

SQA Advanced Unit Specification

General information for centres

Unit title: Architectural CADT: Principles and Practice (SCQF level 7)

Unit code: HR6P 47

Superclass: TD

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Unit purpose

This Unit is designed to enable learners to develop the skills and knowledge required for the production and management of 2-dimensional and 3-dimensional architectural drawings using industry-standard CAD software applications. It will allow learners to develop underpinning knowledge in CAD conventions and principles for Architectural Engineering Construction (AEC) environments, and develop the contextual practical skills in the production of typical AEC CAD details. It is suitable for learners wishing to develop skills appropriate to entry level CAD activity in a typical AEC drawing environment.

Outcomes

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

- 1 Produce a standard CAD template file.
- 2 Produce 2-dimensional CAD drawings appropriate to the planning stages of the architectural design process.
- 3 Produce referenced and annotated 2-dimensional CAD drawings appropriate to the building approval stages of the architectural design process.
- 4 Produce conceptual 3-dimensional CAD models from 2-dimensional drawings.

Credit points and level

2 SQA Advanced Credits at SCQF level 7: (16 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

While access to this Unit is at the discretion of the centre, it would be beneficial for learners to have a level of proficiency in Information Technology as evidenced by the possession of Core Skill of IT at SCQF level 5, or any equivalent level of study. Additionally, it would be advantageous for learners to have completed or be studying towards SQA Advanced Units in the architectural design processes, such as the Unit HR6Y 47 *Architecture: Form, Order and Composition* or the Unit HR6V 47 *Architectural Professional Practice: Design Management*, or their equivalents. Learners may also benefit from relevant industrial experience.

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.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from the SQA Advanced subject-specific pages on SQA's website (www.sqa.org.uk/sqa).

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

Unit title: Architectural CADT: Principles and Practice (SCQF level 7)

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.

Outcome 1

Produce a standard CAD template file.

Knowledge and/or skills

- ◆ AEC conventions
- ◆ Architectural CAD drawing types
- ◆ user groups
- ◆ CAD drawing layouts
- ◆ elements
- ◆ annotations

Outcome 2

Produce 2-dimensional CAD drawings appropriate to the planning stages of the architectural design process.

Knowledge and/or skills

- ◆ planning approval
- ◆ AEC conventions in relation to planning approval:
 - effective lineweight control
 - accurate indication of material
 - effective tonal value
 - accurate display of elements
 - effective presentation formatting
- ◆ drawing production:
 - standard templates
 - plan details
 - elevation details
- ◆ system tools:
 - user co-ordinate system
 - layer management
 - element management
 - inquiry commands
 - layout management
- ◆ drawing tools
 - ◆ modification tools
 - ◆ hard copy output:
 - scaled plots

Outcome 3

Produce referenced and annotated 2-dimensional CAD drawings appropriate to the building approval stages of the architectural design process.

Knowledge and/or skills

- ◆ AEC conventions in relation to building control approval:
 - effective lineweight control
 - accurate indication of material
 - accurate display of elements
 - effective presentation formatting
- ◆ drawing production:
 - standard templates
 - sectional drawing
 - construction information
- ◆ construction details
- ◆ hard copy output

Outcome 4

Produce conceptual 3-dimensional CAD models from 2-dimensional drawings.

Knowledge and/or skills

- ◆ 3D conceptual conventions for client need:
 - clarity
 - visualisation
- ◆ 3D modelling techniques
- ◆ 3D editing techniques:
 - object properties
 - 3D operations
 - solid/mass editing operations
- ◆ 3D display options:
 - viewing operations
 - wireframe, hidden line, shaded
 - multiple view presentation formats
- ◆ hard copy output

Evidence Requirements for this Unit

Outcome 1

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

- ◆ explain Architectural CAD drawing types, layouts, elements and annotation in line with AEC conventions, standards and industry practice
- ◆ produce a standard template CAD drawing file using AEC conventions for a specified user capable of recording the following minimum details: site plan, boundary limitations, floor plan details, elevation details

The template file produced in this Outcome will then be used for all further practical assignments.

The explanation of Architectural CAD drawing types for this Outcome is a closed-book assessment and must be supervised and held under controlled conditions.

