set by WJEC for each of the available pathways, shown in Appendix B.

Where possible, the task should be based on a property or land located in Wales. If this is not possible, when work is submitted for moderation, centres must provide an explanation why learners have chosen a property or land which is not located in Wales.

Areas of content

Subject to the rule on choice noted above, learners should be given the opportunity to develop their knowledge and understanding of, and skills in, the sixteen areas of content set out on pages 59 to 82.

Pathway A Building surveying of commercial or residential properties		Pathway B Surveying land	
2.4.1a	Residential and commercial properties	2.4.1b	Linear, levelling and angular measurements
2.4.2a	Building deterioration and degradation	2.4.2b	Fieldwork surveys equipment
2.4.3a	Surveying equipment	2.4.3b	Errors
2.4.4a	Planning to conduct a building survey	2.4.4b	Undertaking fieldwork surveys
2.4.5a	Examining and recording findings	2.4.5b	Drawings of completed fieldwork surveying
2.4.6a	Completing a building survey and measured survey		

Development concepts	
2.4.7	Converting, adapting and changing the use of buildings or land
Construction management	
2.4.8	Effective management
2.4.9	Resource planning
2.4.10	Handover
2.4.11	Construction management techniques
Purchasing and financial management	
2.4.12	Purchasing methods
2.4.13	Costs and taking off quantities
2.4.14	Bill of quantities
Programme of activities	
2.4.15	Producing programmes of activities
2.4.16	Ensuring progress

The content amplification for Unit 4 includes details of how relevant mathematical techniques listed in Appendix C should be integrated into learners' study of *construction practices* in the built environment. The amplification includes details of all relevant mathematical techniques which learners may wish to apply, in the context of their *Building Surveying* or *Surveying Land* NEA. Learners' application of mathematical techniques is likely to vary depending on the nature of their NEA work, though it should be noted that the marking criteria for both pathways refer to learners demonstrating evidence of the relevant application of mathematical principles.

Pathway A - Building surveying of commercial or residential properties

2.4.1a Residential and commercial properties	
In this section learners will gain knowledge and understanding of: • the different types of commercial and residential properties in the built environment • the architectural styles (and periods) in which commercial and residential properties are/have been built • the impact of style and type on future maintenance.	
Content	**Amplification**

(a) The different types of commercial and residential properties in the built environment	Learners should know the different type of properties within the built environment:
	• the main types of commercial properties
	  • offices
	  • retail
	  • industrial
	  • leisure
	  • healthcare
	• the main types of residential properties
	  • terraced house
	  • semi-detached house
	  • detached house
	  • bungalow
	  • flat.

(b) The architectural styles (and periods) in which commercial and residential properties are/have been built	Learners should be aware of architectural styles from the following periods: • Art Deco • Modernism • Prefabs (post WWII) • 1960s Modern Movement Architecture • Edwardian – Art Nouveau • Victorian – Arts and Crafts • Regency • Georgian.
(c) The impact of style and type on future maintenance	Learners should be aware of the characteristics of the following building materials (as used in different architectural styles) in terms of positive attributes, negative attributes and sustainability features (cost, availability and recyclability): • clay and concrete bricks/blocks • stone • slate, clay, composite roof systems and flat bitumen/single ply roof construction • timber • textiles • plaster • glass and ceramics • electrical • plumbing.

2.4.2a Building deterioration and degradation

In this section learners will gain knowledge and understanding of building deterioration and degradation with respect to:

- common defects to external envelopes of residential properties and suitable means of repair or renewal
- common internal defects of residential properties and suitable means of repair or renewal.

Content	Amplification

(a) Common defects to external envelopes of residential properties and suitable means of repair or renewal	Learners should be aware of the following common defects to the external envelopes of residential properties and suitable means of repair or renewal:
	• foundations:
	  • clay heave – expansion board products
	  • undermining from water movement – underpinning
	  • high water table – grout injection
	• walls:
	  • damp – chemical DPC injection or replacement
	  • water ingress above an opening – replacement of failed cavity trays
	  • horizontal cracking of mortar joints – cavity wall tie replacement
	  • vertical/diagonal cracking of mortar joints and masonry – replacement and 'stitch method' of reinforcement
	• rooves:
	  • water ingress – replacement of slates/tiles and membrane, service penetrations repair
	  • condensation – ventilation and insulation
	• chimneys:
	  • water ingress through stack – repair of cavity trays, soaker and flashings
	  • blockage – sweeping and endoscope services, stack 'pot' replacement
	  • cracking – vegetation removal and treatment
	• drainage and rainwater disposal systems:
	  • gutters – repair
	  • blocked waste pipes – unblocking by chemical and/or mechanical means
	  • blocked toilets – rodding and jetting
	  • maintenance – use of CCTV
	• doors and windows:
	  • excessive wear and tear or damage – repair or replacement of products or components.

Content	Amplification

(b) Common internal defects of residential properties and suitable means of repair or renewal	Learners should be aware of the following common internal defects of residential properties and suitable means of repair or renewal:
	• ground floors:
	  • dry rot – timber replacement/treatment
	• upper floors:
	  • joist failure – timber joist replacement/treatment
	• ceilings:
	  • lath and plaster – over-boarding
	• walls:
	  • cracked plaster on solid walls – replacement
	  • stud wall failures – installation of additional studs/noggins, replacement of boards
	• stairs and openings:
	  • worn/creaking stairs or damaged spindles – repair or replacement
	• drainage and rainwater disposal systems:
	  • failed drainage systems below ground – CCTV survey to identify the defect.

2.4.3a Surveying equipment

In this section learners will gain knowledge and understanding of surveying equipment with respect to:

- manual and electronic equipment
- relevant mathematical principles involved in using this equipment.

Content	Amplification

(a) Manual and electronic equipment	Learners should be aware of:
	• the types of manual and electronic equipment for inspecting, measuring and recording information, including:
	  • paper/pen/pencil
	  • mobile phone with voice recorder/camera features (or separate voice recorder and digital camera)
	  • tablet with appropriate software package(s)
	  • tape/rod/laser measuring device
	  • moisture meter
	  • spirit level
	  • torch
	  • ladder for accessing up to three metres above floor level
	  • binoculars for surveying parts of the property at high level
	• the use of this equipment to produce an accurate and detailed record of the property at the time of the inspection.

(b) Relevant mathematical principles involved in using this equipment	Learners should be able to measure: • length • area of 2D shapes • volume of 3D objects/shapes • angles, including addition and subtraction of angles. Learners should be able to use Pythagoras' theorem ($a^2 + b^2 = c^2$) when using surveying equipment.

4

2.4.4a Planning to conduct a building survey

In this section learners will gain knowledge and understanding of the following aspects of planning a building survey:

- sequence of surveying activities
- health and safety planning
- arranging access to relevant areas.

Content	Amplification
(a) Sequence of surveying activities	Learners should be aware of the stages involved in undertaking a building survey: • confirming the type of survey to be undertaken and the date and time of the survey • visiting the site and undertaking an internal and external inspection of the property, services and grounds • undertaking a desk-top study and oral enquiries for further information • producing a report of the results of the survey for the client.

Content	Amplification

(b) Health and safety planning	Learners should understand that all aspects of a building survey must be undertaken safely.
	
	Learners should be aware of:
	• the importance of risk assessment and risk management when planning and undertaking a building survey
	• the types of risk which may be encountered during a building survey, relating to working:
	  • alone
	  • at height
	  • in a building in a poor state of repair
	  • in high or low temperatures
	  • in areas with poor lighting
	  • in confined spaces
	  • in proximity to hazardous substances or materials
	• the need for relevant health and safety equipment including:
	  • mobile phone
	  • personal alarm
	  • appropriate PPE, such as protective facemask, headgear, shoes, overalls and gloves
	  • first-aid kit
	  • means of personal identification.

(c) Arranging access to relevant areas	Learners should be aware that the surveyor needs to arrange access to the property to undertake the survey. Depending on the type of survey, the surveyor may also attempt to obtain the property owner's consent for access to: • outbuildings • roof spaces. The surveyor will also seek the property owner's co-operation to ensure that: • heavy furniture does not block areas for inspection • stored items do not block access to the roof space/loft.

2.4.5a Examining and recording findings

In this section learners will gain knowledge and understanding of the following aspects relating to examining and recording findings of a building survey:

- state of repair of building elements and features
- measuring the relevant dimensions related to findings
- capturing appropriate and relevant evidence.

Content	Amplification
(a) State of repair of building elements and features	Learners should know that the surveyor gives the following condition ratings to the main parts of the property being inspected: • condition rating 3 [red] – defects that are serious and/or need to be repaired, replaced or investigated urgently • condition rating 2 [amber] – defects that need repairing or replacing but are not considered to be either serious or urgent. The property must be maintained in the normal way • condition rating 1 [green] – no repair is currently needed. The property must be maintained in the normal way.
(b) Measuring the relevant dimensions related to findings	Learners should be aware that relevant dimensions may be measured using: • paper/pencil and conventional measuring tape • laser measuring device.
(c) Capturing appropriate and relevant evidence	Learners should be aware that evidence from a building survey may be captured as: • audio or audio/visual recordings • digital images • annotated sketches/drawings • written/typed notes.

2.4.6a Completing a building survey and measured survey

In this section learners will gain knowledge and understanding of the following aspects of completing a building survey and measured survey:

- the requirements of building survey and measured survey reports
- producing scaled survey drawings.

