National Unit specification

General information

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

Unit code: H65X 46

Superclass: TE

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Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This Unit has been developed as a mandatory Unit in the National Certificate Built Environment at SCQF level 6 and an optional Unit in the National Certificate Civil Engineering at SCQF level 6 but may also be taken as a free-standing Unit.

The Unit introduces the learner to the principles, methods and processes of the site planning and construction of low rise building substructure on Greenfield sites. The content of the Unit includes site investigation and preparation of the site for building purposes and the functional requirements and constructional detailing of the substructure of a building. Learners will produce sketches of details of substructure construction.

This Unit is suitable for learners who have limited knowledge of the various factors which are involved with the groundwork's and substructure of domestic buildings. Study of this Unit will contribute to the development of appropriate skills and knowledge for learners considering a career in the construction industry as technicians, technologists and other construction professionals.

National Unit specification: General information (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

Outcomes

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

1 Plan the establishment of a site to enable construction work to commence.
2 Describe common forms of domestic substructure construction and the associated processes.

Credit points and level

1 National Unit credit at SCQF level 6: (6 SCQF credit points at SCQF level 6)

Recommended entry to the Unit

While entry is at the discretion of the centre, learners will normally be expected to have attained one of the following:

- Intermediate 2 Scottish Group Award in an appropriate area
- Intermediate 2 Course in Structures, Craft and Design, Graphic Communication or Technological Studies
- Standard Grades at grade 3 or above, or Intermediate 2, in English, Mathematics, Physics or Technological Studies, Craft and Design or Graphic Communication.
- National 4 or Above in Mathematics, English, Physics or Technological Studies, Craft and Design or Graphic Communication

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 instrument of 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).

National Unit specification: General information (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

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**.

National 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

Plan the establishment of a site to enable construction work to commence.

Performance Criteria

(a) Select temporary works for site establishment of a given site with regard to current good practice and safety.
(b) Plan temporary site facilities required for safety, security, welfare and storage for a given site in accordance with current good practice and legislation.

Outcome 2

Describe common forms of domestic substructure construction and the associated processes.

Performance Criteria

(a) Describe the reasons for and techniques of site investigation in terms of function, economy and safety.
(b) Describe examples of common forms of domestic substructure, with the aid of annotated details.
(c) Describe the processes relating to the excavation and earthworks in terms of current good practice.
(d) Describe the sequence of construction operations that is in compliance with current good practice.

Evidence Requirements for this Unit

Written/recorded oral and product evidence is required which demonstrates that the learner has achieved all Outcomes and Performance Criteria of this Unit.

The assessment for this Unit is a combination of practical and knowledge-based activities. The Outcomes should be assessed with two assessments comprising:

- A 60 minute closed-book test for Outcomes 1 and 2.
- A folio of work for Outcome 2 (PC (b)) produced in open-book conditions as a natural part of the learning and teaching process.

National Unit specification: Statement of standards (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

The closed-book test will include a series of short answer and/or restricted response questions on planning the establishment of a site and the site layout and explaining the processes associated with substructure construction. Learners will complete a practical exercise in planning a site layout for a given construction project. This will be carried out in controlled conditions: learners are not permitted to collaborate in their responses.

The open-book assignment folio of work is a collection of annotated sketches of the construction of building substructure. The production of the folio will be carried out in open-book, supervised conditions. Learners are free to co-operate with colleagues in the researching of technical information and construction technology details. They may also confer with regard to drawing and sketching techniques and presentation. Assessors must, nevertheless, satisfy themselves that learners' folios contain their own work.

The assessment instruments must, taken together, cover all Outcomes and satisfy all Performance Criteria.

Achievement in the closed-book test can be decided by the use of a cut-off score. The Assessment Support Pack items illustrate the standard that should be applied and also the nature and extent of the sample to be used. If a centre wishes to design its own assessments for this closed-book test, they should be of a comparable standard.

Achievement in the folio of work will be decided on an achieved/not achieved basis. The criteria for achievement in the folio of work are that the annotated sketches will:

- be accurate in terms of content and be well proportioned.
- be annotated and presented in accordance with current industry practice.
- demonstrate knowledge of the function of the materials and components included in the details.
- demonstrate recognition/understanding of the specification of the materials and components.

An exemplar for the folio of work can be accessed via the SQA Co-ordinator for each centre. The exemplar illustrates the standard that should be applied for the folio of work.

For the closed-book test for Outcomes 1 and 2, where learners fail to reach the agreed threshold score, reassessment should follow using an alternative instrument of assessment.

For the folio of work for Outcome 2(b), where learners fail to reach the required performance, re-assessment of one or more sub-tasks may be all that is required to bring the learner's performance up to an acceptable standard.

Evidence will be gathered at appropriate points throughout the delivery of the Unit.

Assessment must be manageable and practicable for centres and the closed-book, supervised assessment portion should not exceed 1 hour.