Although all practical assessments are to be conducted under 'open-book' conditions, all assessments must be conducted under controlled, supervised conditions to ensure that tutors oversee learners' developmental processes and to ensure the authenticity of learner work. Learners should be allowed to refer to relevant course material, texts or other sources of aid, such as the software Help system.

Outcome 2

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

- ◆ produce two drawings to the standard necessary for planning approval submission using a standard AEC template file (from Outcome 1), which must include site plan, boundary limitations, floor plan details, elevation details, appropriate cross referencing between views and appropriate annotation.

The drawings must **incorporate all system tool elements** and a **minimum of eight different Drawing Tools** and **eight different Modification Tools** in both drawings. Both produced drawings must be presented as hard copy output to stipulated scales and paper sizes of two A3 scaled plots and should additionally be submitted electronically to tutors.

Although all practical assessments are to be conducted under 'open-book' conditions, all assessments must be conducted under controlled, supervised conditions to ensure that tutors oversee learners' developmental process in the acquisition of knowledge and skills, and to ensure the authenticity of learner work. Learners should be allowed to refer to relevant course material, texts or other sources of aid, such as the software Help system.

Outcome 3

Learners will need to provide evidence to demonstrate their knowledge and/or skills by producing:

- ◆ two drawings using a standard AEC template file (from Outcome 1), each of which must include separate sectional drawings incorporating all details from the knowledge and skills section

Sectional drawings should be **of two Constructional Details items** (two from: substructure, superstructure, internal or external component). The drawings and sectional details could be suitable 2-dimensional drawings for a contractor at the tender stage (such as plans, elevations and sections). Alternatively, they may be drawings typically indicative of those required for building warrant approval by local authorities. In either example, the range of drawings produced should predominantly be those of working detail types.

Both drawings must be presented as hard copy output to stipulated scales and paper sizes of two A3 scaled plots and should additionally be submitted electronically to tutors.

Although all practical assessments are to be conducted under 'open-book' conditions, all assessments must be conducted under controlled, supervised conditions to ensure that tutors oversee learners' developmental process in the acquisition of knowledge and/or skills, and to ensure the authenticity of learner work. Learners should be allowed to refer to relevant course material, texts or other sources of aid, such as the software Help system.

Outcome 4

Learners will demonstrate all knowledge and skills by:

- ◆ producing one drawing layout using a standard AEC template file (from Outcome 1), which develops 2-dimensional drawings created for Outcomes 2 or 3

The completed drawing of the model must be presented as hard copy output to stipulated scales and paper sizes of one A3 scaled plots and should additionally be submitted electronically to tutors.

- ◆ using **a minimum of one 3D modelling technique** to generate a 3D conceptual drawing for the client's consideration

Although all practical assessments are to be conducted under 'open-book' conditions, all assessments must be conducted under controlled, supervised conditions to ensure that tutors oversee learners' developmental process in the acquisition of knowledge and skills, and to ensure the authenticity of learner work. Learners should be allowed to refer to relevant course material, texts or other sources of aid, such as the software Help system.

SQA Advanced Unit support notes

Unit title: Architectural CADT: Principles and Practice (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 80 hours.

Guidance on the content and context for this Unit

This Unit has been designed in order to allow learners to develop knowledge, understanding and skills in the following areas: Industry conventions and application in CAD drawing customs appropriate to typical activities and processes in architectural practice during various stages of the building design process, the production of 2-dimensional architectural drawings and details, manipulation of 2-dimensional architectural drawings and details and the production of conceptual 3D models appropriate to the built environment.

The Unit is at SCQF level 7 and has been devised as a mandatory Unit within Year 1 of the SQA Advanced Diploma in Computer Aided Architectural Design and Technology award. However, this does not preclude the use of the Unit in other awards where appropriate.

The design of this Unit allows for content to be contextualised within topics which allow for a simulation of working practices when preparing a response to a residential client brief.

Consideration for other users and an adherence to practices and procedures impacting on security and safety would be a routine aspect of good practice. Learners could in some circumstances be advised on techniques for diagnosing, and if practical, correcting some technical problems.

A list of possible learning topics is provided in the next section.

A typical minimum hardware configuration for use in this Unit would be a current single user PC fitted with suitable peripherals attached such as a printer/plotter to produce hard copies of work. Alternatively other configurations such as networked CAD stations are acceptable provided they can satisfy the Unit's criteria.

