Department for Education

Construction: Design, Surveying and Planning

T Level outline content: final version for inclusion in ITT

August 2018

Contents

Introduction

T Levels are new, two-year, technical study programmes, designed with employers to give young people the skills that industry needs. T Levels will provide a mixture of:

- technical knowledge and skills specific to their chosen industry or occupation
- an industry placement of at least 45 days in their chosen industry or occupation
- relevant maths, English 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.

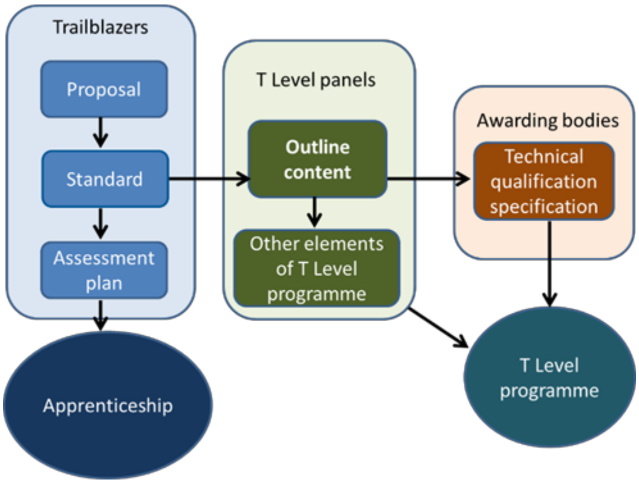
When they complete a T Level study programme, students will be able to choose between moving into a skilled occupation or further study, for example, a higher or degree level apprenticeship, or higher level technical study, including higher education.

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 (TQ) 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 a minimum of 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.

T Level programme

1800 hours over two years (with flexibility)

Subject content is set by T Level panels and approved/managed by the Institute for Apprenticeships

Technical Qualification (TQ)

Between 900-1400 hours

Core

20% - 50% of the total TQ time

- Knowledge and understanding of the concepts, theories and principles relevant to the T Level and the broader route
- Core skills relevant to the T Level

- Assessed through an external examination and a substantial, employer-set project

Occupational specialisms (min. 1 per TQ)

50% - 80% of the total TQ time

- Knowledge, skills and behaviours required to achieve threshold competence in an occupational specialism
- Maths, English and digital skills integrated where they are necessary to achieve threshold competence

- Assessed synoptically through rigorous practical assignments.

T Level Industry Placement

Between 315-420 hours

- Undertaken with an external employer
- Minimum of 45 days
- Students develop technical skills and apply their knowledge in a workplace environment
- Provider should pay for/contribute to travel and subsistence costs, if not covered by the employer
- Employers not expected to pay students

Maths and English requirements

- Students are expected to achieve a level 2 in maths and English. This can be achieved through GCSEs (grade 4 and above) or level 2 Functional Skills (pass)
- T Level panels are free to set higher maths and English requirements, where necessary

Other requirements set by T Level panels

- Occupation-specific requirements included, where possible, if they are essential for skilled employment e.g. licence to practice qualification or professional registration

Employability, enrichment and pastoral requirements

Purpose Statement

Qualification Purpose

The purpose of the level 3 Technical Qualification is to ensure students have the knowledge and skills 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 and skills required for at least one occupational specialism relevant to the qualification.

- be up-to-date, providing the knowledge and skills needed for the occupations to 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).

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[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	The knowledge and skills 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

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Awarding organisations will need to ensure that students have an up-to-date knowledge of the legal and regulatory obligations relating to employment in the occupations relevant to the T Level, and understand the practical implication of these on their work.

