SQA Advanced Unit Specification

General information for centres

Unit title: Architectural CADT: Building Systems and Services (SCQF level 7)

Unit code: HR75 47

Superclass: TD

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Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This Unit is designed to enable learners to develop the skills and knowledge required in the evaluation of domestic building systems and services and the communication of these using advanced computer-aided design software packages.

Outcomes

On successful completion of the Unit the learner will be able to:

1 Illustrate building service supply details for a low-rise, domestic building.
2 Select and justify a water supply distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.
3 Select and justify an electrical distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.
4 Select and justify a heating distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.

Credit points and level

1 SQA Advanced Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

This Unit assumes learners to have existing CAD skills using both two dimensional and three-dimensional CAD techniques prior to the commencement of this Unit. Such experience may be evidenced by possession of the Units HR6P 47 *Architectural CADT: Principles and Practice* and HR6M 47 *Architectural CADT: Residential Design*, or similar, equivalent Units.

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the support notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**.

SQA Advanced Unit specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Illustrate building service supply details for a low-rise, domestic building.

Knowledge and/or skills

- utilities:
  - gas
  - electricity
  - water
  - telecommunications
- entry points:
  - depths, heights
  - materials
  - protection and safety
  - routes of entry
- output:
  - plan details
  - elevation details
  - section details
  - statutory references
  - conventions, symbols and annotation

Outcome 2

Select and justify a water supply distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages

Knowledge and/or skills

- hot and cold water distribution:
  - direct
  - indirect systems
- mains supply, rising main
- water storage
- frost protection
- pipework sizing
- jointing

- materials
- current quality standards
- environmental innovation in water management:
  - water filtration/treatment
  - water recycling
  - water usage
- illustration:
  - plan details (horizontal distribution)
  - section details (vertical distribution)
  - statutory references
  - conventions, symbols and annotation
- drainage:
  - above ground
  - below ground

Outcome 3

Select and justify an electrical distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.

Knowledge and/or skills

- mains supply and control:
  - division of responsibility and ownership
  - meter
  - isolating switches
  - protective elements
- consumer unit controls:
  - distribution
  - isolation
  - arrangement
- distribution circuits:
  - power
  - lighting
- distribution elements:
  - cabling
  - switchgear
  - lighting
  - power
  - other
- current electrical regulations
- environmental innovation in electrical management:
  - low-energy lighting options
  - automated control systems
  - alternative/supplementary power generation
- illustration:
  - plan details (horizontal distribution)
  - section details (vertical distribution)
  - statutory references
  - conventions, symbols and annotation

Outcome 4

Select and justify a heating distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.

Knowledge and/or skills

- space heating types
- fuel types
- boiler types
- emitters
- heating controls:
  - tariff details
  - control mechanisms
- appliances:
  - fire appliances traditional, non-traditional
- environmental innovation in space heating:
  - alternative fuel sources for heating requirements
  - automated control systems
  - insulation contribution
  - integrative solutions
- output:
  - plan details (horizontal distribution)
  - section details (vertical distribution)
  - section details (appliance, flue route and termination)
  - statutory references
  - conventions, symbols and annotation

Evidence Requirements for this Unit

Outcome 1

Evidence for the knowledge and/or skills section for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **two utilities** should always be sampled and **all** of the remaining knowledge and/or skills items. In order to ensure that learners will not foresee what items they will be assessed on the sample will be unseen, open-book and supervised and a different sample of the key utility items is required on each assessment occasion. Learners **will be allowed** access to course material, textbooks or the Help files associated with the software used once the assessment is underway.

A learner's response can be judged satisfactory where the evidence provided is sufficient to meet the requirement for all items by showing that the learner is able to:

- respond to a brief and produce accurate CAD details illustrating a **minimum of two** of the utility connections and all the remaining knowledge and/or skills items for a low-rise, domestic building

Graphical output will be in the form of CAD drawings presented as hard-copy finished drawings **and** the CAD files presented electronically on disk. The range of CAD details required is to include fully annotated plan, elevation and section details for the given building brief as well as extracted schedule data for the details created.

Outcome 2

Evidence for the knowledge and skills section for this Outcome will be provided on a sample basis. In any assessment of this Outcome one direct or indirect water distribution system incorporating both hot and cold supply must always be sampled and **all** the remaining knowledge and/or skills items.

In order to ensure that learners will not foresee what items they will be assessed on the sample will be unseen, open-book and supervised and a different sample of the key utility items is required on each assessment occasion. Learners **will be allowed** access to course material, textbooks or the Help files associated with the software used once the assessment is underway.