Guidance on approaches to delivery of this Unit

Outcome 1

Produce a standard CAD template file.

In this Outcome the learner should be able to demonstrate the range of conventions applied in the production of architectural drawings. The learner is required to produce a response to identify this range and provide a clear understanding of basic knowledge prior to application of this knowledge in the practical Outcome assignments to follow. This response might be in the form of short answer responses to given questions, best generated by the interrogative response to given architectural drawings presented as case study examples. The learner is also required to demonstrate this knowledge by producing a standard CAD template file for AEC application. Learning topics could be:

- ◆ AEC conventions
- ◆ Architectural CAD drawing types:
 - the purpose of the range of drawings:
urban plans, site layouts, floor plans, elevations, sections, pictorial views
- ◆ the needs of differing user groups:
 - local authorities, client groups, associated consulting professionals, contractors and trades
- ◆ the use of CAD standardisation in the origination of drawings and layouts:
 - standard paper sizes, orientation and scale
 - architectural templates, layouts and formats
 - system settings, user settings, drawing management tools
 - appropriate line types, line weights for AEC drawings
 - rules of orthographic projection and arrangement
 - appropriate lettering, notation and detailing to drawings
 - cut planes
- ◆ elements:
 - current standards relative to the correct display of site components, external building components, internal building components
- ◆ annotation and communication in drawings (clarity of expression, coherence)
appropriate detail level for range of drawing types, hierarchy of lines, indication of materials

Outcome 2

Produce 2-dimensional CAD drawings appropriate to the planning stages of the architectural design process.

In this Outcome, the learners should be able to demonstrate the knowledge gained in Outcome 1 and apply this knowledge through practical skills in the production of drawing details. The focus of the drawing details produced in this Outcome should reflect examples from the range of details routinely required at the early stages of the architectural design process. The drawings should be typically indicative of those required for planning permission approval to local authorities or could be 2-dimensional drawings for client approval, such as site plans, floor plans and/or elevations. In either example, the range of drawings produced should include the following detail from the standard template produced for Outcome 1:

- ◆ plan details (urban, site and boundary definitions, area, floor, or other)
- ◆ elevation details (relative to the plans produced)
- ◆ appropriate cross referencing between views
- ◆ appropriate level of annotation

Drawing output should be no more than two A3 scaled plots in total.

CAD skills should be developed using drawing and modification techniques identified in the form of practical tutorials. Learning topics should be governed by these and the following progressive approach is recommended:

- ◆ planning approval:
 - drawing requirements:
 - range, type, clarity, level of detail
- ◆ AEC conventions:
 - line weight manipulation/editing
 - shape drawing
 - boundary definitions
 - line management/property options
 - drawing management: layer settings, layer control
- ◆ drawing production:
 - contextual drawing
 - plan details, elevation details
 - plan conventions:
 - lineweight, linetype
 - plan arrangement
 - identification/indication of elements within plans:
 - door, window, fixture, fitting, feature, component, symbol
 - relevance of the cut plane
 - identification/indication of elements within elevations:
 - door, window, aperture, fixture, fitting, feature, component, symbol
 - indication of vertical data within elevation
 - storey height, sill, lintel, floor, ceiling levels

- ◆ system tools:
 - the full range of available system tools for the CAD package being used should be explored, with particular emphasis on the development of the learner’s knowledge and skills in the areas of drawing inquiry, management and control, using for example, co-ordinate systems, dimensional control, layer or object management systems, element properties and layout configurations. The exact nature of these will be dependent upon the software used.

- ◆ drawing tools:
 - (line, construction line, multiline, polyline, polygon, rectangle, circle, arc, ellipse, block, hatch, spline, region, group, and table)

 - the full range of drawing techniques available within the CAD software being used should be explored, with particular emphasis on the development of the learner’s knowledge and skills across as wide a range of these as is possible. Focus should be placed clearly on those practices most relevant to those in AEC practice, and it is recommended centres exploit opportunities to develop skills in the areas of ‘block’ creation, manipulation and production, with attribute data where appropriate.