Core content

The core content relates to the whole route, and the pathway that the Technical Qualification covers. This content will vary depending on the requirements of the route and the pathway or occupations covered by the scope of the Technical 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 regulations (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, environmental and financial. • Development of safe systems of work, including company management systems, 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 including, • 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	Benefits of good design including within budget, of good design to product performance e.g on budget, over specified, difficult to assemble/build, • Design principles, e.g. buildability and integration of services. • Role of different disciplines (e.g. contractor, architect) involved in design. • Design process from conception to completion. Human factors, e.g. inclusivity,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. • How projects are procured within the construction sector e.g. tenders and supply chain. • Roles and responsibilities of the construction professions e.g. surveyor, carpenter, heating engineer. • The role of CPD in developing the knowledge and skills of those working in the sector and those that may provide it eg through professional bodies, accreditation, certification bodies. • 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. e.g. post Grenfell, tax changes for self-employed, augmented reality.
Sustainability	• Importance of sustainability when planning and delivering a construction project e.g. environmental protection. • 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 and how they impact on design and construction. • Environmental performance measures e.g. water use, radioactive waste. • 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 including types of materials that require specific actions (e.g. asbestos) and the measures in place by construction organisations. • Energy production and energy use (including embodied energy).
Measurement	• The benefits of accurate and appropriate measurement on built environment performance e.g accurate reporting. • 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 construction, built environment and civil engineering structures, sub-structures, superstructures, foundations and external works. • Building regulations and their purpose in construction including renovation. • Building standards and their purpose in renovation and construction including ISO, British and industry. • Manufacturers' instructions 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.
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 construction project delivery e.g. at design stage, through construction, to handover and in use. • 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 to team and project performance. • 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 e.g. win-win. • Conflict management techniques e.g. mediation. • Methods (e.g. verbal, non-verbal) and styles (e.g. formal, informal) of communication and suitability for different situations that may arise throughout a construction project. • Employment rights and responsibilities of the employer and employee e.g. health and safety. • Ethics and ethical behaviour e.g. honesty, fairness. • How sources of information, including social networking contribute to knowledge sharing.
Digital Technology	• Internet of things, e.g. crowd sourcing digital data to assist just in time asset management, information interdependencies. • Digital engineering techniques e.g. simulation,

	animation. • Opportunities for the use of technology used in other industries and contexts and adapting for use 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, e.g. community design, local recruitment. • Principles of entrepreneurship and innovation e.g. vision, research, finance. • How businesses measure success, e.g. benchmarking, KPIs and target setting. Principles of project management e.g. clear goals and objectives, defined roles, milestones • Quality management and techniques used in business.

Design, surveying & planning pathway knowledge and understanding

Element	Content
Project management	• Principles of quantification and costing e.g. New Rules of Measurement, Cost Reporting Guidance Note. • Financial control e.g. setting, monitoring, measuring, reporting. • Project management whole lifecycle and work stages. • Management of procurement process including selecting procurement routes and tendering process. • Project, construction and commercial risk management.
Law	• English & Welsh legal system including the difference between case law and legislation, criminal and civil law and related sanctions. • Implications of land law to the built environment, including planning, land ownership, easement and boundaries. • Permissions required to undertake survey work, including geospatial, e.g. Drone use / unmanned aircraft systems CAA regulations. • Implications of the law of contract to construction projects including types of contracts used in construction. • Relevant examples of case law related to the law of tort, and the law of landlord and tenant, including duty of care. • Implications of building regulations and breaches to the construction project and key stakeholders. • Implications of intellectual property legislation to individuals and organisations.

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
Law • Permissions required to undertake survey work including geospatial, e.g. drone use. **Digital Technology** • How the Internet of things contributes to the measurement of the built environment, . • Geospatial equipment, their applications, suitability and use. • Digital engineering techniques and appropriate software. • Geospatial information conveyance and sourcing, including GIS, cartographic and other commercially available data. **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 principles and limitations of measurement e.g. parallax. • Techniques used to gather data, including geospatial data e.g. Global Navigation Satellite Sytems (GNSS), photogrammetry. • The importance of coordinating systems, projects, transformations and datums. • Construction industry measurement	• Explore requirements of the task using open questioning and listening. • Gather information from appropriate sources specific to the scope of works including Geographical Information Systems (GIS). • Determine the level of accuracy required. • Capture data using appropriate measurement methods. • Process data using appropriate techniques e.g. classification, presentation. • Extract and manage data using appropriate techniques e.g. restricting access, secure disposal. • Quality assure the surveying 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. • Manage waste including the quantification, classification and disposal of waste

standards, guidance and practice, including measurement rules. • Good survey practice, e.g. whole to the part, local vs national and error propagation.	