Content	Amplification
(a) The requirements of building survey and measured survey reports	Learners should be aware that building survey reports include the following sections: • introduction to the report • about the inspection • overall assessment and summary of the condition ratings • about the property • outside the property • inside the property • services • grounds • issues for legal advisers • risks • energy efficiency • surveyor's declaration.

Content	Amplification

(a) The requirements of building survey and measured survey reports (continued)	Learners should be aware that measured survey reports:
	• include accurate drawings to scale of the building
	• include details of the:
	  • floor plan
	  • roof plan
	  • elevation
	  • cross sections
	• are specified to an agreed level of detail, accuracy tolerances and scale
	• show linear and area calculations.
	
	Learners should be aware of the types of data that may be included in building survey and measured survey reports and how those data could be presented.

(b) Producing scaled survey drawings	Learners should understand the use of: • symbols • conventions • terminology. Learners should understand the format, content and arrangement of traditional drawings in the context of the subject/work area, including: • plans • sections • elevations • freehand sketches • digital ‘marked-up’ images used to convey features and/or defects. Learners should be aware of traditional and digital drawings.

Pathway B - Surveying land

2.4.1b Linear, levelling and angular measurements	
In this section learners will gain knowledge and understanding of the following: • purpose and development of survey frameworks • measuring horizontal and sloped distances • traverse types in surveying • the purposes, principles and methods of levelling • the mathematical principles used in conducting the critical content above.	
Content	**Amplification**
(a) Purpose and development of survey frameworks	Learners should be aware of the purpose of a: • physical survey • triangulation survey • trilateration survey • traverse survey • levelling survey • radiation survey.
(b) Measuring horizontal and sloped distances	Learners should understand: • how to choose an appropriate measuring device to measure horizonal and sloped distances • the limitations of measuring devices • how to apply Pythagoras' theorem ($a^2 + b^2 = c^2$) as appropriate when measuring distances.
(c) Traverse types in surveying	Learners should understand the differences between: • closed traverse, where the lines form a circuit which ends at the starting point (used for defining woods, ponds and large areas) • open traverse, where the lines form a circuit which does not end at the starting point (used for defining a coastline, footpath or road).
(d) The purposes, principles and methods of levelling	Learners should understand the process of determining the height of one level relative to another to establish: • the elevation of a point relative to a datum • a point at a given elevation relative to a datum with consideration of: • degrees of accuracy • rise and fall method • height of plane of collimation method.
(e) The mathematical principles used in conducting the critical content above	Learners should be able to measure: • angles, including addition and subtraction of angles • polar (r, θ) and cartesian (x, y) co-ordinates • bearings. Learners should be able to use Pythagoras' theorem ($a^2 + b^2 = c^2$) and the properties of angles and lines when undertaking linear, levelling and angular measurements.

2.4.2.b Fieldwork surveys equipment	
In this section learners will gain knowledge and understanding of the use of fieldwork surveys equipment: • manual, electronic and technological equipment • interpreting the results of fieldwork surveys • the mathematical principles required when using the above equipment.	
Content	**Amplification**

(a) Manual, electronic and technological equipment	Learners should be aware of:
	• the types of manual, electronic and technological equipment
	• the use and limitations of equipment
	• the importance of:
	  • maintaining equipment
	  • securing and attending to equipment
	• how to work in pairs
	• relevant hand signals and electronic communications.

(b) Interpreting the results of fieldwork surveys	Learners should understand the importance of: • selecting the appropriate format for recording results • clearly recording data • checking data in suitable environments. Learners should be aware of the types of data that may be generated by the use of fieldwork surveys equipment and how those data could be presented.
(c) The mathematical principles required when using the above equipment	Learners should be able to calculate: • angles, including addition and subtraction of angles • polar (r, θ) and cartesian (x, y) co-ordinates • bearings. Learners should be able to use Pythagoras' theorem ($a^2 + b^2 = c^2$) and the properties of angles and lines when using fieldwork surveys equipment.

2.4.3b Errors	
In this section learners will gain knowledge and understanding of identifying, understanding and rectifying: • human/gross errors • systematic equipment errors • random errors.	
Content	**Amplification**
(a) Human/gross errors	Learners should be aware of how to identify, understand and rectify human (personnel) errors in terms of: • skills • use of equipment • environment • blunders (gross errors)/mistakes.
(b) Systematic equipment errors	Learners should understand that systemic equipment errors may relate to: • surveying equipment • observation methods • environmental factors. Learners should understand the importance of recognising: • cumulative errors • compensating errors • the need for calibrating surveying equipment.
(c) Random errors	Learners should understand: • that random errors are errors not directly related to the conditions or circumstances of the observation • the need to accept unpredictability and uncertainty • the importance of checking work.

2.4.4b Undertaking fieldwork surveys

In this section learners will gain knowledge and understanding of aspects of fieldwork surveys:

- linear surveys
- levelling surveys
- reading and recording angles on a closed traverse
- the mathematical principles required when carrying out the above tasks.

Content	Amplification
(a) Linear surveys	Learners should be aware of the following approaches to linear surveys: • direct (including use of tapes) • optical • electronic • GPS • drones.

(b) Levelling surveys	Learners should know:
	• the types of level devices
	• how to:
	  • hold the staff
	  • read the staff
	  • undertake book observations.

(c) Reading and recording angles on a closed traverse	Learners should be able to: • prepare the survey book for recording data • complete the tables with the record book • make notes for data retrieval and checking purposes.
(d) The mathematical principles required when carrying out the above tasks	Learners should be able to measure: • angles, including addition and subtraction of angles • polar (r, θ) and cartesian (x, y) co-ordinates • bearings. Learners should be able to make relevant use of: • Pythagoras' theorem ($a^2 + b^2 = c^2$) • powers, indices and roots • properties of angles and lines • properties of right-angle and non-right-angle triangles • area and perimeter formulae when undertaking fieldwork surveys.

2.4.5b Drawings of completed fieldwork surveying

In this section learners will gain knowledge and understanding of the conventions of drawings of fieldwork surveys:

- the conventions and notation required in developing drawings
- plotting survey lines accurately
- cross sections and long sections.

Content	Amplification
(a) The conventions and notation required in developing drawings	Learners should understand the use of: • symbols • conventions • terminology. Learners should understand the format, content and arrangement of traditional drawings in the context of the subject/work area: • plans • sections • elevations • isometric projection • vanishing points • freehand sketches • digital 'marked-up' images used to convey concepts, potential design solutions and defects • digital 'marked-up' screenshots taken by various devices. Learners should be aware of traditional and digital: • 1D drawings • 2D drawings • 3D drawings and the meaning and potential of 4D modelling and its use in the current built environment. Learners should be aware of the types of data that may be included in drawings of completed fieldwork surveying and how those data could be presented.
(b) Plotting survey lines accurately	Learners should understand the production of contour surveys (hand drawn or digital) to different sized 'grids of levels' such as: • 1m linear plot of ground floor internal space recording 'as-built' levels within the building • 3m x 3m 'grid of levels' of an existing surfaced area such as a car park or playground • 5m x 5m grid of levels of a field or sports pitch or rough visibly sloping ground.
(c) Cross sections and long sections	Learners should understand: • the production of large-scale cross sections of defined roads, footpaths, boundary lines or similar landmarks, using OS GB 1:25000/1:500000 map data to define these routes • the translation of the above into long sections.

Pathway A and Pathway B

Development Concepts

2.4.7 Converting, adapting and changing the use of buildings or land

In this section learners will gain knowledge and understanding of the processes involved in the conversion of buildings and land:

- investigating and evaluating alternative uses for buildings or development land
- the factors influencing the conversion, adaptation or change of use of buildings or development land
- the processes and legislative requirements involved
- feasibility reports
- working drawings for proposed ideas
- planning the use of materials that will meet development aims and user needs, including building safety requirements.

Content	Amplification
(a) Investigating and evaluating alternative uses for buildings or development land	Learners should be aware of: • use of brown field sites • type of ground remediation • change of use planning permission • mixed use developments.
(b) The factors influencing the conversion, adaptation or change of use of buildings or development land	Learners should be aware of the following factors: • shortages of development space • population growth • ageing populations • attraction of the city to the younger population • incentives for developers from Local Government • sources of funding for developing • the housing shortage.
(c) The processes and legislative requirements involved	Learners should be aware of: • the current planning acts • the current building regulation requirements.
(d) Feasibility reports	Learners should be aware of the scope and content of feasibility reports
(e) Working drawings for proposed ideas	Learners should be aware of the use of appropriate working drawings, and be able to produce drawings relevant to the scope of their NEA task.
(f) Planning the use of materials that will meet development aims and user needs, including building safety requirements	Learners should be able to plan the use of materials relevant to the scope of their NEA task, taking account of: • current Building Research Establishment Environmental Assessment Method (BREEAM) requirements for excellent ratings • choice of materials appropriate to location • local vernacular nuances of the built environment.

Construction management

2.4.8 Effective management

In this section learners will gain knowledge and understanding of:

- management and leadership style
- project management teams: roles, responsibilities, interdependencies and decision-making roles
- uses of Building Information Modelling (BIM) technologies
- contingency planning.