A learner's response can be judged satisfactory where the evidence provided is sufficient to meet the requirement for all items by showing that the learner is able to:

- respond to a brief and produce accurate CAD details illustrating the layout drawings for hot and cold water distribution for a low-rise, domestic building, incorporating:
  - **either** direct or indirect distribution systems
  - **all** the remaining knowledge and/or skills items
- produce supporting CAD schedule data for the water distribution system, extracted from the CAD details generated
- produce supporting evidence describing the technical justification for the specifications selected

Evidence must be generated through assessment undertaken in controlled, supervised conditions. Learners should be allowed to refer to relevant course material.

Graphical illustrations will be in the form of CAD drawings presented as hard-copy finished drawings **and** the CAD files presented electronically on disk. The range of CAD details required are to include fully annotated plan and section details for the given building brief as well as extracted schedule data for the details created.

Outcome 3

Learners will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- respond to a brief and produce accurate CAD details illustrating the layout drawings for electrical distribution incorporating **all** the knowledge and skills items
- produce supporting schedule data for the electrical distribution system, extracted from the CAD details generated
- produce supporting evidence describing the technical justification for the specifications selected

Evidence must be generated through assessment undertaken in controlled, supervised conditions. Learners should be allowed to refer to relevant course material.

Graphical illustrations will be in the form of CAD drawings presented as hard-copy finished drawings **and** the CAD files presented electronically on disk. The range of CAD details required are to include fully annotated plan and section details for the given building brief as well as extracted schedule data for the details created.

Outcome 4

Evidence for the knowledge and skills section for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **one** space heating type, **one** fuel type, **one** boiler type, **one** emitter type and **all** the remaining knowledge and skills items must always be sampled. In order to ensure that learners will not foresee what items they will be assessed on the sample will be unseen, open-book and supervised and a different sample of the key utility items is required on each assessment occasion. Learners **will be allowed** access to course material, textbooks or the Help files associated with the software used once the assessment is underway.

A learner's response can be judged satisfactory where the evidence provided is sufficient to meet the requirement for all items by showing that the learner is able to:

- in response to a brief, produce accurate CAD details illustrating the layout drawings for space heating requirements for a low-rise, domestic building
- produce supporting schedule data for the space heating system, extracted from the CAD details generated
- produce supporting evidence describing the technical justification for the specifications selected

Evidence must be generated through assessment undertaken in controlled, supervised conditions. Learners should be allowed to refer to relevant course material.

Graphical illustrations will be in the form of CAD drawings presented as hard-copy finished drawings **and** the CAD files presented electronically on disk. The range of CAD details required are to include fully annotated plan and section details for the given building brief as well as extracted schedule data for the details created.

SQA Advanced Unit support notes

Unit title: Architectural CADT: Building Systems and Services (SCQF level 7)

Unit support notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit has been written in order to allow learners to develop knowledge, understanding and skills in then following areas:

1 Illustrate building service supply details for a low-rise, domestic building.
2 Select and justify a water supply distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.
3 Select and justify an electrical distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.
4 Select and justify a heating distribution system for a low-rise, domestic building, and produce accurate details for this using computer-aided design packages.

The Unit is at SCQF level 7 and has been devised as an optional Unit within the SQA Advanced Certificate and SQA Advanced Diploma in Computer Aided Architectural Design and Technology. However, this does not preclude the use of the Unit in other awards where award designers feel this to be appropriate.

- space heating types:
  - wet systems
  - warm air systems
  - electrical systems
- fuel types:
  - gas
  - oil
  - solid fuel
  - electricity
- boiler types:
  - condensing
  - combination
  - low water content
- emitters:
  - underfloor tubing
  - skirted tubing
  - blower vents
  - radiators
  - storage heaters

Guidance on approaches to delivery of this Unit

In all Outcomes the learner should be able to evaluate the range design criteria and building project briefs, as provided by assessor(s) from given building briefs, following the knowledge and skills items.

Learners should be encouraged to explore a range of possible solutions. Additional learning from acceptable texts, e-learning environments and other resources should be actively supported. Assessor(s) should make maximum use of visual data in the delivery of all topics.

Learners should evaluate the briefs and select the most appropriate medium with which to develop and realise design solutions — no specific software is recommended, though it is anticipated centres use advanced Architectural software such as Architectural Desktop, Revit, Revit Services, or similar.

At all times, learners are required to illustrate solutions in a clear and coherent manner, typical of professional requirements in industry. Emphasis throughout delivery of the topic should be placed on the design relationships inherent in building service provision. Evaluation of the brief, required Performance Criteria and the range of possible solutions for the brief should be used to establish a strong design based approach to solutions, and provide for the required written elements of the Outcome. Learners will be encouraged to use their own discretion and judgement in the selection of CAD software best suited to both the interrogative study of solutions, recording of elemental data and the production of graphic solutions.

In determining design solutions, emphasis is encouraged in areas of environmental objectives, eco-friendly solutions and other sustainable objectives directed towards maximisation of life cycle planning, costing and operation.

Learners are generally required to produce two dimensional CAD details for all solutions in the form of floor plans and sections to illustrate horizontal and vertical distribution of services through given buildings. Three-dimensional solutions may also be produced at the discretion of centres, and dependent upon the nature of computer-aided software packages available.

