

SQA Advanced Unit specification

General information

Unit title: CAD: Feature-Based Modelling 1 (SCQF level 7)

Unit code: HV1G 47

Superclass: CH

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Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This Unit is designed to introduce learners to feature-based modelling and enable them to understand how feature-based modelling techniques can be applied in an industrial concept. The Unit allows learners to develop the necessary knowledge and skills to allow them to understand the advantages and terminology of feature-based modelling. The Unit also provides learners with the opportunity to develop the practical skills to enable them to create part and assembly models using feature-based modelling techniques.

Outcomes

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

- 1 Create geometric profiles and apply two dimensional (2D) constraints.
- 2 Create feature-based models from sketched profiles.
- 3 Create and modify placed features.
- 4 Create an assembly of feature-based model components.
- 5 Explain the terms and benefits associated with feature-based modelling techniques.

Credit points and level

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

Recommended entry to the Unit

Access is at the discretion of the centre. However, learners should possess a basic knowledge and understanding of 2D draughting techniques. This may be evidenced by the possession of SQA Advanced Units in Computer Aided Draughting and/or a Higher in Graphical Communication or equivalent.

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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 Unit may be linked/integrated with the following Units: *Computer Aided Draughting and Design: Graded Unit 1*; *CAD: Visualisation, Rendering and Presentation*.

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 SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

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.

Outcome 1

Create geometric profiles and apply two dimensional (2D) constraints.

Knowledge and/or Skills

- ◆ Straight and curved elements
- ◆ Geometric constraints (this being relevant to the software package used)
- ◆ Dimensional constraints (this being relevant to the software package used)

Outcome 2

Create feature-based models from sketched profiles.

Knowledge and/or Skills

- ◆ Modelling techniques (this being relevant to the software package used)
- ◆ Annotated and dimensioned drawings
- ◆ Orthographic projection
- ◆ Sectioning
- ◆ Printing

Outcome 3

Create and modify placed features.

Knowledge and/or Skills

- ◆ Placed features:
 - holes
 - fillets
 - chamfers
 - shelling
 - webs/ribs
 - sketched
- ◆ Bi-directional associativity
- ◆ Printing

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Outcome 4

Create an assembly of feature-based model components.

Knowledge and/or Skills

- ◆ Part retrieval for assembly modelling
- ◆ 3D constraints (this being relevant to the software package used)
- ◆ Assembly drawings
- ◆ Parts list in assembly drawing
- ◆ Balloon detailing in assembly drawing
- ◆ Printing

Outcome 5

Explain the terms and benefits associated with feature-based modelling techniques.

Knowledge and/or Skills

- ◆ Use of feature types
- ◆ Use of 2D constraints
- ◆ Parametric modelling
- ◆ Associativity relating to CAD

Evidence Requirements for this Unit

Outcome 1

A learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the learner is able to:

- ◆ create a minimum of four sketched 2D profiles from linear and curved elements.
- ◆ add appropriate geometric and dimensional constraints which fully constrain the sketched profiles.
- ◆ produce hardcopy prints of the sketched profiles.

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

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Outcome 2

A learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the learner is able to:

- ◆ create a minimum of four feature-based model components using a minimum of three modelling techniques.
- ◆ create one annotated/dimensioned drawing for each of the four feature-based model components in orthographic projection. At least one drawing should contain a section view.
- ◆ produce hardcopy prints of the completed drawings.

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

Outcome 3

A learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the learner is able to:

- ◆ apply placed features to existing feature-based models.
- ◆ create one annotated and dimensioned drawing for each of the feature-based model components, showing the added placed features, in orthographic projection.
- ◆ modify a minimum of two existing placed features, one from within the part environment and the other directly from the drawing.
- ◆ create one annotated/dimensioned drawing for each of the modified feature-based model components, in orthographic projection.
- ◆ produce hardcopy prints of the completed drawings.

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

Outcome 4

A learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the learner is able to:

- ◆ retrieve part models for creation of assembly (minimum of four components).
- ◆ apply appropriate 3D constraints between part models which achieve the desired physical link.
- ◆ create an assembly drawing in orthographic projection with a 3D Isometric view.
- ◆ create a parts list and balloon detailing in an assembly drawing.
- ◆ produce hardcopy print of the completed assembly drawings.

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

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Outcome 5

A learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the learner is able to:

- ◆ list a minimum of five 2D constraints.
- ◆ explain the term parametric in relation to CAD.
- ◆ state a minimum of two benefits of using a feature-based modelling system.
- ◆ state two reasons why 2D constraints are used in feature-based modelling.
- ◆ list the three main feature types used in feature-based modelling and explain their use.
- ◆ explain the term associativity in relation to CAD.