Content	Amplification
(a) Management and leadership style	Learners should be aware of how managers exercise their authority in the workplace to ensure objectives are achieved: • autocratic leadership • democratic/participative • laissez-faire. Learners should be aware of the difference between management and leadership.
(b) Project management teams: roles, responsibilities, interdependencies and decision-making roles	Learners should be aware of the roles, responsibilities, interdependencies and decision-making roles within: • a design office (architect) • a site delivery team (contractor) • a developers' office • a local authority.
(c) Uses of BIM technologies	Learners should be aware of the use of BIM throughout a project life cycle, and: • the advantages of using BIM when interrogating, manipulating and retrieving data • the use of 2D, 3D and 4D modelling • how BIM can be applied to existing buildings.
(d) Contingency planning	Learners should be aware of: • risk and opportunity matrices • contingency sums • risk capture of time/cost overrun • mechanisms within building contracts • collaborative approaches to contingency planning.

2.4.9 Resource planning

In this section learners will gain knowledge and understanding of:

- cash flow
- ordering and scheduling material deliveries
- human resource requirements, including health and safety needs
- plant resource needs
- site storage
- supervision of workforce and quality assurance of output.

Content	Amplification
(a) Cash flow	Learners should be able to draft a basic cash flow forecast, and be aware of the: • purpose and objectives for the client • benefits for the contractor • benefits for the supply chain.
(b) Ordering and scheduling material deliveries	Learners should be aware of the use of spreadsheet applications for ordering materials and scheduling deliveries.
(c) Human resource requirements, including health and safety needs	Learners should be aware of the need to consider: • competence of the site team • competence of the supply chain • resource schedules • package schedules.
(d) Plant resource needs	Learners should be aware of the need to consider: • plant schedule • running cost • fuel provision • insurance provision • competency of operators • security provision.
(e) Site storage	Learners should be aware of the need to consider: • size • location • supervision/security • Control of Substances Hazardous to Health (COSHH) Regulations when planning site storage needs.
(f) Supervision of workforce and quality assurance of output	Learners should be aware of the importance of the: • competency of the work force – Construction Skills Certification Scheme (CSCS) and Competent Person Scheme (CPS) • span of control of managers and supervisors.

2.4.10 Handover

In this section learners will gain knowledge and understanding of:

- Royal Institute of British Architects (RIBA) Plan of Work Stages 6 and 7
- commissioning building services installations
- health and safety files
- handover period
- the completion period and client feedback.

Content	Amplification
(a) RIBA Plan of Work Stages 6 and 7	Learners should be aware of the core objectives of RIBA Plan of Work: • Stage 6. Handover and close out • Stage 7. In use.
(b) Commissioning building services installations	Learners should be aware of: • testing regimes and certifications • methods of testing, inspecting and reporting defects to the supply chain.
(c) Health and safety files	Learners should be aware of the: • content of health and safety files • stakeholders involved during the drafting process.
(d) Handover period	Learners should be aware of the: • responsibilities of the contractor for rectifying defects during the 'defects liability period' • content of a handover plan.
(e) The completion period and client feedback	Learners should be aware of the: • Government Soft Landings (GSL) objectives • concepts of customer care and procedures for satisfaction surveys • concept of continual improvement.

2.4.11 Construction management techniques

In this section learners will gain knowledge and understanding of:

- master programmes such as lines of balance, Gantt charts and critical path analyses
- risk assessments and method statements (RAMS)
- quality assurance systems and testing methods
- management of human resources and subcontractors.

Content	Amplification
(a) Master programmes such as lines of balance, Gantt charts and critical path analyses	Learners should be aware of the use of lines of balance to: • measure progress against objectives • examine deviations from plans • identify problem areas in advance • forecast future performance. Learners should be aware of the use of Gantt charts to illustrate a project schedule, the tasks needed and the timescale, showing: • what the activities are • when each activity starts and finishes/how long it takes • where activities overlap with other activities and by how much • the start and end date for the entire project. Learners should be aware of the use of critical path analyses to map out: • key tasks/phases • the amount of time needed to finish each task • the dependencies of each task on others. Learners should be aware of the importance of considering timescales during the pre-construction, construction, handover and post construction phases of a project.
(b) Risk assessments and method statements (RAMS)	Learners should be aware of: • the difference between a risk assessment (identifying risks) and a method statement (setting out work in a logical sequence) • the concept and application of meaningful ‘control measures’ in context of ‘safe systems of work’ • the factors and variables that must be recorded to produce a risk assessment
(c) Quality assurance systems and testing methods	Learners should be aware of the importance of: • having clean and safe work areas • working to ISO 9001 • inspection test and inspection plans • hold points during the works • sign-off of work prior to ‘closing-up’ the works • methods of snagging, recording defects and defect closure working collaboratively with the supply chain.

Content	Amplification
(d) Management of human resources and subcontractors	Learners should be aware of the role of the main contractors during the construction phase of a project and how the management of the supply chain on-site is reliant on a collaborative and compliant approach to: • method statements and risk assessments • safe systems of work • competent persons.

Purchasing and financial management

2.4.12 Purchasing methods

In this section learners will gain knowledge and understanding of:

- suitable and reliable suppliers
- seeking and evaluating quotations for materials and sub-contractors
- evaluating and managing delivery lead times and managing just-in-time delivery models
- purchasing locally, sustainably, ethically and in a socially responsible way
- fixed, single and serial contracts
- using purchase orders.

Content	Amplification
(a) Suitable and reliable suppliers	Learners should be aware of the importance of identifying and using suitable and appropriate suppliers to the overall success of a built environment project.
(b) Seeking and evaluating quotations for materials and sub-contractors	Learners should be aware of the roles and responsibilities of the: • estimator • quantity surveyor.
(c) Evaluating and managing delivery lead times and managing just-in-time delivery models	Learners should be aware of the different requirements when evaluating and managing lead times when planning the procurement programme in the context of: • the target/contract programme with adequate tolerances where a site has ample storage • the target/contract programme with adequate tolerances where there is little or no storage and/or a fast track programme.
(d) Purchasing locally, sustainably, ethically and in a socially responsible way	• Learners should be aware of the: • benefits and limitations of local supply chains • importance of purchasing sustainably in an ethical and socially responsible way • value of frameworks in public sector procurement, such as South East and Mid Wales Collaborative Construction Framework (SEWSCAP).

Content	Amplification
(e) Fixed, single and serial contracts	Learners should be aware of the following types of contracts, and their main advantages and limitations: • fixed • single • serial.
(f) Using purchase orders	Learners should be aware of the key content of purchase orders, and how they are used.

2.4.13 Costs and taking off quantities

In this section learners will gain knowledge and understanding of costs:
- materials
- labour
- cost value comparisons
- managing costs/cost savings.

Content	Amplification
(a) Materials	Learners should be aware that materials costs may be based on: • area measurement • linear measurement • volume calculation.
(b) Labour	Learners should be aware that labour costs may be based on: • specialist supply chain contractors • specialist sub-contractors • traditional labour only sub-contractors • directly employed staff and operatives • skilled labour.
(c) Cost value comparisons	Learners should be aware of the importance of: • cost versus quality and the expectations of clients • quotations received from the supply chain • plant costs when making cost value comparisons.
(d) Managing costs/cost savings	Learners should be aware of the importance of: • cost, value reconciliation processes (CVRs) • risk and opportunity registers/spreadsheets • best case/worse case forecast • procurement schedules • overheads and profits when managing costs and seeking to identify opportunities for savings.

2.4.14 Bill of quantities

In this section learners will gain knowledge and understanding of:

- preliminary items
- prices
- units and dimensions
- New Rules of Measurement (NRM).

Content	Amplification
(a) Preliminary items	Learners should be aware that a bill of quantities defines the quality and quantity of works required, and that the preliminary items describe: • the project • the contractor's general obligations • general facilities • setup and running costs.
(b) Prices	Learners should be aware that: • an unpriced bill of quantities is issued to tenderers, who then estimate their price for each item • a priced bill of quantities is the unpriced bill of quantities with the tenderers' rates, costs and totals included.
(c) Units and dimensions	Learners should be familiar with the use of the following units: • linear metres • square metres • cubic metres when measuring length, area of two dimensional shapes and volume of three dimensional objects/shapes. Learners should be aware of the use of: • a traditional scale ruler to measure hard copy drawings • electronic measurement tools to measure drawings in PDF and DWG file formats.
(d) New Rules of Measurement	Learners should be aware of NRM: • NRM 1 – order of cost estimating and cost planning for building works • NRM 2 – detailed measurement for building works • NRM 3 – order of cost estimating and cost planning for building maintenance work and the relationship of the above to the current RIBA Plan of Work.

Programme of activities

2.4.15 Producing programmes of activities

In this section learners will gain knowledge and understanding of:

- selecting the most appropriate master programme
- RAMS
- site layout
- site storage
- visual monitoring tools
- site traffic management plans
- waste management plans.

Content	Amplification
(a) Selecting the most appropriate master programme	Learners should be aware of the need to consider the: • Contract Programme • Target Programme • Procurement Programme.
(b) RAMS	Learners should be aware, in the context of risk assessments and method statements, of the need to consider: • severity • likelihood • risk • harm • control measure • personal protective equipment (PPE) • safe systems of work • work permits • competent persons.
(c) Site layout	Learners should be aware of the need to consider: • location of immediate adjacent users and hazards outside the boundary • access and egress points • speed limits • segregation of operatives and vehicles • lighting • first aid • management and supervision • accommodation and welfare • work areas/zones • overhead services • existing site restrictions • buried services (new and existing).

