Department for Education

Construction: Design, Surveying and Planning

T Level outline content: final version for approval

May 2018

Contents

Introduction

T Levels are new two-year, level 3 study programmes that include a substantial technical qualification. They will enable students to secure skilled employment, by providing a mixture of:

- practical skills and knowledge specific to their chosen industry and occupation
- at least 45 days' industry placement in their chosen industry or occupation
- English, maths and digital skills.

T Levels will become one of three major options when a student reaches level 3, alongside apprenticeships for students who wish to study and train for a specific occupation 'on the job', and A levels for students who wish to continue academic education.

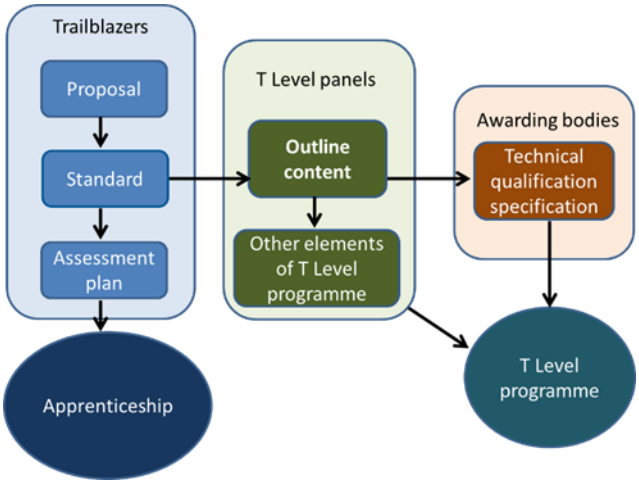
When they complete a T Level study programme, students will be able to choose between moving into a skilled occupation or further study, for example, a higher or degree level apprenticeship, or higher level technical study, including higher education.

Technical education has been categorised into fifteen different technical routes, according to occupational specialism. T Levels will be available across eleven of those routes, with occupations in the remaining four routes accessible through an apprenticeship only. Most routes have been split into a number of pathways; the T Level will broadly sit at pathway level. The occupations within scope for each T Level are set out in the Institute of Apprenticeships' occupational maps.

Outline content

This outline content has been produced by T Level panels of employers, professional bodies and providers, based on the same standards as those used for apprenticeships. The outline content will form the basis of the qualification specifications for T Level qualifications, which will be developed by awarding organisations for approval by the Institute for Apprenticeships. Awarding organisations will be appointed after a procurement process.

The diagram below demonstrates how the same standard created by employer-led Trailblazer groups is used for both apprenticeships, and as the basis for this outline content. It also shows that this outline content will be used by awarding organisations to develop the full technical qualification specification.