- ◆ modification tools:
 - the full range of modification or editing tools available within the CAD software being used should be explored, with particular emphasis on the development of the learner’s knowledge and skills in those most frequently required modification techniques in the production of typical details. This should extend, as a **minimum**, to the commands: erase, copy, move, rotate, scale, stretch, fillet, chamfer, offset, array, trim, extend, polyedit, and object properties, or their equivalents.

- ◆ output options:
 - layouts
 - viewports
 - scaled details within viewports

Outcome 3

Produce referenced and annotated 2-dimensional CAD drawings appropriate to the building approval stages of the architectural design process.

In this Outcome, the learners should be able to demonstrate the knowledge and skills gained in Outcomes 1 and 2, and apply this knowledge through practical skills in the production of drawing details. The focus of the drawing details produced in this Outcome should reflect examples from the range of details routinely required at the intermediate stages of the architectural design process. These could be 2-dimensional drawings for contractor at the tender stage, such as plans, elevations and sections. Alternatively, they may be drawings typically indicative of those required for building warrant approval by local authorities. In either example, the range of drawings produced should predominantly be those of typical working details.

The exact nature of the working details produced may be left to the discretion of the individual centre to more readily reflect centre specific objectives.

The order of learning topics could be:

- ◆ AEC conventions in relation to building control approval:
 - effective lineweight control
 - accurate indication of material
 - accurate display of elements
 - effective presentation formatting

- ◆ drawing production:
 - use of standard templates
 - sectional drawing
 - construction information

- ◆ construction details:
 - site details:
 - drainage, soakaway, inspection chamber, services
 - from substructure:
 - foundations, footing walls, ground floors, service details
 - from superstructure:
 - cavity walls, internal walls, intermediate floor, roof detail, eave detail
 - internal component:
 - door, staircase, fixture, fireplace
 - external component:
 - door, window, canopy/awning, chimney

- ◆ hard copy output:
 - layouts
 - viewports

It is recommended that drawing output be limited to a maximum of two A3 scaled plots in total.

It is envisaged that each of the A3 plots produced reflect one each of the relevant construction details required for building control approval. For each of these, it is recommended that full working details of the component be fully annotated and cross referenced and include:

- ◆ referenced plan detail
- ◆ referenced elevation detail
- ◆ a **minimum** of two section details

CAD skills should be developed using the range of drawing and modification techniques identified in the knowledge and skills section in the form of practical tutorials. Learning topics should be governed by these and the following progressive approach is recommended:

- ◆ orthographic projection of details
- ◆ material indication
- ◆ clarity of expression
- ◆ notation, specification of elements
- ◆ relevant use of scales
- ◆ relevant use of viewports
- ◆ relevant use of layouts
- ◆ creation and inclusion of tables

Outcome 4

Produce conceptual 3-dimensional CAD models from 2-dimensional drawings.

In this Outcome, the learners should be able to demonstrate a range of 3D modelling skills in the production of conceptual Architectural CAD details. It is the general aim of the Outcome that learners will develop a greater visual sense of real 3-dimensional objects, and develop the skills required to produce and visually display such modelled objects for the benefit of client groups and other associated groups in the architectural design process. No specific software or modelling technique is mandatory, allowing individual centres to use a variety of approaches in achieving a centre specific resolution to the Outcome, however, it is envisaged that centres will use the 2-dimensional drawings produced at Outcomes 2 and 3 as the primary data for the activity in this Outcome. Centres are encouraged to focus strongly on aspects relative to centre or course specific requirements, such as 3D mesh modelling for geo-technical visualisation.

CAD skills should be developed using the range of drawing and modification techniques identified in the knowledge and skills section in the form of practical tutorials. Learning topics should be governed by these and the following progressive approach is recommended:

- ◆ 3D conceptual conventions for client need:
 - clarity
 - visualisation
 - introduction to 3D geometry and space
 - XYZ co-ordinate system
 - viewing principles
 - 3D operations (zoom, pan, spin/orbit)
 - 3D operations (copy, move, rotate, etc)

- ◆ 3D modelling techniques:
 - 3D wireframe models:
 - wireframe models and definitions, practical exercises
 - wireframe models, creation and editing
 - wireframe models, benefits and limitations
 - object properties

 - 3D polymeshes

 - 3D surface models:
 - surface models, creation and editing
 - surface models, benefits and limitations
 - object properties

 - 3D editing techniques

 - 3D solid/mass models:
 - solid/mass models, creation and editing
 - solid/mass models, benefits and limitations
 - object properties

- ◆ 3D display options:
 - Viewing operations
 - Wireframe, hidden line, shaded
 - Multiple view presentation formats

- ◆ hard copy output:
 - model presentation within layouts
 - model presentation within viewports
 - model display options:
 - wireframe viewing
 - hidden line removal
 - shaded viewing (with/without edge details)

 - appropriate annotation

Drawing output should be no more than two A3/A4 plots in total.