Performance Outcome 2: Analyse the built environment

Knowledge Specific to Performance Outcome	Skills
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). **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.	• 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.

Performance Outcome 3: Design the built environment

Knowledge Specific to Performance Outcome	Skills
Design • How designs are prepared, including design briefs, work stages, schedules, specifications, recommendations and programmes. • The level of detail needed in designs for different situations and the importance of detail in communicating the design intent. • The implications of statutory obligations to designs e.g. utility diversion. • 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 • Technical drawing techniques • Inclusive design, including equality and diversity by impact	• Identify information and data r • Quality assure information and expertise. • Conduct precedent research, i benchmarks and design guide • Use suitable data i.e. quality a practice. • Model design using digital soft techniques. • Present appropriate design inf different methods and formats. • Manage data in a collaborative data environment. • Communicate design and cons appropriate methods, e.g. Des

assessment. **Health and safety** • The CDM Regulations 2015 and the duties of the designer. • The identification and design of hazards and risks and methods of 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 and their suitability for different situations. • Consultation requirements, e.g. the expertise input of 3rd party knowledge. • Processes of collaborative design, e.g. coordination of team input and clash management. **Digital Technology** • Digital design tools, e.g. Computer Aided Design (CAD). • Digital specification tools, e.g. the National Building Specification (NBS), BS1192. • Digital data, e.g. spreadsheets and schedules. • Digital presentation, image handling and desk top publishing, e.g. brochures and reports	2015). • Manage relationships, e.g. the negotiation, mediation and cor • Provide creative solutions to cl requirements. • Adapt design proposals in resp and stakeholder feedback in te material factors.

Performance Outcome 4: Verify delivery of the built environment

Knowledge Specific to Performance Outcome	Skills
Sustainability • Legal obligations relating to pollution and waste. • Environmental performance measures that must be met and how they are measured. • Principles of heritage and conservation. **Valuations** • Industry valuation standards, guidance and practice and how these are used to verify delivery of the built environment. • Valuation benchmarking and how this is used to verify delivery of the built environment. **Measurements** • Types of measurement for the combined data, e.g. cross checking interfaces and valuations. • Techniques for value engineering, e.g.	• 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.

cost, quality and time. • Rules of measurement and contractual implications, e.g. RICS rules.	

Occupational Specialism: Civil engineering

Performance Outcome 1: Analyse civil engineering solutions

Knowledge Specific to Performance Outcome	Skills
Health and safety • Task specific risk management including hazards, risk assessment, controls. **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. • Methods used to test structures e.g. stress, aerodynamics. **Material properties** • 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** • Beams, frames, walls; effect of different loading conditions and failure of, e.g. beams, walls, frames, struts and ties. **Maths for structural analysis** • Relationship between force (load), mass and acceleration; coplanar forces; Hooke's law; loading, shear forces and bending moments of beams. **Structural mechanics**	• 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 i.e. information relevant to the task • Use tools and equipment with accuracy. • Operate safely and apply good housekeeping. • Extract relevant information from appropriate sources. e.g. by analysing sources and classifying information for relevance. • 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 appropriate techniques to check accuracy of analysis e.g predictive models. • Produce sketches based on information and data. • Model analysed information and data, including geotechnical, structural and materials appropriate for audience using digital software. • Collate information and data into digital engineering software.

• How structural elements (eg beams, columns, frameworks) behave under load. • Solve structural mechanics problems eg reactive forces, maximum. **Maths techniques** • Algebra including indices, logarithms, linear equations. • Trigonometric and standard formulae including circular and triangular measures. • Elementary calculations and techniques including integration and differentiation. • Statistical methods including averages, tendency and dispersion. **Geology / substructure beyond the core** • 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** • Excavation, cuttings, embankments, earth moving equipment and concreting equipment.	