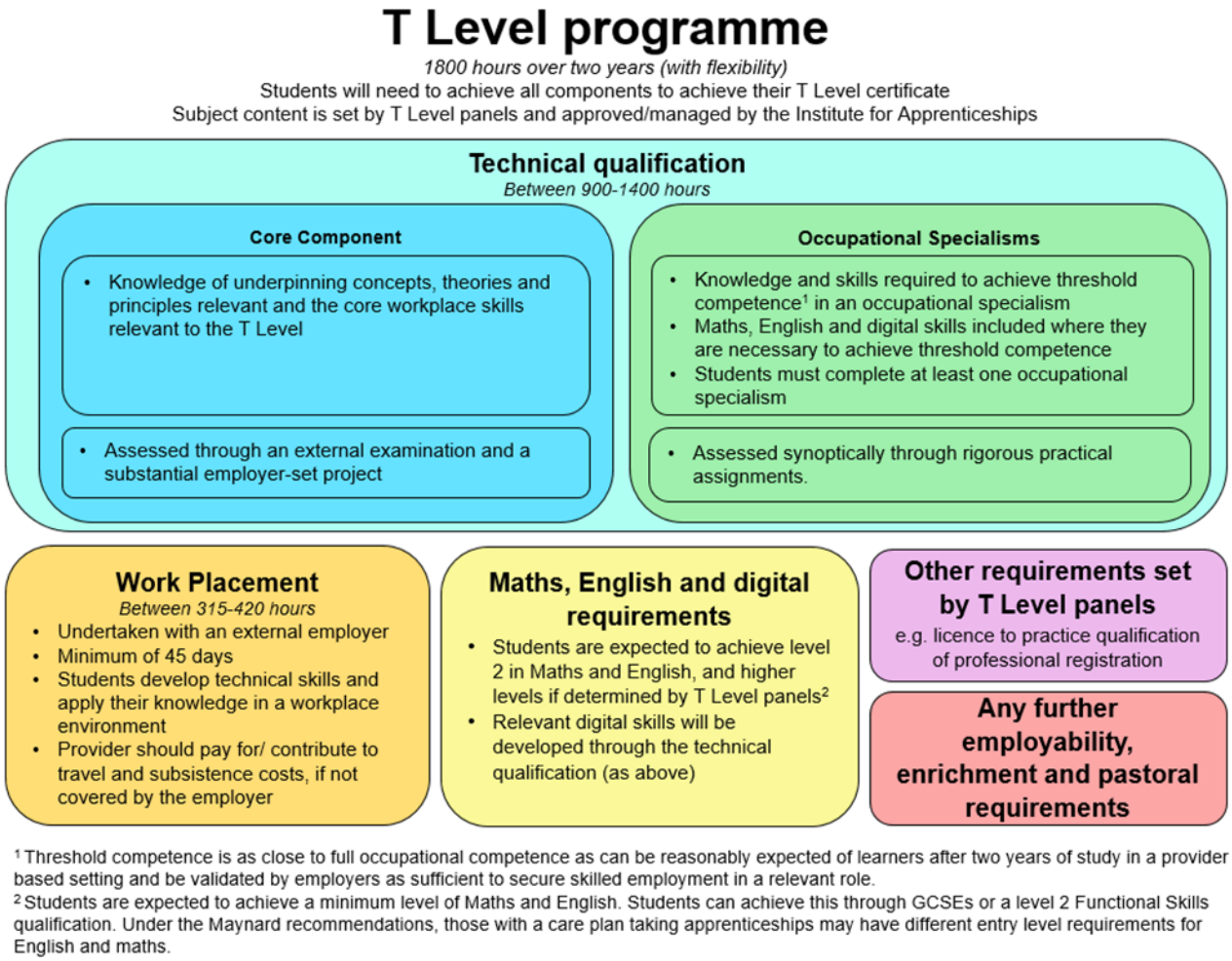


Colleges and other education and training providers will decide how to structure the T Level courses they offer, based on the qualification specifications. This will enable them to deliver the study programme's mandatory components in the most effective way for students.

T Level study programmes will include the following mandatory elements:

- a 'core' set of underpinning knowledge, concepts and skills, tailored for their chosen industry and occupation: 'core content'
- specialist training covering occupational or industry-specific skills: 'occupational specialist content'
- an industry placement with an employer, which will last for 45 working days.

The diagram below demonstrates the different elements of a T Level programme. This outline content relates solely to the technical qualification part of a T Level programme.



[1] Threshold competence is as close to full occupational competence as can be reasonably expected of learners after two years of study in a provider based setting and be validated by employers as sufficient to secure skilled employment in a relevant role.
[2] Students are expected to achieve a minimum level of Maths and English. Students can achieve this through GCSEs or a level 2 Functional Skills qualification. Under the Maynard recommendations, those with a care plan taking apprenticeships may have different entry level requirements for English and maths.

Purpose Statement

Qualification Purpose

The purpose of the level 3 technical qualification is to ensure students have the knowledge, skills and behaviours needed to progress into skilled employment or higher level technical training relevant to the T Level.[1]

To achieve this, each level 3 technical qualification must:

- provide reliable evidence of students' attainment in relation to:
    - the core knowledge and skills relevant to the route and occupational specialisms covered by the qualification
    - the knowledge skills and behaviours required for at least one occupational specialism relevant to the qualification.

- be up-to-date, providing the knowledge, skills and behaviours needed for the occupations have continued currency among employers and others.

- ensure that maths, English and digital skills are developed and applied where they are essential to achieve occupationally relevant outcomes.

- ensure that the minimum pass grade standard for occupational specialisms attests to threshold competence, meets employer expectations, and is as close to full occupational competence as possible.

- allow the accurate identification of students' level of attainment and the effective differentiation of their performance.

- provide a clear and coherent basis for development of suitably demanding high-quality level 3 courses, which enable students to realise their potential.

- provide students with the opportunity to manage and improve their own performance.

- support fair access to attainment for all students who take the qualification, including those with special educational needs and disabilities (SEND).

[1] The Institute for Apprenticeships may only approve the qualification "if satisfied that by obtaining the qualification a person demonstrates that he or she has attained as many of the outcomes set out in the standards as may reasonably be expected to be attained by undertaking a course of education" (sA2DA(3) of the 2009 Act).

Technical Qualification Design

T Level programmes will differ in length to reflect the requirements of different occupations, but are expected to last 1800 hours over two years (on average).

To accommodate legitimate differences in content across T Levels, we propose that the total time for the technical qualification:

- will fall within a defined range of between 900 and 1400 hours
- is no less than 50% of the time for the T level programme as a whole and
- is no more than 75% of the total time for the programme as a whole.

Component	Content	Assessment	Grading	Planned Hours
Core Students complete one component which covers all the core content	Knowledge and understanding of contexts, concepts, theories and principles relevant to the T Level Ability to apply core knowledge and skills, through a project, to meet employer-set requirements	Assessed through an externally set test and an employer-set project	Six point scale plus ungraded (U) A* – E and U	Between 20% and 50% of the qualification time
Occupational specialisms Students must complete at least one, or more depending on the minimum requirements specific to the qualification	Knowledge, skills and behaviours needed to achieve threshold competence	Synoptic assessment of performance outcomes, to determine whether a student meets the minimum requirements for threshold competence	Three point scale plus ungraded (U) Distinction, Merit, Pass and Ungraded	Between 50% and 80% of qualification time

Construction: Design, surveying & planning

Core Content

The core content relates to the whole route, and the pathway that the qualification covers. This content will vary depending on the requirements of the route and the pathway or occupations covered by the scope of the qualification.