Content	Amplification
(d) Site storage	Learners should be aware of the need to consider: • logistics • location • security • authorised persons • Control of Substances Hazardous to Health (COSHH) Regulations • supervision.
(e) Visual monitoring tools	Learners should be aware of the value of: • situational awareness • proactive site surveys • reactive attendance • continual improvement • lean management techniques.
(f) Site traffic management plans	Overlapping and integral to (c) above, learners should be aware of the need to consider: • speed limits • adjacent risks • segregation • locations of static and mobile plant working on site • supervision.
(g) Waste management plans	Learners should understand that waste management plans are developed with regard to: • national waste reduction targets • local/regional nuances • the concepts of reduce, recycle and reuse • segregation of waste • waste transfer.

2.4.16 Ensuring progress

In this section learners will gain knowledge and understanding of:

- the causes of delays and the impacts they have on projects
- overcoming delays
- facilitating ahead-of-schedule progress
- adopting and adapting contingency plans.

Content	Amplification
(a) The causes of delays and the impacts they have on projects	Learners should be aware of the possible source of delays to the construction process: • design responsibilities • change control • timely confirmation of verbal instructions/information • weather • non-compliant/poor quality workmanship • insufficient time/programme over-run • skills shortages. Learners should be aware of the effects on the above of: • scope gaps • late issuing of instructions/information • the UK climate • meaningful programming • 'cost' versus 'value for money' decisions when appointing competent contractors.
(b) Overcoming delays	Learners should be aware that common digital communication systems such as BIM provide a valuable means for overcoming delays. Learners should also be aware of the potential value of: • collaborative planning • value stream mapping • increased production opportunities • extensions of time applications • adjusting the programme.
(c) Facilitating ahead-of-schedule progress	Learners should be aware of the potential value of: • optimising collaborative planning • optimising value stream mapping • incentivising the workforce.

(d) Adopting and adapting contingency plans	Learners should be aware of the potential value of:
	• risk and opportunity matrices when reviewing the construction process
	• identification of sections or phases of the project that can be protected from delay
	• understanding the client's needs and priorities for:
	  • handover
	  • beneficial use
	  • partial possession at handover.

3 ASSESSMENT

3.1 Assessment objectives and weightings

Below are the assessment objectives for this specification. Learners must:

AO1
Demonstrate knowledge and understanding of the built environment, including the roles, practices and materials involved in its design, construction, use and maintenance.

AO2
Apply knowledge and understanding of the built environment and of the processes, stages, needs, roles and materials involved in its design, construction, use and maintenance.

AO3
Plan, develop and evaluate built environment projects that:

- meet the business, development and user needs
- at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.

The table below shows the weighting of each assessment objective for each unit and for the qualification as a whole.

AS	AO1	AO2	AO3	Total
Unit 1	35%	10%	5%	50%
Unit 2	0%	25%	25%	50%
Overall weighting	**35%**	**35%**	**30%**	**100%**

A level	AO1	AO2	AO3	Total
Unit 1	14%	4%	2%	20%
Unit 2	0%	10%	10%	20%
Unit 3	15%	9%	6%	30%
Unit 4	0%	15%	15%	30%
Overall weighting	**29%**	**38%**	**33%**	**100%**

Quality of written communication will be assessed in a specified question in each of the written examinations (Unit 1 and Unit 3) which requires extended writing.

Quality of written communication takes into account the candidate's use of specialist language. It also takes into account the candidate's spelling, punctuation and grammar.

3.2 Arrangements for non-examination assessment

Unit 2 and Unit 4 are non-exam assessments (NEA). They are internally assessed by the centre and externally moderated by WJEC. Details on arrangements for NEA are provided by the Joint Council for Qualifications (JCQ). Please refer to the JCQ website, www.jcq.org.uk for further information.

Tasks

The tasks for assessment within Unit 2 and Unit 4 are presented in Appendix B of this specification. The Unit 2 task is based on a contextualised brief set by WJEC each examinations series, and issued on 01 December in the calendar year before the award. The Unit 4 task will remain the same for the lifetime of this specification, to allow scope for learners to focus on an area of particular interest and/or the built environment local to them. There are two pathways in Unit 4: Pathway A (Building Surveying) and Pathway B (Surveying Land). The building or land which forms the focus of the surveying task should be chosen carefully to ensure learners have an opportunity to access the highest mark bands within the assessment criteria.

Pathway A: the building should, as a minimum, be a low-rise building with a footprint area of at least 75 m^2. It is important that the building presents opportunities for identifying maintenance implications along with internal and external defects.

Pathway B: the land should, as a minimum, be of around 2,500 m^2. However, the overall size of the land is less significant than its features. It is important that the land presents opportunities for the measurement of linear, levelling and angular data.

Preparation for NEA

NEA tasks may be completed and assessed at any suitable time during the course. However, centres need to ensure they have delivered the content needed for candidates to be able to access marks allocated to all aspects of the relevant NEA.

Before the course starts, the teacher is responsible for informing candidates of WJEC's regulations concerning malpractice. Candidates must not take part in any unfair practice in the preparation of work for GCE Built Environment.

Candidates must understand that information from published sources must be referenced. They should be given guidance on setting out references and be aware that they must not plagiarise other material. They should know that to present material copied directly from books or other sources without acknowledgement will be regarded as deliberate deception. Centres must report suspected malpractice to WJEC.

It is important that NEA activity is monitored by centres to ensure that candidates' work is their own. All candidates are required to sign that the work submitted is their own and teachers are required to confirm that the work is solely that of the candidate concerned and was conducted under the required conditions.

Candidates must not work together on either of their NEA tasks.

Time available for NEA

Learners should spend approximately 30 hours on their NEA task for Unit 2 and approximately 40 hours on their NEA task for Unit 4. These times refer to work completed under direct supervision in the classroom.

Investigative work may be undertaken outside the supervised time, and should not be logged as counting towards the times noted above. However, all work other than investigation must be completed under direct supervision and does count towards the times noted above.

The NEA tasks do not have a required or recommended length in words or pages.

Supervision and Monitoring of NEA

- Once the NEA is underway, candidates' work should remain within the centre at all times and be stored securely between timetabled sessions to mitigate the risks of malpractice taking place.

- Candidates **do not** need to be directly supervised at all times.

- During their NEA, the use of resources, including the internet, is not tightly prescribed and candidates may have access to such resources. However, the centre **must** ensure that:
  - there is sufficient supervision of every candidate to enable work to be authenticated
  - the work that an individual candidate submits for assessment is their own.

- Investigative work may be completed outside of the centre without direct supervision, provided that the centre is confident that the work produced is the candidate's own. Outside of the centre, candidates may:
  - have unlimited access to electronic and printed resources
  - use the internet without restriction.

- Teachers may provide guidance and support to candidates to ensure that they have a clear understanding of the requirements of the NEA tasks, the assessment and the associated marking criteria.

- Teachers may advise candidates on the suitability of the context chosen for their NEA work, with regard to the opportunity for the resulting work to address all relevant assessment requirements. Once work is underway, feedback must be limited to general advice on what needs to be improved. Teachers must not provide specific guidance on how to make these improvements.

- 'General advice' in the context of GCE Built Environment NEA includes:
  - ensuring that candidates understand the requirements of the relevant task, including the required outcome and the time available
  - ensuring that candidates' routes through the NEA have the potential to meet the requirements of the marking criteria and be of sufficient demand to achieve marks from the highest bands
  - providing guidance on the safe use of equipment and materials, and the ICT hardware and software available to candidates undertaking NEA activities.

- Within the context of 'general advice' teachers are **not allowed** to**:**
  - give a candidate detailed advice and take the lead through the NEA process
  - specify the context for the NEA activity, it must be the candidate's own decision (and within the overall context set by WJEC for Task 2)
  - correct or modify a candidate's work
  - give specific direction to a candidate in order to achieve higher marks
  - produce any form of writing frame for use within NEA activities.

- Candidates are allowed access to resources which may include information gathered outside of school/college, for example as part of their investigation, research or surveying activities.

- During the time candidates are working on their NEA, teachers must monitor progress sufficiently to be able to authenticate the work as the candidate's own (see also the information on authentication below).

- Once the task is finished and the final assessment made, no further amendments may be made.

The time spent working on each NEA task should be recorded by the teacher as a log and this may be requested by WJEC in addition to the work submitted for moderation. The log should be monitored by the centre to ensure that candidates spend approximately 30 hours and 40 hours on their relevant NEA tasks for Unit 2 and Unit 4.

Authentication

It is important that NEA work is rigorously monitored by centres to ensure that candidates' work is their own. Centres should monitor candidates' work by:

- keeping a careful record of progress during the timetabled sessions
- carefully considering whether the written evidence submitted is characteristic of the candidates' ability/attainment
- keeping work secure in the centre once the evidence is handed in
- ensuring work is not returned to the candidate to make changes.

References

References to sources of information used in NEA tasks must be acknowledged. This can be through an appended bibliography using a conventional in-text referencing system, or through footnotes.

Evidence to be submitted

Centres must assure WJEC that the evidence submitted is the work of the candidates concerned. Other than investigation activities, all work must be undertaken under direct supervision.

The teacher responsible for the supervision of the candidate's work must complete a declaration that she/he is satisfied that the evidence submitted is that of the candidate concerned.

Unit 2
A task completed by the candidate, a mark sheet completed by the assessor, signed declarations of authentication (by the teacher and the candidate) submitted to the moderator.