National Unit Support Notes

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

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 developed as an optional Unit in the National Certificate Civil Engineering at SCQF level 6 and a mandatory Unit in the National Certificate Built Environment at SCQF level 6 and can also be:

- improve employment opportunities as technicians or technologists in a related field.
- lead to work based training in a related SVQ award.
- allow progression to a related HNC/D award in Civil Engineering or the Built Environment.

This Unit on the subject of substructure construction is set in the context of low-rise domestic buildings or dwelling houses. It shares some subject matter in common with the topics of industrial and commercial substructure technology. However, there are some distinct differences between domestic and other forms of construction. No prior knowledge of building construction is required of learners undertaking this Unit.

Content to be covered (Outcomes 1 and 2)

Learners will become familiar with the establishment of a site, site investigation and the processes associated with substructure construction.

Outcome 1— provides the learners with knowledge of the techniques employed in site establishment for housebuilding. It also develops knowledge of the techniques involved in planning the layout of temporary works on site. This will cover vehicular access and parking, temporary roads, storage of materials, locations for large plant, temporary health and welfare accommodation, site safety, security and temporary services.

National Unit Support Notes (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

Outcome 2 — provides the learner with knowledge of substructure construction, beginning with site investigation and soil testing. The topic then progresses from the commencement of excavations and earthworks through the underbuilding construction to damp-proof course level. It will provide the learner with a sound knowledge of the types and forms of foundations normally used in low-rise domestic buildings and introduce them to relevant health and safety considerations. It also provides an opportunity for learners to develop sketching skills.

Learners who study this Unit will develop knowledge and understanding of the reasons for a thorough site investigation, especially in the context of the selection of foundations and excavation techniques. The overall discussion of site investigation will include aspects of site planning and layout as well as health and safety issues. Specific legislation could be discussed where appropriate and helpful. The importance of providing health and safety information to contractors at an early stage in the project must be emphasised. It would be appropriate at this stage to give the learner an appreciation of the purpose of the legislation, but to delve too deeply into specific legislation would not be appropriate.

Site Establishment

For site establishment an outline drawing of a site plan for a development of 15–20 houses will be given to learners. Learners will plan the requirements of the following items for the site and indicate with graphics and/or text:

- Access and egress for vehicles and pedestrians having regard to convenience and safety
- Parking for vehicles
- Location and specification of temporary roads within the boundaries of the site
- Methods of protecting the public during construction operations
- Temporary accommodation (assuming a maximum of 30 persons on site at any one time)
- Location of items of large plant (if required)

In addition, learners will have to identify the location of and describe the facilities for the following:

- Temporary services:
  - — electricity
  - — water
  - — telephone
  - — foul drainage

- Storage facilities with respect to protection, safety, security and good site practice related to:
  - — cement
  - — aggregates
  - — bricks
  - — timber

- trussed rafters
- plasterboard
- windows
- doors
- paint
- plumbing and heating pipes and fittings
- sanitary fittings
- electrical fittings
- small tools

The focus of this aspect of the Unit is the planning of the site establishment. This includes the selection of a location for the site access, temporary roads, storage of materials and components and temporary accommodation. All of these must be selected in a way that provides for an efficient site. The specification of the temporary road materials is part of the subject matter of the Unit. The learner will study the different solutions commonly adopted to secure the site and protect the public during construction works. The learner will also study the provision of temporary services such as electricity, water, telephones and foul drainage.

Site investigation

Study of Outcome 2 might best begin with a brief introduction to the objectives and techniques of site investigation, covering desk study, walk over and ground investigation.

Learners will have to be prepared to answer a series of short answer and/or restricted response questions based on the given site plan. These questions will be on the sequencing and processes involved in low-rise housing substructure, including:

- The reasons for site investigation for the given site.
- Techniques of site investigation: justification of any two appropriate methods.

Reference should be made to the techniques adopted for the ground investigation, namely trial pits and bore holes, together with information gathered from *in situ* testing and laboratory testing. *In situ* testing should include the cone penetration test (CPT), standard penetration test (SPT) and the field vane test. Laboratory testing should include pH, sulphate, moisture content and particle size distribution. Learners should be referred to current published standards for site investigation and in-situ tests (although these will not be the subject of specific assessment). Specifically, learners should be given an appreciation of the reasons for and techniques available for testing ground and soil samples. They should learn where and when the different methods are appropriate.

National Unit Support Notes (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

Substructure construction

The function and functional requirements of this element of the building should be stressed.

- Current health and safety practices associated with excavation and earthworks for substructure.
- Current methods of constructing foundations and underbuilding including:
  - Strip foundations
  - Pad foundations
  - Raft foundations
  - Short-bored piles and ground beams
- The sequencing of operations for the foundation type selected above from initial excavations up to and including substructure walls to damp proof course (dpc) level and ground floor structure; including methods for mixing, transporting, placing, compacting, curing and protecting concrete and (if required) installation of reinforcement.

NOTE: *The use of prefabricated foundations and underbuildings is increasing in housing construction. Learners may refer to prefabrication techniques in assessment responses.*

Excavation and earthworks should include foundation trenches, pits and earthwork support. Sloping sites, techniques of excavation and stepped foundations, may be discussed but do not require to be covered in depth or for assessment purposes of this Unit.