The core content focuses on the students' knowledge and understanding of contexts, concepts, theories, principles and core skills relevant to the T Level. This could include, where appropriate, assessment of knowledge, understanding and skills relevant to the route and the pathway. This breadth of content will help to ensure students are able to apply their skills in a variety of contexts and for a variety of different purposes.

The core content is assessed through an examination and a practical employer-set project. Awarding organisations can integrate knowledge in the employer-set project, to contextualise core skills. The allocation of content to each type of assessment will need to be approved by the Institute for Apprenticeships.

Construction core knowledge and understanding

Element	Content
Health and safety	• Legislation, e.g. HASAWA, COSHH, Working at Height, Construction Design and Management (CDM) including an overview of roles, responsibilities and enforcement. • Liability including public liability and employers liability. • Approved codes of practice, including Managing Health and Safety in Construction. • Implications of poor health and safety performance, including ethical, legal and financial. • Development of safe systems of work, including risk assessments, method statements and permits to work. • Safety conscious behaviours, e.g. following safe systems of work, reporting potential hazards and implications of poor housekeeping.
Science	• Scientific principles, their applications, interaction between them to meet the purpose of the built

	environment and how their performance in the building is measured. • Materials science, including material properties, chemical composition, degradation, failure and effects of environmental conditions. • Mechanical science, including the relationship between force, work, energy and power. • Electricity, including sources of power, generation, transformation, distribution and the relationship between voltage, current, resistance, electrical power, energy, efficiency and work done. • Structural science, including forces, loads, materials, and structural members. • Heat, including heat transfer, air temperature, air density humidity, condensation air movement, heat loss, thermal conductivity and resistance. • Light, including refraction, difference in artificial and natural light, glare, directed and reflected light, flow of light energy and daylight factor. • Acoustics, including frequencies, reverberation, decibels, comfort levels and privacy. • Earth science, including physical geography, hydrology, geology, earth forces, natural phenomenon (e.g. earthquakes) and weather.
Design	• Importance of design. • Design principles, e.g. buildability and integration of services. • Role of different disciplines involved in design. • Design process. • Human factors, e.g. heat, acoustics, lighting and air quality. • Understanding of the whole building, including life cycle assessment.

Construction & the built environment industry	• Structure of the construction industry. • How the construction industry serves the economy as a whole. • Integration of the supply chain through partnering and collaborative practices. • Types of procurement and contracts. • Roles and responsibilities of all trades. • Professional bodies, accreditation and certification bodies and the role of CPD. • Building information modelling, including Digital Plan of Works (DPoW), Employer's Information Requirements (EIR), Common Data Environment (CDE), information exchange and the effect on project delivery. • How current examples of PESTLE factors may impact the industry.
Sustainability	• Importance of sustainability. • Types of sustainable solutions, e.g. social, environmental, economic and human. • Obligations under environmental legislation, e.g. Clean Air Act and Water Act. • Environmental policies and initiatives. • Environmental performance measures. • Principles of heritage and conservation, e.g. listed buildings, traditional buildings and maintenance of existing stock. • Lean construction including reduce, repurpose and recycle. • Waste management. • Energy (including embodied energy).
Measurement	• Purposes of measurement. • Types of measurement, including standard units of measurement and mensuration techniques.

	• Measurement standards, guidance and practice including measurement rules.
Building Technology	• Construction methods, including traditional and modern methods, e.g. on and off-site construction and robotics. • Forms of structures, sub-structures, superstructures, foundations and external works. • Principles of building regulations and their purpose in renovation and construction. • Principles of building standards and their purpose in renovation and construction including ISO, British and industry. • Principles of manufacturers' instruction and their purpose in renovation and construction. • Internet of things, e.g. data capture in a completed building, utilising data for manufacture and delivery and machine to machine learning. • Key elements of data, including accuracy, generalisation, interoperability, level of detail and metadata. • Purpose of information standards, regulation, and guidance and practice. • Sources of information, e.g. product data and manufacturer's specifications. • Data management and confidentiality including data protection legislation and typical organisational procedures.
Information and data	• Key elements of data, including accuracy, generalisation, interoperability, level of detail and metadata. • Purpose of information standards, regulation, and guidance and practice. • Sources of information, e.g. product data and manufacturer's specifications. • Data management and confidentiality, including data protection legislation and typical organisational procedures.

Relationship Management	• Types of stakeholders, e.g. client, team and end user. • Roles, expectations and interrelationships of different stakeholders throughout the project delivery. • The importance of a collaborative approach to project delivery and reporting, and how this is applied in practice. • Customer service principles, e.g. product knowledge, time and communication. • The importance of team work. • Team dynamics, including what is expected of a team member, what qualities are needed and how these qualities are demonstrated. • Equality, diversity and representation including related legislation. • Negotiation techniques. • Conflict management techniques. • Methods and styles of communication and suitability for different situations. • Employment rights and responsibilities of the employer and employee. • Ethics and ethical behaviour. • How sources of information, including social networking contribute to knowledge sharing.
Digital Technology	• Internet of things, e.g. machine to machine learning and asset reporting. • Digital engineering techniques. • Opportunities for the use of technology in construction and the built environment.
Commercial/Business	• Business structures, e.g. community interest companies and SMEs. • Business objectives, e.g. financial and social. • Business values, e.g. care for life, ethical and transparent, commit to customer and better together.