At all times, the design criteria should establish the physical nature of the products, systems and details, and replicated accurately within the CAD environment using professional, industry standard approaches in layout, organisation, annotation, use of symbols and components.

Learners whose assessment response does not meet the minimum evidence may be offered remediation and the opportunity for re-submission to reflect industry practice. For example, drawing details requiring minor revision or modification may be remediated and re-submitted.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Assessment for this Unit could be delivered in individual assessment events on an Outcome-by-Outcome basis, or by combining elements of Outcomes, or by one single holistic assessment covering all Outcomes. If assessment is conducted using a holistic approach, it is recommended that a project driven approach to the development of solutions is used by centres. For this approach, a brief should be provided by lecturers, with the emphasis on low-rise construction systems, suitable for residential or small commercial buildings.

Assessment guidelines

Outcome 1

The recommended time allocation for this assessment activity is three hours.

A checklist could be used to support the assessment requirements for each of the knowledge and/or skills required in the Outcome.

Solutions in graphic (CAD) format might be presented individually on an Outcome-by-Outcome basis, with all evidence eventually collated into a portfolio of drawings with justifications for solutions.

Outcome 2

The recommended time allocation for this Outcome is two hours. A checklist could be used to support the assessment requirements for each of the knowledge and/or skills required in the Outcome.

The justifications produced by the learner supporting the design decisions reached for the technologies assessed could be integrated across all Outcomes as a developed, formal submission. If assessing on an Outcome-by-Outcome basis, such rationale evidence could support the drawn CAD details in the form of specification schedule data, annotation and referencing to the drawings.

Outcome 3

The recommended time allocation for this Outcome is two hours. A checklist could be used to support the assessment requirements for each of the knowledge and/or skills required in the Outcome.

The justifications produced by the learner supporting the design decisions reached for the technologies assessed, could be integrated across all Outcomes, as a developed, formal submission covering all Outcomes. If assessing on an Outcome-by-Outcome basis, such rationale evidence could support the drawn CAD details in the form of specification schedule data, annotation and referencing to the drawings.

Outcome 4

The recommended time allocation for this Outcome is two hours. A checklist could be used to support the assessment requirements for each of the knowledge and/or skills required in the Outcome.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use

e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at **www.sqa.org.uk/e-assessment**.

Opportunities for developing Core and other essential skills

There are opportunities to develop the Core Skills of *Information and Communication Technology (ICT)*, *Problem Solving* and *Numeracy* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Learners are working to a remit which requires the ability to create and manipulate objects in a computer-aided design environment. Access to, and evaluation of, examples of complex design drawings would be of value in formative work. Learners should be able to work unaided in correct file management: considerations of security and safety should be a routine aspect of good practice.

The selection of appropriate software application packages and the ability to manipulate objects, components and annotation is integral to achievement, as are techniques in editing data to meet identified needs of purpose and content.

Accuracy of interpretation and effective communication of numerical and graphic information underpins the competencies developed in the Unit, and learners are assessed on their ability to create and edit elements within a drawing using a full range of software commands. Some learners may benefit from formative opportunities to further develop effectiveness in the understanding, analysis and application of numerical and graphic data, and the use of software packages or online tutorials to reinforce *Numeracy* skills may be useful.

Learners could additionally benefit from discussions with the class group and/or assessor in order to encourage analytical evaluation of approaches to the design process.

History of changes

Version	Description of change	Date

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

General information for learners

Unit title: Architectural CADT: Building Systems and Services (SCQF level 7)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This Unit has been designed to help you develop underpinning knowledge in the evaluation and selection of building service technologies and systems for domestic and small commercial buildings, and provide you with the sophisticated CAD skills required to produce two dimensional (and possibly three-dimensional) details for these, using advanced computer-aided design software packages.

Within this Unit, a range of building service systems and technologies for small building projects will be considered, including:

- utility supply and connection
- water distribution systems
- electrical distribution systems
- space heating distribution systems

The Unit will be taught with a series of lectures, practical exercises and design tutorials, which will logically and sequentially progress from the simple to the complex. At all times, a strong design base will underpin learning and assessment. A key element to the design process will be the consideration and evaluation of environmental and sustainable options in the generation and use of the range of building services to meet sustainable life cycle objectives, and the expanding 'green' agenda.

There are four formal assessment events with the emphasis on the practical production of CAD solutions, appropriate to each brief.

The assessments will be supervised and conducted under open-book conditions in which you will be allowed access to notes, textbooks and other material during the assessment. You will sit these assessments at prescribed points during the Unit at the discretion of the lecturer.

As you will be working consistently with numerical and graphical data within an IT-based platform, opportunities exist within this Unit for you to also develop Core Skills in *Information and Communication Technology (ICT)*, *Problem Solving* and *Numeracy* at SCQF level 6.