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.

The practical evidence generated at Outcome 1 forms part of a continuing integrative assessment for all other Outcomes in the Unit. Outcome 1 consists of both a practical assignment and an explanatory response to justify the underpinning knowledge. This will be assessed by a closed-book, supervised test. Outcomes 2, 3 and 4 are in the form of practical assessments and should be assessed by a series of progressive, related practical assignments, reflecting industry practice in the development of typical, project-specific, architectural layout drawings. Details on which to develop the assessment for Outcome 4 will be drawn from evidence generated for Outcomes 1, 2 and 3.

Although all practical assessments are to be conducted under 'open-book' conditions, all assessments must be conducted under controlled, supervised conditions to ensure that tutors oversee learners' developmental processes to ensure the authenticity of learner work. Learners should be allowed to refer to relevant course material for all assessment occasions.

If a learner's assessment response does not meet the minimum evidence and a remediation attempt is offered, the resubmission should reflect industry practice. For example, drawing details requiring minor revision or modification may be remediated and resubmitted rather than the whole of the project details.

Assessment guidelines

Outcome 1

It is recommended that centres develop checklists from Outcome 1 to fully integrate the learning in Outcomes 2, 3 and 4. The explanatory elements of the assessment event for Outcome 1 could be in the form of a closed-book, short answer/restricted response questioning held in a controlled, supervised environment, with a recommended duration of one hour. The recommended time for the practical assignment, producing the CAD template file, is one and a half hours.

Outcome 2

The recommended time allocation for this Outcome is two hours.

Outcome 3

The recommended time allocation for this Outcome is two hours.

Outcome 4

The recommended time allocation for this Outcome is two hours.

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

Learners are working to a remit which requires the ability to create and manipulate objects in a computer aided design environment. This provides them with the opportunities to use *Problem Solving* techniques, use IT platforms and manipulate numerical data thus developing the Core Skills of *Information and Communication Technology (ICT)* and *Problem Solving* at SCQF level 6. Access to, and evaluation of, examples of complex design drawings would be of value in formative work and further develop the Core Skills elements of Review and Evaluate of the Core Skill *Problem Solving*. Learners should also 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. All these tasks develop the Core Skills of *Information and Communication Technology (ICT)*, *Numeracy* and *Problem Solving* at SCQF level 6.

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 on-line tutorials to reinforce *Numeracy* skills may be useful, thus developing this Core Skill. 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

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

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General information for learners

Unit title: Architectural CADT: Principles and Practice (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 knowledge, understanding and basic skills in Architectural CAD principles, and the use of Computer Aided Design application software for the creation of two-dimensional and three-dimensional drawings relevant to the AEC (Architectural Engineering Construction) industrial context. This Unit provides the sound platform for progression into other, more advanced Architectural Design and CAD related subjects. Within the Unit, you will learn about typical AEC standards, conventions and principles, and develop practical skills in applying these principles into the practical production of AEC CAD drawings.

There will be a series of lectures, practical exercises and tutorials, which will logically, and sequentially progress from the simple to complex ideas.

All assessments are supervised and conducted predominantly 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.

This is largely a practical Unit requiring the use of a CAD system and appropriate software to enable you to generate (and regenerate) drawings. Additionally, you will have the opportunity to develop the Core Skills of *Information and Communication Technology (ICT)*, *Problem Solving and Numeracy* all at SCQF level 6 within this Unit as you will be working to a remit which requires the ability to create and manipulate objects in a computer aided design environment. The use of appropriate CAD software packages, system tool and techniques will allow you to develop skills in the manipulation of objects, components and annotation, as well as 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 provides you with formative opportunities to further develop your effectiveness in the understanding, analysis and application of numerical and graphical data.