	• Principles and examples of corporate social responsibility. • Principles of entrepreneurship and innovation. • How businesses measure success, e.g. benchmarking, KPIs and target setting. • Principles of project management.

Design, surveying & planning pathway knowledge and understanding

Element	Content
Project management	• Principles of project management. • Principles of quantification and costing. • Financial control. • Project management whole lifecycle and work stages. • Types of procurement. • Project and construction risk management.
Law	• English legal system. • Land law, including planning, land ownership and boundaries. • Permissions required to undertake survey work, including geospatial, e.g. Drone use / unmanned aircraft systems CAA regulations. • Law of contract including types of contracts used in construction. • Law of tort. • Law of landlord and tenant. • Building regulations. • Intellectual property. • Employment law. • Duty of care.

Employer-set project

The employer-set project ensures students have the opportunity to combine core knowledge and skills to develop a substantial piece of work in response to an employer-set brief.

To ensure consistency in project scope and demand, awarding organisations will develop assessment objectives which require learners to:

- plan their approach to meeting the brief.
- apply core knowledge and skills as appropriate.
- select relevant techniques and resources to meet the brief.
- use maths, English and digital skills as appropriate.
- realise a project outcome and review how well the outcome meets the brief.

The awarding organisation will work with a relevant employer or employers to devise a set brief that:

- ensures a motivating starting point for students' projects, for example, a real-world problem to solve.
- ensures students can generate evidence that covers the assessment objectives.
- is manageable for providers to deliver.
- is officially approved by the AO and employer.

For design, surveying and planning, in achieving the assessment objectives and meeting the brief students must demonstrate the following core skills:

- communication, e.g. providing information and advice to customers and / or wider stakeholders on the potential risks of a project, or making a relevant presentation to a stakeholder on a proposed design.
- work with others, e.g. to develop content for a tender document.
- applying a logical approach to solving problems, identifying issues and proposing solutions, e.g. through setting performance criteria for a design, using cost / benefit analysis of any potential negative effects of a system or solution.
- primary research, e.g. obtaining measurements related to a design and / or customer requirements.

Occupational Specialist Content

Specialist content is structured into different occupational specialisms, which correspond to the apprenticeship standards listed on the occupational map covered by the T Level. Occupational specialisms ensure students develop the knowledge, skills and behaviours necessary to achieve ‘threshold competence’ in the occupational specialism.

Achievement of threshold competence signals that a student is well-placed to develop full occupational competence, with further support and development, once in work (including an apprenticeship). The knowledge and skills listed are required to achieve one or more ‘performance outcomes’. These indicate what the student will be able to do as a result of learning and applying the specified knowledge and skills.

In essence, each performance outcome describes, at a high level, what the student ‘can do’ to have achieved threshold competence in an occupational specialism.

Occupational Specialist Content

Occupational Specialism: Surveying and design for construction and the built environment

Performance Outcome 1: Measure the built environment

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Law • Permissions required to undertake survey work including geospatial, e.g. drone use. **Digital Technology** • Internet of things, e.g. machine to machine. • Geospatial equipment, their applications, suitability and use. • Digital engineering techniques and appropriate software. • Geospatial information conveyance and sourcing, e.g. GIS, cartographic and other commercially available data.	• Explore requirements of the task using open questioning and listening. • Gather information from appropriate sources specific to the scope of works including GIS. • Determine the level of accuracy required. • Capture data using appropriate measurement methods. • Process data using appropriate techniques. • Extract and manage data using appropriate techniques. • Quality assure the measurements. • Communicate health and safety risks associated with the task and environment using appropriate methods, e.g. briefing. • Assess health and safety risks associated with the task and environment. • Select and use tools and equipment with accuracy and efficiency, e.g. electronic measurement devices, automatic levels, lasers, scanners and global positioning systems. • Operate equipment and perform tasks safely.	**Maths** Process data. Understand data. Communicate using mathematics. Optimise work processes. Measure with precision. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written).

Measurement • Types of measurement and detection. • How to capture, process, manage, use and quality assure data, including geospatial. • Calculations required and how to undertake them. • The principle and limitations of measurement. • Techniques used to gather data, including geospatial data. • The importance of coordinating systems, projects, transformations and datums. • Measurement standards, guidance and practice, including measurement rules. • Good survey practice, e.g. whole to the part, local vs national and error propagation.	• Manage waste.	Read, understand and synthesise written information. Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. **Digital** Collate, manage, access and use digital data in spreadsheets, databases and other formats. Gather and organise information from different digital sources. Follow licensing guidelines, using only approved and licensed software applications.