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

SQA Advanced Unit Support Notes

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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 the following areas:

- 1 Creation of geometric profiles and application of 2D constraints.
- 2 Creation of feature-based models from sketched profiles.
- 3 Creation and modification of placed features.
- 4 Creation of an assembly of feature-based model components.
- 5 Explanation of the terms and benefits associated with feature-based modelling techniques.

This Unit is at SCQF level 7 and may form part of a group award or be completed as a free-standing Unit.

In designing this Unit, the Unit writer has identified the range of topics that would be expected to be covered by lecturers. The writer has also given recommendations as to how much time should be spent on each Outcome assessment. This has been done to help lecturers decide what depth of treatment should be given to the topics attached to each of the Outcomes. While it is not mandatory for centres to use this list of topics, it is recommended that they do so as the Assessment Support Pack (ASP) for this Unit is based on the Knowledge and/or Skills and list of topics in each of the Outcomes.

A list of topics for each Outcome is given below. Lecturers are advised to study this list in conjunction with the Assessment Support Pack (ASP) so that they can get a clear indication of the standard of achievement expected of learners in this Unit.

Outcome 1

Create geometric profiles and apply two dimensional (2D) constraints (2.5 hours)

The following topics are generic in nature but should be put into context by reference to the CAD software application package being used at the centre:

- ◆ Use of 2D linear and curved elements to create sketched profiles.
- ◆ Use of 2D geometric constraints, eg horizontal, vertical, perpendicular, parallel, tangential, etc. The constraints being used to establish position, orientation and relationships of each element in a sketched profile.
- ◆ Use of dimensional constraints, ie linear, radial and angular, to establish size and proportion of each element within a sketched profile.

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Outcome 2

Create feature-based models from sketched profiles (10 hours)

The following topics are generic in nature but should be put into context by reference to the CAD software application package being used at the centre:

- ◆ Use of the revolve function
- ◆ Use of the extrude function
- ◆ Use of the loft function
- ◆ Use of the sweep function
- ◆ Use of work features:
 - planes
 - axes
 - points
- ◆ Creation of drawings with multiple views in orthographic format:
 - elevation, end elevation, plan, section, detail, isometric, auxiliary, etc
- ◆ Use of the dimension/annotation functions within the drawing environment
- ◆ Retrieving dimensional information from the part model, ie parametric dimensions

Outcome 3

Create and modify placed features (10 hours)

The following topics are generic in nature but should be put into context by reference to the CAD software application package being used at the centre:

- ◆ The addition of placed features to existing feature-based models:
 - hole, fillet, chamfer, shell, web, rib, sketched, etc
- ◆ The modification of placed features in both the part and drawing environment, which will help satisfy the bi-directional associativity aspects of this Outcome

Outcome 4

Create an assembly of feature-based model components (10 hours)

The following topics are generic in nature but should be put into context by reference to the CAD software application package being used at the centre:

- ◆ The retrieval of drawings from library/files for use in an assembly environment
- ◆ The application of 3D constraints to form an accurate physical relationship between multiple parts (this should reflect the real working solution)
- ◆ Creation of drawings with multiple views in orthographic format
- ◆ Creation of parts list and balloon detailing (should be used to convey important information about the components in the assembly). The parts list could contain information on the following:
 - Part Number
 - Part Name
 - Quantity
 - Material
 - Description

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Outcome 5

Explain the terms and benefits associated with feature-based modelling techniques (taught throughout the Unit).

Outcome 5 looks at the terms and benefits associated with feature-based modelling. The learners should be aware of the following:

- ◆ Feature types: identification and explanation of the purpose of the main feature types, ie work, base and placed features:
 - work feature: used to position and orientate the model geometry.
 - base feature: the simplest form of an object before the addition of placed features. The base feature will start from a sketched profile.
 - placed features: these are applied to the existing base feature to produce a geometric change, eg holes, fillets, chamfers, etc.
- ◆ 2D constraints: identification and explanation of the purpose of 2D constraints:
 - geometric constraints: horizontal, vertical, perpendicular, parallel, tangential, concentric, etc. Geometric constraints are used to establish relationships between the elements of a sketched profile.
 - dimensional constraints: linear, radial and angular. Dimensional constraints control the size of each element in a sketched profile.
- ◆ Parametric modelling: acknowledgement of the power of parametric dimensioning where a dimensional change will enforce a geometric change.
- ◆ Associativity relating to CAD: part, drawing and assembly files are linked; therefore, a change in one file will be reflected in the others, etc.

Guidance on approaches to delivery of this Unit

It is intended that this Unit be presented at all times using the specialist application CAD software available at the centre. Appropriate technical and support material should be available to the learner.

In the delivery of this Unit, learners should be provided with the opportunity to gain as much 'hands on' experience as possible. Each learner should have access to a PC with the CAD software installed. Learners should NOT work in groups.