Performance Outcome 2: Design civil engineering solutions

Knowledge Specific to Performance Outcome	Skills
Design • How designs are prepared, including design briefs, work stages, schedules, specifications, recommendations and programmes. • The level of detail needed in designs for different situations and the importance of detail in communicating the design intent. • The implications of statutory obligations to designs e.g. utility diversion. • The use and importance of	• 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

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. **Measurements** • Measurement standards, guidance and practice. • Types of surveying equipment, e.g. total station, GNSS and how they are operated effectively. **Digital Technology** • Digital design tools, e.g. Computer Aided Design (CAD). • Digital specification tools, e.g. the NBS, BS1192. • Digital data, e.g. spreadsheets and schedules. • Digital presentation, image handling and desk top publishing, e.g. brochures and reports **Material properties** • 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** • Beams, frames, walls; effect of different loading conditions and failure of, e.g. beams, walls, frames, struts and ties. **Maths for structural analysis** • Relationship between force (load), mass and acceleration; coplanar forces; Hooke's law; loading, shear forces and bending moments of beams. **Structural mechanics** • How structural elements (eg beams, columns, frameworks) behave under load. • Solve structural mechanics problems eg reactive forces, maximum.	arising from requirements. • Assess commercial risk related to potential solutions. • Apply mathematical principles to the scope of work. • Resolve technical issues in the design. • Select methods to present information, e.g. software and drawing techniques. • Determine performance of materials. • Use appropriate techniques to confirm validity of calculations e.g. case studies, historic records. • Model information using appropriate digital software and other tools. • Use appropriate techniques to check accuracy of measurements, including scale and proportion e.g. Ground Validation Points (GVP), known measurements. • Draw upon a range of media to communicate a design proposal.

Maths techniques • Algebra including indices, logarithms, linear equations. • Trigonometric and standard formulae including circular and triangular measures. • Elementary calculations and techniques including integration and differentiation. • Statistical methods including averages, tendency and dispersion. **Geology / substructure beyond the core** • 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** • Excavation, cuttings, embankments, earth moving equipment and concreting equipment.	

Performance Outcome 3: Verify delivery of civil engineering solutions

Knowledge Specific to Performance Outcome	Skills
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. Civil Engineering standard methods of measurement (CESMM). **Valuations** • Industry valuation standards, guidance and practice and how these are used to verify delivery of the built environment. • Valuation benchmarking and how this is used to verify delivery of the built environment.	• 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 to solve structural mechanics problems including algebra, statistics, trigonometry, calculus.

Material properties • 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** • Beams, frames, walls; effect of different loading conditions and failure of, e.g. beams, walls, frames, struts and ties. **Maths for structural analysis** • Relationship between force (load), mass and acceleration; coplanar forces; Hooke's law; loading, shear forces and bending moments of beams. **Structural mechanics** • How structural elements (eg beams, columns, frameworks) behave under load. • Solve structural mechanics problems eg reactive forces, maximum. **Maths techniques** • Algebra including indices, logarithms, linear equations. • Trigonometric and standard formulae including circular and triangular measures. • Elementary calculus and techniques including integration and differentiation. • Statistical methods including averages, tendency and dispersion. **Geology / substructure beyond the core** • 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** • Excavation, cuttings, embankments, earth moving equipment and concreting equipment.	

Occupational Specialism 3: Building services design

Performance Outcome 1: Analyse building services solutions

Knowledge Specific to Performance Outcome	Skills
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. **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.	• 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 eg classification, presentation. • Convey data using appropriate techniques, e.g. sketch, calculations and present digitally. • Calculate data required for design e.g air changes, thermal changes.

• **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** • Types of systems (e.g. heating, plumbing, indoor air quality) their purposes, similarities and differences in operation. • Mechanical components (e.g. fans, pipework, motors), their characteristics, function within the system and implications to the system of component failure. • Electrotechnical components (e.g. cabling, terminators), their characteristics, function within the system and implications to the system of component failure. • Types of control systems (e.g. digital signal processors), their purposes, components, similarities and differences. • Monitoring systems (digital, analogue) and how they collect and transmit data. **Sources of information their content and purpose e.g.** • Visuals e.g. drawings and charts, Manufacturer's information, Asbestos	

register, Conventions, Digital applications, Symbols, Specifications, Building regulations.	