Performance Outcome 2: Analyse the built environment

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Project management • Project programmes, e.g. relevance and techniques for reporting. • Digital workflows, e.g. the relevance and use of digital engineering techniques, protocols, BIM Execution Plans (BEPs), Employer's Information Requirements (EIR) and Common Data Environments (CDE).	• Sequence and prioritise tasks. • Analyse information available to determine requirements of the task. • Interpret information and data, including from visual and other sources. • Convey data, e.g. measurement and cost data using appropriate techniques.	**Maths** Process data. Understand data. Optimise work processes. Measure with precision. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. **Digital**

		Gather and organise information from different digital sources. Adopt professional approaches to using digital communications and social media.

Performance Outcome 3: Design the built environment

Knowledge Specific to Performance Outcome	**Skills**	**Maths, English and Digital**
Design • How designs are prepared, including design briefs, work stages, schedules, specifications, recommendations and programmes. • Detailed designs. • Statutory obligations. • The use and importance of specifications, e.g. as applicable to design guides and legislation. • The relevance of measurement in the design process, e.g. area (net and gross) volumes, height and length. **Health and safety** • The CDM Regulations 2015 and the duties of the designer. • The identification and design of hazards and risks and methods of	• Identify information and data required to complete the task. • Quality assure information and data, including 3rd party expertise. • Conduct precedent research, including best practice, benchmarks and design guides. • Use suitable data. • Model design using digital software and other tools and techniques. • Present appropriate design information and data using different methods and formats. • Manage data in a collaborative environment, e.g. common data environment. • Communicate design and construction risks using appropriate methods, e.g. Design Risk Assessments (CDM 2015).	**Maths** Process data. Understand data. Optimise work processes. Communicate using mathematics. Measure with precision. Work with proportion. Cost a project. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written).

assessment, e.g. Design Risk Assessments (CDM 2015). • Fire and Emergency Safety, e.g. the Hackitt Review. **Relationship management** • Negotiation, mediation and conflict management techniques. • Consultation requirements, e.g. the expertise input of 3rd party knowledge. • Processes of collaborative design, e.g. coordination of team input and clash management. **Sustainability** • How sustainable design principles influence the design process. **Digital Technology** • Digital design tools, e.g. Computer Aided Design (CAD). • Digital specification tools, e.g. the NB, BS1192. • Digital data, e.g. spreadsheets and schedules. • Digital presentation, image handling and desk top publishing, e.g. brochures and reports	• Manage relationships, e.g. the application of techniques for negotiation, mediation and conflict management. • Provide creative solutions to challenges arising from requirements. • Adapt design proposals in response to design constraints, and stakeholder feedback in terms of time, cost and material factors.	Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). **Digital** Adopt professional approaches to using digital communications and social media. Make use of standard analytical tools in applications to better interpret information. Design and create new digital artefacts and materials, such as digital writing, digital imaging, digital audio and video, digital code, apps and interfaces and web pages.

Performance Outcome 4: Verify delivery of the built environment

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Sustainability • Legal obligations. • Environmental performance measures. • Principles of heritage and conservation. **Valuations** • Valuation standards, guidance and practice. • Valuation benchmarking. **Measurements** • Types of measurement for the combined data, e.g. cross checking interfaces and valuations. • Techniques for value engineering, e.g. cost, quality and time. • Rules of measurement and contractual implications, e.g. RICS rules.	• Verify suitability of information and data from appropriate sources specific to the scope of works. • Interpret information and data, including from visual and other sources. • Present information using oral, visual and written communication. • Use software with accuracy to verify specific items utilising appropriate tools, e.g. CAD, BIM and spreadsheets. • Complete costings analysis through the use of market rates and spreadsheet software, including best value and whole life costing. • Apply appropriate mathematical techniques in a construction context, e.g. areas, volumes, quantities, units and tolerances.	**Maths** Process data. Understand data. Communicate using mathematics. Optimise work processes. Cost a project. Use rules and formulae. Work with proportion. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information.

		Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. **Digital** Adopt professional approaches to using digital communications and social media.

Occupational Specialism: Civil engineering

Performance Outcome 1: Analyse civil engineering solutions

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Health and safety • Task specific risk management. **Sustainability** • How sustainability is embedded into solutions. • How and why sustainability seeks to balance economic, environmental and social objectives, e.g. whole life including decommissioning. **Project management** • Project and construction risk management, e.g. consideration of project management solutions. **Design** • Inclusive design, including equality and diversity by impact assessment. • Testing structures.	• Sequence and prioritise tasks. • Identify information and data requirements. • Assess health and safety risks associated with the task. • Adapt actions to the level of risk. • Select data collection and analysis methods. • Inspect the suitability of tools and equipment, e.g. PPE and surveying equipment. • Gather relevant information and data. • Use tools and equipment with accuracy. • Operate safely and apply good housekeeping. • Extract relevant information from appropriate sources. • Quality assure the processes used to collect information and data against protocols and standards. • Analyse environments against client brief to identify potential issues and problems. • Carry out calculations related to the scope of work. • Use techniques to check accuracy of analysis. • Produce sketches based on information and data. • Model analysed information and data, including geotechnical, structural and	**Maths** Process data. Understand data. Optimise work processes. Measure with precision. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. **Digital**

	materials appropriate for audience using digital software. • Collate information and data into digital engineering software.	Collate, manage, access and use digital data in spreadsheets, databases and other formats. Gather and organise information from different digital sources. Follow licensing guidelines, using only approved and licensed software applications.