Unit 4 Pathway A/Pathway B
A task completed by the candidate, a mark sheet completed by the assessor, signed declarations of authentication (by the teacher and the candidate) submitted to the moderator. Where appropriate, an explanation why a learner has surveyed a building or land which is not based in Wales.

NEA coversheets must be completed for all candidates, not just those selected for moderation. The forms can be downloaded from WJEC's secure website.

Security of candidates' work

Candidates' work **must** be kept securely between timetabled NEA sessions, and until the deadline for a review of moderation has passed or until a review of moderation or appeal or malpractice investigation has been completed, whichever is the later.

Assessment criteria for Unit 2 and Unit 4 (Pathways A and B)

The assessment criteria for Unit 2 and Unit 4 (Pathways A and B) are summarised in the tables below and shown in detail in Appendix A.

Unit 2

Assessment Criteria		Assessment objective	Marks
(a)	Factors, including legislation and government policy, that influence the design process for buildings and assets	AO3	12
(b)	Initial project briefs taking account of the stages involved in the design process	AO3	12
(c)	Producing designs	AO2	16
(d)	Virtual modelling design	AO2	24
(e)	Planning and evaluating construction methods and techniques	AO3	16
			Total 80

Unit 4

Assessment Criteria		Assessment objective	Marks
(a) Pathway A only	Building surveying of commercial or residential properties	AO3	25
(a) Pathway B only	Surveying land	AO3	25
(b)	Development concepts	AO3	15
(c)	Construction management	AO2	15
(d)	Purchasing and financial management	AO2	10
(e)	Programme of activities	AO2	15
			Total 80

4 TECHNICAL INFORMATION

4.1 Making entries

This is a unitised qualification which allows for an element of staged assessment.

Assessment opportunities will be available in the summer assessment period each year, until the end of the life of this specification.

Unit 1 and Unit 2 will be available in 2023 (and each year thereafter) and the AS qualification will be awarded for the first time in summer 2023.

Unit 3 and Unit 4 will be available in 2024 (and each year thereafter) and the A level qualification will be awarded for the first time in summer 2024.

Assessment opportunities will be available in May/June each year, until the end of the life of this specification.

A qualification may be taken more than once. However, if any unit has been attempted twice and a candidate wishes to enter the unit for the third time, then the candidate will have to re-enter all units and the appropriate cash-in(s). This is referred to as a 'fresh start'. When retaking a qualification (fresh start), a candidate may have up to two attempts at each unit. However, no results from units taken prior to the fresh start can be used in aggregating the new grade(s).

Marks for either or both of the NEA units may be carried forward for the life of this specification.

If a candidate has been entered for but is absent for a unit, the absence does not count as an attempt. The candidate would, however, qualify as a resit candidate.

The entry codes appear overleaf.

	Title	Entry codes	
		English-medium	Welsh-medium
Unit 1	Our Built Environment	2509U1	2509N1
Unit 2	Design and Planning Practices	2509U2	2509N2
Unit 3	Materials, Technologies and Techniques	1509U3	1509N3
Unit 4	Construction Practices (Building Surveying)	1509UA	1509NA
Unit 4	Construction Practices (Surveying Land)	1509UB	1509NB
AS Built Environment cash-in		2509QS	2509CS
A level Built Environment cash-in		1509QS	1509CS

The current edition of our *Entry Procedures and Coding Information* gives up-to-date entry procedures.

There is no restriction on entry for this specification with any other WJEC AS or A level specification.

4.2 Grading, awarding and reporting

The overall grades for the GCE AS qualification will be recorded as a grade on a scale A to E. The overall grades for the GCE A level qualification will be recorded as a grade on a scale A* to E. Results not attaining the minimum standard for the award will be reported as U (unclassified). Unit grades will be reported as a lower case letter a to e on results slips but not on certificates.

The Uniform Mark Scale (UMS) is used in unitised specifications as a device for reporting, recording and aggregating candidates' unit assessment outcomes. The UMS is used so that candidates who achieve the same standard will have the same uniform mark, irrespective of when the unit was taken. Individual unit results and the overall subject award will be expressed as a uniform mark on a scale common to all GCE qualifications. An AS GCE has a total of 200 uniform marks and an A level GCE has a total of 500 uniform marks. The maximum uniform mark for any unit depends on that unit's weighting in the specification.

Uniform marks correspond to unit grades as follows:

		Unit grade				
Unit Weightings	**Maximum unit uniform mark**	**a**	**b**	**c**	**d**	**e**
Unit 1 (20%)	100	80	70	60	50	40
Unit 2 (20%)	100	80	70	60	50	40
Unit 3 (30%)	150	120	105	90	75	60
Unit 4 (30%)	150	120	105	90	75	60

The uniform marks obtained for each unit are added up and the subject grade is based on this total.

		Qualification grade				
	Maximum uniform marks	**A**	**B**	**C**	**D**	**E**
GCE AS	200	160	140	120	100	80
GCE A level	500	400	350	300	250	200

At A level, Grade A* will be awarded to candidates who have achieved a Grade A (400 uniform marks) in the overall A level qualification and at least 90% of the total uniform marks for the A2 units (270 uniform marks).

Appendix A

Marking Grids for Unit 2 and Unit 4

Marking Grids for Unit 2

(a) Factors, including legislation and government policy, that influence the design process for buildings and assets (2.2.2) [12 marks]	
Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*
4	**10-12 marks** • Thorough and effective consideration of a broad range of: • site • planning • statutory • environmental • social • budgetary and economic • CDM • existing building age/heritage requirements and constraints that may influence the design process for buildings and assets relevant to the task. • Critical and objective analysis of how these parameters, requirements and constraints may impact on proposals to meet business, development and user needs within the set context.
3	**7-9 marks** • Effective consideration of a range of: • site • planning • statutory • environmental • social • budgetary and economic • CDM • existing building age/heritage requirements and constraints that may influence the design process for buildings and assets relevant to the task. • A generally objective analysis of how these parameters, requirements and constraints may impact on proposals to meet business, development and user needs within the set context.

Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*
2	**4-6 marks** • Basic consideration of some: • site • planning • statutory • environmental • social • budgetary and economic • CDM • existing building age/heritage requirements and/or constraints that may influence the design process for buildings and assets relevant to the task. • Some analysis of how these parameters, requirements and/or constraints may impact on proposals to meet business, development and/or user needs within the set context.
1	**1-3 marks** • Limited consideration of requirements or constraints that may influence the design process for buildings and assets relevant to the task. • Little or no evidence of analysing how these parameters, requirements or constraints may impact on proposals to meet needs within the set context.
	0 marks Not credit worthy or not attempted.

(b) Initial project briefs, taking account of the stages involved in the design process (2.2.1 & 2.2.3) [12 marks]	
Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*

4	**10-12 marks**
	• Thorough and effective identification of:
	  • a broad range of design parameters, including functional and aesthetic requirements, relevant to the task
	  • highly relevant project outcomes, in terms of function and performance.
	• Strong evidence of:
	  • clear design ideas and detailed, relevant specifications
	  • a thorough and appropriate brief including relevant technical details for the design and construction teams
	  • close alignment with stages 0-4 of the RIBA Plan of Work, and the relevant activities undertaken at each of the five stages.

3	**7-9 marks**
	• Effective identification of:
	  • a range of design parameters, including functional and aesthetic requirements, relevant to the task
	  • relevant project outcomes, in terms of function and performance.
	• Secure evidence of:
	  • design ideas and relevant specifications
	  • an appropriate brief including relevant technical details for the design and construction teams
	  • alignment with stages 0-4 of the RIBA Plan of Work, and the activities undertaken at each of the five stages.

2	**4-6 marks**
	• Basic identification of:
	  • some design parameters, including functional and/or aesthetic requirements, which are generally relevant to the task
	  • project outcomes, in terms of function and/or performance.
	• Some evidence of:
	  • design ideas and/or specifications
	  • a brief including some technical details for the design and/or construction teams
	  • general alignment with stages 0-4 of the RIBA Plan of Work, and the activities undertaken at most of the stages.

Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*

1	**1-3 marks**
	• Limited identification of:
	  • design parameters relevant to the task
	  • project outcomes, in terms of function or performance.
	• Little or no evidence of:
	  • design ideas or specifications
	  • a brief or any technical details
	  • alignment with the RIBA Plan of Work, or the activities undertaken at any of the stages.

	0 marks Not credit worthy or not attempted.

(c) Producing designs (2.2.4) [16 marks]	
Band	**AO2:** *Apply knowledge and understanding of the built environment and of the processes, stages, needs, roles and materials involved in its design, construction, use and maintenance.*

4	**13-16 marks**
	• Excellent application of knowledge, understanding, and sophisticated and highly effective use of techniques, principles and conventions to produce:
	  • a comprehensive range of high quality 2D and 3D sketches and drawings which are relevant to the design and potential users
	  • clear and detailed technical component and material annotations.

3	**9-12 marks**
	• Good application of knowledge, understanding, and effective use of techniques, principles and conventions to produce:
	  • a range of quality 2D and 3D sketches and drawings which are relevant to the design and potential users
	  • clear technical component and material annotations.

2	**5-8 marks**
	• Basic application of knowledge, understanding, and generally effective use of techniques, principles and/or conventions to produce:
	  • 2D and 3D sketches and drawings which are generally relevant to the design and potential users
	  • some technical component and/or material annotations.

1	**1-4 marks**
	• Limited application of knowledge and understanding and little use of techniques, principles or conventions to produce:
	  • 2D or 3D sketches and drawings
	  • technical component or material annotations.