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.

Outcomes 1, 2, 3 and 4 in this Unit should be practical. Outcome 5 should consist of short written questions and answers.

Outcomes 1, 2, 3 and 4 may be integrated into a single assignment. The assignment tasks should involve creating 2D geometric profiles, creating feature-based model components from 2D profiles, adding and modifying placed features to/of feature-based-model components, assembling the components, generating 2D drawing detail from both the components and the assembly to a given specification. The assignment should be completed

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in 7 hours. Learners should be allowed to refer to relevant course material. This assignment should be carried out at the end of the delivery of the Unit.

These assessments should be conducted under controlled, supervised conditions.

It should be noted that learners must achieve all the minimum evidence specified for each Outcome in order to pass the Unit.

It is essential that Centres ensure that evidence generated is the learner's own work. While it would be advantageous for Centres to issue learners with separate models to create, this is not practical, and learners will thus be asked to create the same models for each Outcome. This is acceptable.

An Assessment Support Pack (ASP) is available for this Unit.

Assessment Guidelines

Outcome 1

The assessment for this Outcome should take the form of a single practical exercise. The assessment can be carried out after the topic has been taught or at the end of the Unit. This is at the discretion of the presenting centre. The time allocation for the assessment is 1 hour. It is recommended that centres develop checklists to support the assessment requirements for each of the Knowledge and/or Skills items.

Outcome 2

The assessment for this Outcome should continue from Outcome 1 and should take the form of a practical exercise. The assessment can be carried out after the topic has been taught or at the end of the Unit. This is at the discretion of the presenting centre. The time allocation for the assessment is 2 hours. It is recommended that centres develop checklists to support the assessment requirements for each of the Knowledge and/or Skills items.

Outcome 3

The assessment for this Outcome should continue from Outcome 2 and should take the form of a practical exercise. The assessment can be carried out after the topic has been taught or at the end of the Unit. This is at the discretion of the presenting centre. The time allocation for this assessment is 2 hours. It is recommended that centres develop checklists to support the assessment requirements for each of the Knowledge and/or Skills items.

Outcome 4

The assessment for this Outcome should continue from Outcome 3 and should take the form of a practical exercise. The assessment can be carried out after the topic has been taught or at the end of the Unit. This is at the discretion of the presenting centre. The time allocation for the assessment is 2 hours. It is recommended that centres develop checklists to support the assessment requirements for each of the Knowledge and/or Skills items.

Outcome 5

The assessment for this Outcome should take the form of a short written exercise and should be carried out at the end of the Unit. The time allocation for the assessment is 0.5 hours. It is recommended that centres develop checklists to support the assessment requirements for each of the Knowledge and/or Skills items.

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 Skill of *Problem Solving* at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

All elements of the Core Skill of *Problem Solving*, namely Planning and Organising, Critical Thinking, and Reviewing and Evaluating, should be fully developed and further enhanced as learners undertake the Unit, applying theoretical knowledge to a complex practical task, and meet the requirements of a given brief. Designing and producing potential solutions, identifying and maximising all available resources and recognising and overcoming any potential difficulties will involve a high level of critical thinking. Group discussion of issues may be useful although learners should be independently able to justify and apply effective media techniques allowing on-going opportunities for review and potential adjustment. Learners would benefit from individual discussions with the assessor to reinforce analytical evaluation of achievement as a guide to future activities and further development. Learners should be encouraged to identify appropriate evaluative methods to measure achievement. Evaluation in which all aspects of the application of mixed media and their potential impact are analysed will be a critical underpinning aspect of presentation.

Although communication skills are not formally assessed learners will be expected to analyse, produce and present written and oral materials to standards acceptable in industry, and to express essential ideas and information accurately and coherently. They should ensure that the information they communicate has been considered, is accurate and is effectively presented to meet the needs of purpose and users.

History of changes to Unit

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.

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: CAD: Feature-Based Modelling 1 (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 provide you with the knowledge and skills that will enable you to understand the basic concepts of feature-based modelling.

This Unit will also allow you to develop practical skills that will enable you to create feature-based models.

The formal assessment for this Unit is practical although there is a small written assessment requirement.

The actual assessment times are as follows:

Outcome 1	Practical	1 hour
Outcome 2	Practical	2 hours
Outcome 3	Practical	2 hours
Outcome 4	Practical	2 hours
Outcome 5	Written	0.5 hours

Your being asked to satisfactorily create feature-based models will assess your practical skills. You will be presented with the basic drawing, sizes and layouts that are needed to create these models.

At the discretion of the individual centres, all Outcomes can be carried out after the teaching of the appropriate topics or as an integrated assignment; this will not usually be attempted until all teaching has been completed.