Performance Outcome 2: Design civil engineering solutions

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Commercial / business • Business structures / models, e.g. joint ventures, client, consultant and contractor. **Measurements** • Measurement standards, guidance and practice. • Types of surveying equipment, e.g. theodolite, GPS and how they are operated effectively. **Structural mechanics** • Including testing. **Maths** • Algebraic.	• Extract relevant information and data, e.g. geotechnical, structural, visual, materials from a range of secondary sources. • Quality assure provided data, e.g. in terms of accuracy, currency, authenticity, validity and reliability. • Conduct precedent research into potential solutions to a problem, including best practice, benchmarks and design guides. • Think creatively, adapting to challenges arising from requirements. • Assess commercial risk related to potential solutions. • Apply mathematical principles to the scope of work. • Resolve technical issues in the design.	**Maths** Process data. Understand data. Communicate using mathematics. Optimise work processes. Measure with precision. Represent with mathematical diagrams. Estimation, calculation and error checking. Use rules and formulae.

• Trigonometric and standard formulae. • Elementary calculations and techniques. • Statistical methods. • Graphical techniques. • Applications of maths to structural analysis. **Digital Technology** • Digital design tools, e.g. Computer Aided Design (CAD).	• Select methods to present information, e.g. software and drawing techniques. • Determine performance of materials. • Use techniques to confirm validity of calculations. • Model information using appropriate digital software and other tools. • Use techniques to check accuracy of measurements, including scale and proportion. • Draw upon a range of media to communicate a design proposal.	**English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. **Digital** Gather and organise information from different digital sources. Adopt professional approaches to using digital communications and social media.

Performance Outcome 3: Verify delivery of civil engineering solutions

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital

Structural Mechanics • Including performance.	• Extract relevant information from provided sources. • Process geotechnical, structural behaviour and human factors information, and data related to the performance of proposed solution. • Interpret information and data including from visual and other sources. • Complete technical reports. • Use digital engineering software with accuracy. • Complete costings analysis. • Apply appropriate mathematical techniques.	**Maths** Process data. Understand data. Optimise work processes. Cost a project. Work with proportions Estimation, calculation and error checking. Use rules and formulae. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. Read, understand, evaluate and compare a range of materials,

		identifying bias and misuse of information where appropriate. **Digital** Gather and organise information from different digital sources. Adopt professional approaches to using digital communications and social media

Knowledge relevant to performance outcomes 1, 2, 3
Material properties: e.g. concrete, glass, timber, steel including mass and density; strength (tensile, compressive, shear), bending stiffness, fatigue and creep, degradation and resistance to; degradation including corrosion, chemical degradation; embedded energy; recycling potential and material failure. **Structural elements, loading and potential failure:** e.g. beams, frames, walls; effect of different loading conditions and failure of, e.g. beams, walls, frames, struts and ties. **Maths for structural analysis**: e.g. relationship between force (load), mass and acceleration; coplanar forces; Hooke's law; loading, shear forces and bending moments of beams. **Mathematical formulae:** including algebraic, trigonometric, logarithmic, differential calculus and integral calculus. **Geology / substructure beyond the core:** including bore holes, trial pits; groundwater – water table, contamination; ground load bearing capacity, e.g. soil type; settlement and subsidence; foundations, e.g. strip, raft, pile; piling operations and soil shrinkage. **Setting out:** techniques for setting-out points and developing the physical positions of elements of a building from the plan. **Earthworks**: including excavation, cuttings, embankments, earth moving equipment and concreting equipment. **Temporary works**

Occupational Specialism 3: Building services design

Performance Outcome 1: Analyse building services solutions

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Health and safety • Key requirements, roles and responsibilities associated with health and safety legislation, e.g. Gas Safe Use and Installation Regulations, and Electricity at Work Act. • Legal health and safety obligations of existing installations, e.g. presence of hazardous materials. **Sustainability** • Key requirements, roles and responsibilities associated with environmental protection legislation, e.g. Water Resources Act. • Financial incentives, e.g. carbon footprint level. • Environmental performance measures associated with building services systems, e.g. environmental assessment systems.	• Analyse information, e.g. pre-survey information, available to determine requirements of the task. • Gather required information. • Sequence and prioritise individual tasks. • Interpret information and data including from visual and other sources. • Process data using appropriate techniques. • Convey data using appropriate techniques, e.g. sketch, calculations and present digitally. • Calculate data required for design.	**Maths** Process data. Understand data. Optimise work processes. Measure with precision. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. **Digital**

		Gather and organise information from different digital sources. Adopt professional approaches to using digital communications and social media.