	0 marks Not credit worthy or not attempted.

(d) Virtual modelling design (2.2.5)	[24 marks]
Band	**AO2:** *Apply knowledge and understanding of the built environment and of the processes, stages, needs, roles and materials involved in its design, construction, use and maintenance.*

5	**21-24 marks**
	• Strong evidence of thorough and effective application of knowledge and understanding in the:
	  • setting up of virtual modelling projects
	  • use of common methodologies.
	• Excellent application of knowledge and understanding to produce high quality 2D and 3D virtual modelling outputs, which include:
	  • a range of sophisticated and convincing models of proposals
	  • highly effective use of rendering.

4	**16-20 marks**
	• Secure evidence of effective application of knowledge and understanding in the:
	  • setting up of virtual modelling projects
	  • use of common methodologies.
	• Good application of knowledge and understanding to produce quality 2D and 3D virtual modelling outputs, which include:
	  • a range of convincing models of proposals
	  • effective use of rendering.

3	**11-15 marks**
	• Some evidence of the application of knowledge and understanding in the:
	  • setting up of virtual modelling projects
	  • use of common methodologies.
	• Satisfactory application of knowledge and understanding to produce 2D and 3D virtual modelling outputs, which include:
	  • a range of models of proposals
	  • generally effective use of rendering.

2	**6-10 marks**
	• Basic evidence of the application of knowledge and understanding in the setting up of virtual modelling projects.
	• Basic application of knowledge and understanding to produce straightforward 2D and/or 3D virtual modelling outputs, which include:
	  • models of proposals
	  • use of rendering.

Band	**AO2:** *Apply knowledge and understanding of the built environment and of the processes, stages, needs, roles and materials involved in its design, construction, use and maintenance.*
1	**1-5 marks** • Limited evidence of the application of knowledge and understanding in the setting up of virtual modelling projects. • Limited application of knowledge and understanding to produce simple 2D or 3D virtual modelling outputs, which include outline models of proposals.
	0 marks Not credit worthy or not attempted.

(e) Planning and evaluating construction methods and techniques (2.2.6) [16 marks]	
Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*

4	**13-16 marks**
	• Strong evidence of thorough and effective planning of construction methods and techniques, including at least five of the following:
	  • the primary and secondary requirements of the building
	  • how the existing building will be conserved and how the design of the extension reflects the heritage of the existing building
	  • contemporary construction methods for substructures & superstructures
	  • sustainable construction methods, techniques and considerations
	  • water and wastewater systems
	  • landscape and site design.
	• Strong evidence of perceptive and informed judgements about how the proposed construction methods and techniques could be further developed, or improved, to better meet the needs of the intended users.

3	**9-12 marks**
	• Secure evidence of effective planning of construction methods and techniques, including at least four of the following:
	  • the primary and secondary requirements of the building
	  • how the existing building will be conserved and how the design of the extension reflects the heritage of the existing building
	  • contemporary construction methods for substructures & superstructures
	  • sustainable construction methods, techniques and considerations
	  • water and wastewater systems
	  • landscape and site design.
	• Secure evidence of reasoned judgements about how the proposed construction methods and techniques could be further developed, or improved, to better meet the needs of the intended users.

2	**5-8 marks**
	• Some evidence of planning of construction methods and techniques, including at least three of the following:
	  • the primary and secondary requirements of the building
	  • how the existing building will be conserved and how the design of the extension reflects the heritage of the existing building
	  • contemporary construction methods for substructures & superstructures
	  • sustainable construction methods, techniques and considerations
	  • water and wastewater systems
	  • landscape and site design.
	• Some evidence of judgements about how the proposed construction methods and/or techniques could be further developed, or improved, to better meet the needs of the intended users.

Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*
1	**1-4 marks** • Limited evidence of planning of construction methods or techniques, with little reference to any of the following: • requirements of the building • heritage issues • construction methods • sustainability • water or wastewater systems • landscape or site design. • Little evidence of judgements about how the proposed construction methods or techniques could be further developed.
	0 marks Not credit worthy or not attempted.

Assessment criteria	Specification content (main focus)						Mark allocation			
	Section						Total Marks	AO1 Marks	AO2 Marks	AO3 Marks
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6				
(a)		✓					**12**	0	0	12
(b)	✓		✓				**12**	0	0	12
(c)				✓			**16**	0	16	0
(d)					✓		**24**	0	24	0
(e)						✓	**16**	0	0	16
	Total marks						**80**	**0**	**40**	**40**

Marking grids for Unit 4

(a) Building surveying of commercial or residential properties (2.4.1a – 2.4.6a) **(Pathway A)** [25 marks]	
Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*

5	**21-25 marks**
	• Clear identification of property style and type, and thorough and effective consideration of relevant maintenance implications.
	• Thorough and accurate identification of a range of common external and internal defects and suitable means of repair or renewal.
	• Strong evidence of:
	  • consistently accurate and appropriate use of suitable equipment and application of relevant mathematical principles
	  • excellent survey planning, including consideration of relevant health and safety issues.
	• Excellent consideration of the requirements of clearly and accurately examining, recording and reporting surveying findings.

4	**16-20 marks**
	• Clear identification of property style and type, and effective consideration of relevant maintenance implications.
	• Accurate identification of common external and internal defects and suitable means of repair or renewal.
	• Secure evidence of:
	  • accurate and appropriate use of suitable equipment and application of relevant mathematical principles
	  • good survey planning, including consideration of health and safety issues.
	• Good consideration of the requirements of clearly and accurately examining, recording and reporting surveying findings.

3	**11-15 marks**
	• Generally clear identification of property style and type, and some consideration of relevant maintenance implications.
	• Generally accurate identification of common external and internal defects and means of repair or renewal.
	• Evidence of:
	  • generally accurate and appropriate use of equipment and application of relevant mathematical principles
	  • satisfactory survey planning, including some consideration of health and safety issues.
	• Satisfactory consideration of the requirements of accurately examining, recording and reporting surveying findings.

Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*

2	**6-10 marks**
	• Basic identification of property style and/or type, and some related maintenance implications.
	• Basic identification of some common external and/or internal defects and some means of repair or renewal.
	• Some evidence of:
	  • use of equipment and application of mathematical principles
	  • survey planning.
	• Basic consideration of the requirements of examining, recording and reporting surveying findings.

1	**1-5 marks**
	• Limited identification of property style or type, or maintenance implications.
	• Limited identification of defects.
	• Little or no evidence of:
	  • use of equipment or application of mathematical principles
	  • survey planning.
	• Little or no consideration of the requirements of examining, recording or reporting surveying findings.

	0 marks Not credit worthy or not attempted.

(a) Surveying land (2.4.1b – 2.4.5b) **(Pathway B)**	[25 marks]
Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*

5	**21-25 marks**
	• Thorough and accurate measurement and recording of a broad range of linear, levelling and angular data.
	• Strong evidence of consistently accurate and appropriate:
	  • use of suitable equipment and application of relevant mathematical principles
	  • interpretation of results
	  • identification and rectification of errors.
	• Fieldwork surveys are completed with a high level of accuracy and precision.
	• Excellent use of a broad range of drawing techniques to clearly and accurately communicate the outcomes of completed fieldwork surveys.

4	**16-20 marks**
	• Accurate measurement and recording of a range of linear, levelling and angular data.
	• Secure evidence of accurate and appropriate:
	  • use of suitable equipment and application of relevant mathematical principles
	  • interpretation of results
	  • identification and rectification of errors.
	• Fieldwork surveys are completed with accuracy and precision.
	• Good use of a range of drawing techniques to accurately communicate the outcomes of completed fieldwork surveys.

3	**11-15 marks**
	• Generally accurate measurement and recording of linear, levelling and/or angular data.
	• Evidence of generally accurate and appropriate:
	  • use of equipment and application of relevant mathematical principles
	  • interpretation of results
	  • identification and rectification of errors.
	• Fieldwork surveys are completed generally with accuracy.
	• Satisfactory use of drawing techniques to communicate generally accurate outcomes of completed fieldwork surveys.

Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*

2	**6-10 marks**
	• Some accurate measurement and recording of linear, levelling or angular data.
	• Some evidence of appropriate:
	  • use of suitable equipment and application of mathematical principles
	  • interpretation of results
	  • identification of errors.
	• Fieldwork surveys are undertaken with some accuracy.
	• Basic use of drawing techniques to communicate some outcomes of fieldwork surveys.

1	**1-5 marks**
	• Limited measurement and recording of data.
	• Limited evidence of:
	  • use of suitable equipment or application of mathematical principles
	  • interpretation of results.
	• Fieldwork surveys are undertaken with limited accuracy.
	• Limited use of drawing techniques to communicate any outcomes of fieldwork surveys.

	0 marks Not credit worthy or not attempted.