Performance Outcome 2: Design building services solutions

Knowledge Specific to Performance Outcome	**Skills**
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** • **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. • Understanding mechanical, electrical and plumbing components. **Digital Technology** • Specialist software and digital tools, e.g. for 3D calculation of thermal conductivity. • Digital design tools, e.g. Computer Aided Design (CAD). • Digital specification tools, e.g. the NBS, BS1192. • Digital data, e.g. spreadsheets and schedules. • Digital presentation, image handling and desk top publishing, e.g. brochures and reports. **Design** • How designs are prepared, including design briefs, work stages, schedules, specifications, recommendations and	• 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. • 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.

programmes. • The level of detail needed in designs for different situations and the importance of detail in communicating the design intent. • The implications of statutory obligations to designs e.g. utility diversion. • 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. **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** • Types of systems (e.g. heating, plumbing, indoor air quality) their purposes, similarities and differences in operation. • Mechanical components (e.g. fans, pipework, motors), their characteristics, function within the system and implications to the system of component failure. • Electrotechnical components (e.g. cabling, terminators), their characteristics, function within the system and implications to the system of component failure. • Types of control systems (e.g. digital signal processors), their purposes, components, similarities and differences. • Monitoring systems (digital, analogue) and how they collect and transmit data. **Sources of information their content and purpose e.g.** • Visuals e.g. drawings and charts, Manufacturer's information, Asbestos register, Conventions, Digital applications, Symbols, Specifications, Building regulations.	

Performance Outcome 3: Verify delivery of building services solutions

Knowledge Specific to Performance Outcome	Skills
Valuations • Industry valuation standards, guidance and practice and how these are used to verify delivery of the built environment. • Valuation benchmarking and how this is used to verify delivery of the built environment.	• Collate information and data e.g. commissioning test results, operations manual. • Verify suitability of information and data from appropriate sources specific to the scope of works. • Interpret information and data,

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. **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. Civil Engineering standard methods of measurement (CESMM). **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,	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 e.g. spreadsheet software. • Present information using oral and written communication.

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** • Types of systems (e.g. heating, plumbing, indoor air quality) their purposes, similarities and differences in operation. • Mechanical components (e.g. fans, pipework, motors), their characteristics, function within the system and implications to the system of component failure. • Electrotechnical components (e.g. cabling, terminators), their characteristics, function within the system and implications to the system of component failure. • Types of control systems (e.g. digital signal processors), their purposes, components, similarities and differences. • Monitoring systems (digital, analogue) and how they collect and transmit data. **Sources of information their content and purpose e.g.** • 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
Health and safety • Public liability laws to consider when inspecting the built environment e.g. duty of care. • Implications of poor health and safety performance (ethical, legal, financial). • Risk management. • Safety conscious behaviours required when inspecting build environments. **Commercial/business** • Confidentiality e.g. of client data. **Hazardous materials** • How the use and regulation of hazardous materials (including asbestos) has changed over time • The intended construction purpose of hazardous materials (including asbestos) and where they are likely to have been used in buildings • 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, including safe methods of working. **Law and regulations** • Permissions required to undertake survey work.	• 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 e.g. cork borers, air quality measurement device • Operate safely and applying good housekeeping. • Apply safe process to waste disposal. • Use appropriate techniques to check accuracy of collected data e.g. predictive models

Performance Outcome 2: Identify hazardous materials

Knowledge Specific to Performance Outcome	Skills
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. **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.	• 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. • Complete required documentation and reports using digital software. • Operate sampling and other equipment. • Inspect the suitability of materials, tools and equipment • Use techniques to ensure the integrity of samples including visual inspections of work areas and enclosuresrisk.