Performance Outcome 2: Design building services solutions

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Health and safety • CDM responsibilities, e.g. plant equipment and maintenance and building life cycle. • Legal health and safety implications of proposed designs with existing designs. **Construction and the Built Environment Industry** • Planning permission and Building Regulations relating to all notifiable works. **Building Technology** • Understanding materials, e.g. aluminium and steel. • Understanding mechanical, electrical and plumbing components. **Digital Technology**	• Explore requirements of the task using open questioning and listening. • Use appropriate information and data and information. • Conduct precedent research, including best practice, benchmarks and design guides. • Quality assure provided data. • Plan logistics including lifecycle, costing, maintenance and installation. • Apply appropriate mathematical techniques in a construction context, e.g. areas, volumes, quantities and units. • Model design using digital software and other tools. • Present appropriate design information and data using different methods and formats, e.g. commissioning sheets. • Enter data into digital engineering software.	**Maths** Process data. Understand data. Communicate using mathematics. Represent with mathematical diagrams. Optimise work processes. Measure with precision. Work with proportion. Estimation, calculation and error checking. Use rules and formulae. **English**

• Specialist software and digital tools, e.g. for 3D calculation of thermal conductivity.	• Provide creative solutions to challenges arising from requirements. • Adapt design proposals in response to design constraints, and stakeholder feedback in terms of time, cost and material factors.	Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. _____ **Digital** Adopt professional approaches to using digital communications and social media. Make use of standard analytical tools in applications to better interpret information. Design and create new digital artefacts and materials, such as digital writing, digital imagine, digital audio and video, digital code, apps and interfaces and web pages.

Performance Outcome 3: Verify delivery of building services solutions

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Valuations • Valuation standards, guidance and practice. • Valuation benchmarking. **Building Technology** • Suitability and operation of performance measurement equipment, e.g. for air quality, noise levels and light levels. • Surveying techniques, e.g. measurements of flow rates.	• Collate information and data. • Verify suitability of information and data from appropriate sources specific to the scope of works. • Interpret information and data, including from visual and other sources. • Use software with accuracy to verify specific items utilising appropriate tools, e.g. CAD, BIM and spreadsheets. • Complete costings analysis through and spreadsheet software. • Present information using oral and written communication.	**Maths** Process data. Understand data. Optimise work processes. Cost a project. Estimation, calculation and error checking. Use rules and formulae. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently.

		Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. **Digital** Adopt professional approaches to using digital communications and social media.

Knowledge relevant to performance outcomes 1, 2, 3

Scientific concepts and principles and their application to building services systems

- **International System of Units** (SI), including base units for length, mass, time, electrical current, temperature, amount of substance, luminous intensity.
- **Derived SI units,** including those associated with area, volume, weight, energy, and force.
- **Gas laws,** including Charles's law, Boyle's law.
- **Electrical systems and properties,** including current, magnetic flux, density, frequency, resistance, voltage, Ohm's law, power, acceleration.
- **Mechanical properties, systems and units,** including latent heat, capillary action, velocity, ductility, malleability, force, pressure, flow rates, Dynamic pressure, humidity, atmospheric pressure, conduction, convection, heat transfer, heat losses, stack effects.
- **Strength,** including tensile, compressive, shear.
- **Thermodynamics,** including laws, material science, phase transition.
- **Properties of materials,** including acoustics, corrosion, pH, permeability, castability, brittleness, creep, durability, elasticity, flexibility, fatigue limit, hardness, resilience, size, toughness, viscosity, boiling point, flammability, flash point, melting point, thermal conductivity, vapour pressure.
- **Combustion,** including incomplete combustion, ventilation, stoichiometric, fuels, chemical, smouldering, diffusion, rapid, spontaneous, flue draft.

Building structures

Purpose, importance and types of flues and chimneys.

Sustainability

Energy efficiency of building services systems.
Types of fuels including storage.

Principles of building services engineering systems

- Controls.
- Electrical components.
- Mechanical components.
- System integration.
- Monitoring systems, data collection and transmission.

Sources of information

- Visuals e.g. drawings and charts.
- Manufacturer's information.
- Asbestos register.
- Conventions.
- Digital applications.
- Symbols.
- Specifications.
- Building regulations.

Occupational Specialism 4: Hazardous materials analysis and surveying

Performance Outcome 1: Inspect the built environment

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Health and safety • Public liability. • Implications of poor health and safety performance (ethical, legal, financial). • Risk management. • Safety conscious behaviours. **Commercial/business** • Confidentiality. **Hazardous materials** • Techniques used to locate and identify hazardous materials, including HSE and UKAS requirements. • Appropriate response to each type if hazardous materials, including guidance and mandatory requirements. **Tools, equipment and materials** • Types of equipment, e.g. sampling and measuring. • Operation of specialist plant, processes and machinery,	• Identify information required to complete the task. • Sequence and prioritise research tasks. • Collect information from primary and secondary sources appropriate, including samples and historic records. • Extract relevant information from appropriate sources to identify potential for the presence of hazardous materials. • Process data, including collation and entering into digital software using appropriate techniques. • Quality assure collected data. • Complete required documentation, including method statements and reports using digital software. • Assess health and safety risks associated with the environment and task. • Operate safely in a site environment. • Use tools and equipment with accuracy. • Operate safely and applying good housekeeping. • Apply safe process to waste disposal. • Use techniques to check accuracy of collected data.	**Maths** Process data. Understand data. Communicate using mathematics. Optimise work processes. Organise work. Measure with precision. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information.

including safe methods of working. **Law and regulations** • Permissions required to undertake survey work.		Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. **Digital** Collate, manage, access and use digital data in spreadsheets, databases and other formats. Gather and organise information from different digital sources. Follow licensing guidelines, using only approved and licensed software applications.