(b) Development concepts (2.4.7) **(Pathway A and B)**	[15 marks]
Band	**AO3:** *Plan, develop and evaluate built environment projects that:* • *meet the business, development and user needs* • *at A2, demonstrate skills in investigating the built environment, recording and reporting findings using appropriate methods.*
4	**13-15 marks** • Strong evidence of a thorough and effective investigation, and a perceptive, critical evaluation of alternative uses for the building/land. • Detailed, objective analysis of factors influencing the conversion, adaptation or change of use, its feasibility, and relevant processes and legislative requirements. • Excellent working drawings which clearly and accurately communicate proposed ideas. • Detailed and effective consideration of suitable materials to meet development aims and user needs.
3	**9-12 marks** • Secure evidence of an effective investigation and critical evaluation of alternative uses for the building/land. • Detailed analysis of factors influencing the conversion, adaptation or change of use, its feasibility, and relevant processes and legislative requirements. • Good working drawings which accurately communicate proposed ideas. • Effective consideration of suitable materials to meet development aims and user needs.
2	**5-8 marks** • Some evidence of investigation and evaluation of alternative uses for the building/land. • Basic analysis of some factors influencing the conversion, adaptation or change of use, its feasibility, and/or relevant processes and legislative requirements. • Basic working drawings of the main features of proposed ideas. • Basic consideration of some materials to meet development aims and/or user needs.
1	**1-4 marks** • Limited evidence of investigation or evaluation of alternative uses for the building/land. • Limited analysis of any factors influencing the conversion, adaptation or change of use, its feasibility, or relevant processes and legislative requirements. • Simplistic working drawings of proposed ideas. • Limited consideration of materials.
	0 marks Not credit worthy or not attempted.

(c) Construction management (2.4.8 – 2.4.11) **(Pathway A and B)** [15 marks]	
Band	**AO2:** *Apply knowledge and understanding of the built environment and of the processes, stages, needs, roles and materials involved in its design, construction, use and maintenance.*

4	**13-15 marks**
	• Excellent application of knowledge and understanding to produce a detailed plan of construction management activities to efficiently and effectively realise the development, including:
	  • project and construction management
	  • resource planning
	  • handover.

3	**9-12 marks**
	• Good application of knowledge and understanding to produce a plan of construction management activities to efficiently realise the development, including:
	  • project and construction management
	  • resource planning
	  • handover.

2	**5-8 marks**
	• Basic application of knowledge and understanding to produce an outline plan of some construction management activities to realise the development, including:
	  • project and construction management
	  • resource planning, and/or
	  • handover.

1	**1-4 marks**
	• Limited application of knowledge and understanding to produce a simplistic outline plan of some construction management activities to realise the development, including:
	  • project and/or construction management
	  • resource planning, or
	  • handover.

	0 marks Not credit worthy or not attempted.

(d) Purchasing and financial management (2.4.12 – 2.4.14) [10 marks] **(Pathway A and B)**	
Band	**AO2:** *Apply knowledge and understanding of the built environment and of the processes, stages, needs, roles and materials involved in its design, construction, use and maintenance.*

4	**9-10 marks**
	• Excellent application of knowledge and understanding to produce a detailed plan of purchasing and financial management activities to efficiently and effectively realise the development, including:
	  • purchasing methods
	  • cost and taking off quantities
	  • bill of quantities.

3	**6-8 marks**
	• Good application of knowledge and understanding to produce a plan of purchasing and financial management activities to efficiently realise the development, including:
	  • purchasing methods
	  • cost and taking off quantities
	  • bill of quantities.

2	**3-5 marks**
	• Basic application of knowledge and understanding to produce an outline plan of purchasing and financial management activities to realise the development, including:
	  • purchasing methods
	  • cost and taking off quantities, and/or
	  • bill of quantities.

1	**1-2 marks**
	• Limited application of knowledge and understanding to produce a simplistic outline plan of purchasing and financial management activities to realise the development, including:
	  • purchasing methods
	  • cost and taking off quantities, or
	  • bill of quantities.

	0 marks Not credit worthy or not attempted.

(e) Programme of activities (2.4.15 – 2.4.16) **(Pathway A and B)** [15 marks]	
Band	**AO2:** *Apply knowledge and understanding of the built environment and of the processes, stages, needs, roles and materials involved in its design, construction, use and maintenance.*

4	**13-15 marks**
	• Excellent application of knowledge and understanding to select an appropriate master programme and produce a detailed and realistic programme of activities including:
	  • relevant risk assessments and method statements
	  • thorough site layout, facilities and management plans.
	• Strong evidence of the application of knowledge and understanding to the selected context, to mitigate the risk of delay and help ensure progress throughout all stages of the project.

3	**9-12 marks**
	• Good application of knowledge and understanding to select an appropriate master programme and produce a realistic programme of activities including:
	  • risk assessments and method statements
	  • site layout, facilities and management plans.
	• Secure evidence of the application of knowledge and understanding to the selected context, to mitigate the risk of delay and help ensure progress throughout the project.

2	**5-8 marks**
	• Basic application of knowledge and understanding to select a master programme and produce a programme of activities including:
	  • risk assessments and/or method statements
	  • site layout, facilities and/or management plans.
	• Some evidence of the application of knowledge and understanding to the selected context to help ensure progress in the project.

1	**1-4 marks**
	• Limited application of knowledge and understanding to produce an outline programme of activities including:
	  • simplistic risk assessments or method statements
	  • site layout, facilities or management plans.
	• Little or no evidence of the application of knowledge and understanding to the selected context to help ensure progress.

	0 marks Not credit worthy or not attempted.

Unit 4

Assessment criteria	Specification content (main focus)						Mark allocation			
	Section						Total Marks	AO1 Marks	AO2 Marks	AO3 Marks
	2.4.1a	2.4.2a	2.4.3a	2.4.4a	2.4.5a	2.4.6a				
(a) Pathway A only	✓	✓	✓	✓	✓	✓	**25**	0	0	25
	Sub-total marks						**25**	**0**	**0**	**25**

Assessment criteria	Specification content (main focus)					Mark allocation			
	Section					Total Marks	AO1 Marks	AO2 Marks	AO3 Marks
	2.4.1b	2.4.2b	2.4.3b	2.4.4b	2.4.5b				
(a) Pathway B only	✓	✓	✓	✓	✓	**25**	0	0	25
	Sub-total marks					**25**	**0**	**0**	**25**

Assessment criteria	Specification content (main focus)										Mark allocation			
	Section										Total Marks	AO1 Marks	AO2 Marks	AO3 Marks
	2.4.7	2.4.8	2.4.9	2.4.10	2.4.11	2.4.12	2.4.13	2.4.14	2.4.15	2.4.16				
(b)	✓										**15**	0	0	15
(c)		✓	✓	✓	✓						**15**	0	15	0
(d)						✓	✓	✓			**10**	0	10	0
(e)									✓	✓	**15**	0	15	0
	Sub-total marks										**55**	**0**	**40**	**15**
	Total marks										**80**	**0**	**40**	**40**

Appendix B

NEA Tasks

GCE BUILT ENVIRONMENT

UNIT 2

DESIGN AND PLANNING PRACTICES

SAMPLE CONTEXTUALISED BRIEF[3]

The version for assessment in Summer 2023 will be issued on 01 December 2022

Approximately 30 hours

INSTRUCTIONS FOR CANDIDATES

Read the information overleaf carefully to make sure that you understand what is needed. Any details not provided in the contextualised brief are for you to decide.

It is important that you work independently from other candidates and make sure that what you hand in is your own unaided work.

Make sure that you check your work carefully to ensure that it is accurate and correct.

INFORMATION FOR CANDIDATES

Teachers and candidates will be required to sign a declaration that all work presented is the work of the candidate alone.

Information about the assessment of this unit is shown in Appendix A of the specification.

[3] While the contextualised brief will change each year, the published assessment criteria within Appendix A of the specification are designed to remain constant.

This task is about designing and planning a medical centre

A Welsh town has experienced significant population growth over the last ten years and projections suggest the trend is set to continue. As the population continues to rise, there is an increased demand for access to General Practitioners (GPs).

There is insufficient space for a new-build medical centre, but a derelict property has been identified for conversion into a new medical centre for the town.

The existing building is 110 years old and constructed mainly of brick. It has two storeys and a pitched roof. It has a square footprint with two equally sized rooms downstairs and four equally sized rooms upstairs. It sits in private grounds of approximately one acre in a mainly residential area.

The new medical centre must accommodate six doctors, three nurses and a receptionist. The existing building will have to be extended to address users' needs. The extension will need to be sympathetic to the heritage of the existing building.

You have been contracted to design and plan the conversion and extension of the existing building into suitable accommodation for the medical practice.

You are required to:

(a) consider relevant requirements and constraints that may influence the design of the conversion and extension, including:
- site
- planning
- statutory
- environmental
- social
- budgetary and economic
- construction (design and management) regulations (CDM)
- the existing building and its age/heritage

(b) create initial project briefs for the client which:
- set parameters
- set project outcomes
- outline possible design ideas and specifications
- take account of the activities which are required in the pre-construction stages of the plan to convert and extend the existing building

(c) produce designs for the medical centre which include:
- a range of 2D and 3D sketches and drawings
- technical, component and material annotations

(d) use virtual modelling design to produce:
- 2D and 3D virtual modelling outputs for the medical centre, including rendering

(e) consider the medical centre's requirements, including:
- the primary and secondary requirements of the building
- how the existing building will be conserved and how the design of the extension reflects the heritage of the existing building
- construction methods for substructures and superstructures
- sustainable construction methods, techniques and considerations
- water and wastewater systems
- landscape and site design

Marks are awarded for:

(a)	Considering **factors, including legislation and government policy, that influence the design process for buildings and assets** relevant to the task and how they impact on proposals to meet needs.	[12]
(b)	Creating **initial project briefs** that meet the business, development and user needs taking account of the **stages involved in the design process.**	[12]
(c)	**Producing designs** using 2D and 3D sketches and drawings, including technical, component and material annotations.	[16]
(d)	Setting up virtual modelling projects using common methodologies, and using **virtual modelling design** to produce 2D and 3D outputs including virtual models and rendering.	[24]
(e)	**Planning** and evaluating **construction methods and techniques**, considering the building's requirements, construction methods, sustainability and the site.	[16]
Total marks		**[80]**

GCE BUILT ENVIRONMENT

UNIT 4

CONSTRUCTION PRACTICES

PATHWAY A

BUILDING SURVEYING OF COMMERCIAL OR RESIDENTIAL PROPERTIES

Approximately 40 hours

INSTRUCTIONS FOR CANDIDATES

Read the information overleaf carefully to make sure that you understand what is needed.