Performance Outcome 3: Analyse hazardous materials

Knowledge Specific to Performance Outcome	Skills
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 sampling and measuring of	• Sequence and prioritise task requirement. • Analyse samples using appropriate techniques. • Convey information, data and outcomes using appropriate techniques. • Use chemical preparation, morphology and composition, Phase Contrast Microscopy and fibre counting. • Apply appropriate mathematical

equipment e.g microscopes. • Maintenance of analysis equipment e.g. calibration. • Calibration of analysis equipment. • Repair of analysis equipment. • Operation of different types of technical equipment e.g. microscopes. **Samples analysis** • Techniques for using microscopy including chemical preparation, morphology, composition and phase contact. • Management and disposal of sample materials.	techniques eg trigonometry, statistics. • Operate equipment safely e.g. microscopes. • 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 e.g. technical report. • Use appropriate techniques to check accuracy of analysis predictive models. • Inspect the suitability of scientific tools and equipment, e.g. microscopes.

Performance Outcome 4: Monitoring of hazardous materials

Knowledge Specific to Performance Outcome	Skills
Health and safety • Implications of poor health and safety management (ethical, legal, financial). **Tools, equipment and materials** • Types of equipment used in monitoring hazardous materials,their characteristics and purpose e.g. sampling equipment. • Importance of and how to maintain monitoring equipment, including storage. • The importance of calibration of equipment. • Techniques used in the repair of equipment e.g. calibration, adjustment • Operation of specialist plant and machinery e.g. decontamination units **Monitoring** • Techniques for monitoring hazardous materials including removal and disposal e.g. decontamination • Safe management of retained hazardous materials. • Advice stakeholders require on monitoring responsibilities. **Communication** • Methods of conveying and presenting information to stakeholders e.g. technical reports	• 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.

• Privacy and confidentiality. • Whistleblowing and escalating information.	

Maths, English and digital skills

Maths

The completion of a level 2 mathematics qualification (GCSE mathematics or Functional Skills) is a minimum exit requirement for all T Levels. This will ensure that all students have demonstrated fluency and competence in mathematics, and are able to recognise the importance of mathematics in their own lives, in work and to society. Achievement of a level 2 mathematics qualification will also provide the foundation to access mathematics at a higher level, if required.

Technical Qualifications should contain sufficient and appropriate maths to help students reach threshold competence in their chosen specialism(s). The following General Maths Competencies (GMCs) have been developed with input from the Royal Society Advisory Committee on Maths Education (ACME), and awarding organisations will need to embed these, and the underpinning maths, into the specifications and assessments being developed as part of the Technical Qualification.

The GMCs below are relevant to this particular Technical Qualification:

- Communicate using mathematics
- Cost a project
- Estimate, calculate and error-spot
- Measure with precision
- Optimise work processes
- Process data
- Represent with mathematical diagrams
- Understand data
- Use rules and formulae
- Work with proportion.

Awarding organisations who are awarded an exclusive license will need to integrate these into the Technical Qualification specifications and assessments, drawing upon a more detailed framework of maths that underpins the GMCs, currently being developed in association with the Royal Society ACME.

English

The completion of a level 2 English qualification (English language GCSE or Functional Skills) is a minimum exit requirement for all T Levels. This will ensure that all students have demonstrated that they can read fluently, communicate and write effectively, and demonstrate a confident control of Standard English.

The specifications for Technical Qualifcations should ensure that students acquire the technical vocabulary, and gain the practical communication skills (written and oral), needed to achieve threshold competence in their chosen occupational specialism(s).

The assessments for Technical Qualifications should ensure that students:

- Know the correct technical vocabulary and use it appropriately
- Apply their communication skills (written and oral) appropriately, using Standard English
- Use accurate spelling, punctuation and grammar.

Digital

Technical Qualifications should contain sufficient and appropriate digital skills to help students reach threshold competence in their chosen specialism(s).

This Technical Qualification should support students to develop the digital knowledge and skills needed in order to:

- Adopt professional approaches to using digital communications and social media
- Collate, manage, access and use digital data in spreadsheets, databases and other formats
- 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
- Follow licensing guidelines, using only approved and licensed software applications
- Gather and organise information from different digital sources
- Make use of standard analytical tools in applications to better interpret information.

Awarding organisations who are awarded an exclusive license will need to integrate these into the Technical Qualification specifications and assessments.