Performance Outcome 2: Identify hazardous materials

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Health and safety • Implications of poor health and safety performance (ethical, legal, financial) whilst undertaking processes. • Risk management, e.g. in occupied space. • Safety conscious behaviours, including client, duty of care and information management.	• Extract relevant information from appropriate sources. • Evaluate the suitability of information and data for completing tasks. • Quality assure information and data from secondary sources. • Interpret information and data, including from visual and other sources.	**Maths** Process data. Understand data. Measure with precision. Estimation, calculation and error checking.

Hazardous materials • Techniques used to respond to hazardous materials, e.g. responding, reporting and communicating. **Tools, equipment and materials** • Maintenance of, e.g. sampling and measuring equipment. • Calibration of, e.g. sampling and measuring equipment. • Repair of, e.g. sampling and measuring equipment. • Operation of specialist plant and machinery. **Survey techniques** • How to collect a variety of samples including personal, background, reassurance and clearance sampling. • Requirements for communicating information at appropriate times. • How to collect appropriate samples to enable analysis.	• Complete required documentation and reports using digital software. • Operate sampling and other equipment. • Inspect the suitability of materials, tools and equipment.	**English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. **Digital** Collate, manage, access and use digital data in spreadsheets, databases and other formats. Gather and organise information from different digital sources. Follow licensing guidelines, using only approved and licensed software applications. Adopt professional approaches to using digital communications and social media.

Performance Outcome 3: Analyse hazardous materials

Knowledge Specific to Performance Outcome	Skills	Maths, English and Digital
Health and safety • Implications of poor health and safety performance (ethical, legal, financial). • Risk management in analysis processes. • Safety conscious behaviours during analysis, e.g. sample and material controls. **Tools, equipment and materials** • Types of equipment, e.g. sampling and measuring. • Maintenance of analysis equipment. • Calibration of analysis equipment. • Repair of analysis equipment. • Operation of different types of technical equipment. **Samples analysis** • Techniques for using microscopy including chemical preparation, morphology, composition and phase contact. • Management and disposal of sample materials.	• Sequence and prioritise task requirement. • Analyse samples using appropriate techniques. • Convey information, data and outcomes using appropriate techniques. • Use chemical preparation, morphology and composition and Phase Contrast Microscopy. • Apply appropriate mathematical techniques. • Operate safely. • Apply safe processes to waste disposal. • Manage the confidentiality and security of information and data. • Select information and data and present using techniques appropriate to the audience. • Use techniques to check accuracy of analysis. • Inspect the suitability of scientific tools and equipment, e.g. microscopes.	**Maths** Process data. Understand data. Organise work. Measure with precision. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written). Read, understand and synthesise written information. Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate.

		Digital Gather and organise information from different digital sources. Adopt professional approaches to using digital communications and social media.

Performance Outcome 4: Monitoring of hazardous materials

Knowledge Specific to Performance Outcome	**Skills**	**Maths, English and Digital**
Health and safety • Implications of poor health and safety management (ethical, legal, financial). **Tools, equipment and materials** • Types of equipment. • Maintenance of equipment. • Calibration of equipment. • Repair of equipment. • Operation of specialist plant and machinery. **Monitoring** • Techniques for monitoring hazardous materials including removal and disposal. • Safe management of retained hazardous materials. • Advice stakeholders require on monitoring responsibilities.	• Verify suitability of information and data from appropriate sources specific to the scope of works. • Interpret information and data, including from visual and other sources to identify issues. • Negotiate requirements with stakeholders. • Provide information, advice and guidance using appropriate communication techniques, e.g. ongoing responsibilities. • Present technical information for different types of stakeholders.	**Maths** Process data. Understand data. Communicate using mathematics. Organise work. Measure with precision. Estimation, calculation and error checking. **English** Select, prioritise and summarise main ideas, using appropriate language and structure (verbal or written). Give clear, precise and coherent explanations for a given purpose and audience (verbal or written).

Communication • Methods of conveying and presenting information to stakeholders. • Privacy and confidentiality. • Whistleblowing and escalating information.		Read, understand and synthesise written information. Record information efficiently. Read, understand, evaluate and compare a range of materials, identifying bias and misuse of information where appropriate. **Digital** Adopt professional approaches to using digital communications and social media. Make use of standard analytical tools in applications to better interpret information. Design and create new digital artefacts and materials such as digital writing, digital imagine, digital audio and video, digital code, apps and interfaces and web pages.