It is important that you work independently from other candidates and make sure that what you hand in is your own unaided work.

Make sure that you check your work carefully to ensure that it is accurate and correct.

INFORMATION FOR CANDIDATES

Teachers and candidates will be required to sign a declaration that all work presented is the work of the candidate alone.

Information about the assessment of this unit is shown in Appendix A of the specification.

This task is about surveying a building in Wales and proposing how the building could be developed

Your task is to choose a residential or commercial property in Wales and then undertake a building survey of the property, produce proposals for how the building could be developed and how the project could be managed.

You are required to:

(a) plan and carry out a building survey and produce a report which shows evidence of your planning, including consideration of relevant health and safety issues, understanding of the equipment and principles involved in inspecting a property, and reporting findings in an appropriate way. The survey must include:
- details of the type and style of property and the associated maintenance implications
- identification of external and internal defects, along with suitable means of repair or renewal.

(b) produce development concepts for how the building could be converted, adapted or its use changed, taking into account:
- alternative uses for the building
- factors, including feasibility, influencing the conversion, adaptation or change of use
- relevant processes and legislative requirements
- suitable materials to meet development aims and user needs.

(c) provide appropriate details related to construction management, including:
- how the project could be managed effectively
- resource planning
- handover
- construction management techniques.

(d) provide appropriate details related to purchasing and financial management, including:
- purchasing methods
- costs and taking off quantities
- bill of quantities.

(e) produce an appropriate programme of activities, which includes details of how progress can be ensured

Marks are awarded for:

(a)	Planning and completing a **building survey of a commercial or a residential property**.	[25]
(b)	Producing **development concepts** relating to converting, adapting and changing the use of buildings.	[15]
(c)	Providing details of **construction management** activities	[15]
(d)	Providing details of **purchasing and financial management** activities.	[10]
(e)	Producing **programmes of activities** which will ensure progress.	[15]
Total marks		**[80]**

GCE BUILT ENVIRONMENT

UNIT 4

CONSTRUCTION PRACTICES

PATHWAY B

SURVEYING LAND

Approximately 40 hours

INSTRUCTIONS FOR CANDIDATES

Read the information overleaf carefully to make sure that you understand what is needed.

It is important that you work independently from other candidates and make sure that what you hand in is your own unaided work.

Make sure that you check your work carefully to ensure that it is accurate and correct.

INFORMATION FOR CANDIDATES

Teachers and candidates will be required to sign a declaration that all work presented is the work of the candidate alone.

Information about the assessment of this unit is shown in Appendix A of the specification.

This task is about surveying land in Wales and proposing how it could be developed

Your task is to choose a location in Wales and then undertake a land survey, produce proposals for how the land could be developed and how the project could be managed.

You are required to:

(a) carry out a land survey and produce a report which shows evidence of your understanding of survey frameworks, the use of fieldwork surveys equipment, relevant mathematical principles, identifying and rectifying errors and reporting findings in an appropriate way. The survey must include:
- linear, levelling and angular measurements from the fieldwork surveys
- drawings of the completed fieldwork surveys, using appropriate conventions and notation.

(b) produce development concepts for how the land could be converted, adapted or its use changed taking into account:
- alternative uses for the land
- factors, including feasibility, influencing the conversion, adaptation or change of use
- relevant processes and legislative requirements
- suitable materials to meet development aims and user needs.

(c) provide appropriate details related to construction management, including:
- how the project could be managed effectively
- resource planning
- handover
- construction management techniques.

(d) provide appropriate details related to purchasing and financial management, including:
- purchasing methods
- costs and taking off quantities
- bill of quantities.

(e) produce an appropriate programme of activities, which includes details of how progress can be ensured.

Marks are awarded for:

(a)	Completing a **land survey**.	[25]
(b)	Producing **development concepts** relating to converting, adapting and changing the use of land.	[15]
(c)	Providing details of **construction management** activities.	[15]
(d)	Providing details of **purchasing and financial management** activities.	[10]
(e)	Producing **programmes of activities** which will ensure progress.	[15]
Total marks		**[80]**

Appendix C

Mapping of mathematical techniques to Unit 3 and Unit 4 specification content

Mathematical techniques in the built environment

Through their work in built environment learners are required to apply mathematical knowledge, skills and understanding. The table below maps relevant mathematical techniques to areas of specification content where learners should have an opportunity to apply those techniques.

Mathematical techniques	Mapping to Unit 3 and Unit 4 specification content	
(a) **Algebraic techniques**		
Addition, subtraction, multiplication and division	2.3.4 (a)	Structural analysis of buildings/assets
	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.3.5 (d)	Producing quantities for civil engineering projects
	2.3.5 (e)	Producing bills of quantities for building/asset projects
	2.3.9 (c)	The units, calculations and methods of calculating energy use and requirements
	2.4.3a (b)	Relevant mathematical principles involved in using this (i.e. manual and electronic surveying) equipment
	2.4.6a (a)	The requirements of building survey and measured survey reports
	2.4.1b (b)	Measuring horizontal and sloped distances
	2.4.1b (e)	The mathematical principles used in conducting the critical content above (i.e. linear, levelling and angular measurements)
	2.4.2b (c)	The mathematical principles required when using the above (i.e. manual, electronic and technological surveying) equipment
	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks
Brackets and factors	2.3.4 (a)	Structural analysis of buildings/assets
	2.3.9 (c)	The units, calculations and methods of calculating energy use and requirements
Powers, indices and roots	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks
Sequences	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.3.5 (d)	Producing quantities for civil engineering projects

Mathematical techniques	**Mapping to Unit 3 and Unit 4 specification content**	
Rearranging formulae	2.3.4 (a)	Structural analysis of buildings/assets
	2.3.9 (c)	The units, calculations and methods of calculating energy use and requirements
(b) **Graphical techniques**		
Polar and cartesian co-ordinates	2.4.1b (e)	The mathematical principles used in conducting the critical content above (i.e. linear, levelling and angular measurements).
	2.4.2b (c)	The mathematical principles required when using the above (i.e. manual, electronic and technological surveying) equipment
	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks
(c) **Geometric techniques**		
Properties of angles and lines (radians and degrees)	2.4.1b (e)	The mathematical principles used in conducting the critical content above (i.e. linear, levelling and angular measurements).
	2.4.2b (c)	The mathematical principles required when using the above (i.e. manual, electronic and technological surveying) equipment
	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks
Pythagoras' theorem	2.4.3a (b)	Relevant mathematical principles involved in using this (i.e. manual and electronic surveying) equipment
	2.4.1b (b)	Measuring horizontal and sloped distances
	2.4.1b (e)	The mathematical principles used in conducting the critical content above (i.e. linear, levelling and angular measurements).
	2.4.2b (c)	The mathematical principles required when using the above (i.e. manual, electronic and technological surveying) equipment
	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks
Circles: circumference, perimeter, area, sector areas	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.3.5 (d)	Producing quantities for civil engineering projects
Triangles: right-angle and non-right-angle trigonometry, area, trigonometric ratios	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks

Mathematical techniques	**Mapping to Unit 3 and Unit 4 specification content**	
(d) **Mensuration**		
Area and perimeter formulae of 2D shapes	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.3.5 (d)	Producing quantities for civil engineering projects
	2.4.3a (b)	Relevant mathematical principles involved in using this (i.e. manual and electronic surveying) equipment
	2.4.6a (a)	The requirements of building survey and measured survey reports
	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks
	2.4.14 (c)	Units and dimensions
Volume and surface area formulae for 3D objects	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.3.5 (d)	Producing quantities for civil engineering projects
	2.4.3a (b)	Relevant mathematical principles involved in using this (i.e. manual and electronic surveying) equipment
Area, volume and surface area of non-standard (irregular or compound) shapes	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.3.5 (d)	Producing quantities for civil engineering projects
	2.4.3a (b)	Relevant mathematical principles involved in using this (i.e. manual and electronic surveying) equipment
	2.4.6a (a)	The requirements of building survey and measured survey reports
	2.4.4b (d)	The mathematical principles required when carrying out the above (i.e. surveying) tasks
Centre line calculations	2.3.5 (c)	Producing quantities for substructures and superstructures

Mathematical techniques	**Mapping to Unit 3 and Unit 4 specification content**	
(e) **Statistical techniques and data**		
Types of data and forms and methods of presenting data	2.4.6a (a)	The requirements of building survey and measured survey reports
	2.4.2b (b)	Interpreting the results of fieldwork surveys
	2.4.5b (a)	The conventions and notation required in developing drawings
Calculating averages and understanding cumulative frequency and standard deviation of data	2.3.5 (c)	Producing quantities for substructures and superstructures
	2.4.8 (c)	Uses of BIM technologies