Earthwork supports and preparation of surfaces of excavations to receive concrete or other fill should be included. Reference should be made to the specification for fill materials and their correct compaction techniques and equipment. Relevant health and safety aspects should be covered.

The study of foundations in this Unit incorporates the underbuilding up to damp proof course level and will therefore include substructure brick/blockwork and dwarf walls as well as solum treatments. The focus of attention for learners will be on the details of foundation construction and the perimeter walls in the underbuilding. They will also look at the tying in of the solum and the ground floor construction with the substructure walls.

Simple foundation types should be limited to strip foundations, pad foundations, raft foundations, short bored piles and ground beams. These should be considered in the context of low-rise domestic buildings only. The placement of and the reasons for the inclusion of steel reinforcement in foundations and in-situ concrete floor slabs should be studied.

Specification and supply of concrete mixes for foundations should include designated, designed, prescribed and standard mixes detailed in current standards. Reference should be made to the current standards for concrete. Methods of batching, mixing, transporting, placing, compacting, curing and protecting the concrete must be studied.

The use of pre-fabricated foundations in housebuilding is increasing. Learners should be made aware of this development and become familiar with some of the systems commercially available. Learners may refer to prefabrication techniques, where appropriate, in their responses to assessment tasks.

National Unit Support Notes (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

Substructure walling, including the support for floors, position of damp-proof courses, damp-proof membranes, service entries, sub-floor ventilation and solum treatment should also be included.

The topic of ground floors in this Unit includes suspended timber floors, in-situ concrete floors and beam and block floors. Damp proof membranes should be included in this Unit as should ground floor insulation.

Health and safety must be stressed throughout each aspect of the Unit. Focus should be given to the ways in which legislation is applied to remove hazards and protect the operatives on site.

Open-book folio of work (Outcome 2 (PC (b))

A folio of work for the assignment will be prepared by each learner individually. Centres will ensure that the work submitted in the folio is the learner's own work. It is anticipated that the folio of work is produced as a natural part of the learning and teaching process.

The folio of work will include:

Annotated sketches with details of building substructure for a foundation for low-rise housing including a cross-section showing:

- Excavations
- Foundations
- Substructure brickwork and blockwork (if applicable)
- Damp proof course (DPC)
- Solid concrete floor construction ***or*** suspended timber floor construction ***or*** beam and block floor construction (although these should all be covered in learning and teaching)
- Damp proof membranes (if applicable)
- Insulation
- Solum treatment (if applicable)
- Service entries
- Underfloor ventilation (if applicable)
- Fill

The sketches must:

- contain detailing that complies with current building legislation and good practice.
- contain appropriate content and be well proportioned.
- be presented in accordance with current good practice in the construction industry.

The annotations must:

- include appropriate specification of materials.
- be presented in accordance with current good practice in the construction industry.

National Unit Support Notes (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

The reasons for having standards in drawing layout/presentation should be emphasised. Sketches should be well proportioned, ie each component is depicted in sensible proportion to the rest of the sketch. They should include clarity of detail. Learners may refer to textbooks, technical literature and architectural drawings to gain an appreciation of the detail required for specific sketches. These should include foundations, floor/wall junctions for ground floor slabs and suspended floors of timber and concrete construction.

Guidance on approaches to delivery of this Unit

Suggested teaching and learning methods for this Unit might include computer assisted learning, question and answer sessions, group work, directed investigative study, student learner guides, site/building visits, sketching and drawing.

The Outcomes in this Unit are arranged logically in the order in which the activities would take place in the construction of the building. This permits learners to relate the different requirements of the construction process to one another and to think logically about the process of the construction of a building. Outcome 2 could be addressed in terms of function and functional requirements. A combination of the two approaches is likely to be most effective.

The teaching of construction technology can be made visual with the use of construction drawings. Use of electronic whiteboards, projectors, photographic images and computer-aided drawings is increasing in some centres and is useful in illustrating the different stages of building work. Electronic resources are particularly useful for learners who are remote from their centre and for those wishing to access materials outwith centre hours.

Textbooks and DVDs on house construction are readily available. Some centres subscribe to electronic libraries that contain a vast wealth of written and pictorial information on house building. Resources also exist from national construction research organisations and trades organisations.

- Current British Standards
- Building Research Establishment digests, information papers, good practice guides and defect action sheets
- Current Building Standard (Scotland) Regulations

Increasingly manufacturers and suppliers of building materials produce technical literature that highlights how their products comply with current building legislation. Learners will likely find that such literature is very informative and visual as well as being available online from the company website. The current legislation pertaining to building construction in Scotland should be referred to throughout the Unit. The technical guidelines provided by the NHBC (National House Building Council) will be of particular interest and value because they relate purely to house construction.

National Unit Support Notes (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

Field trips to building sites are always of benefit to learners. On housing sites there are often several plots under development at any one time; learners can often see at one glance the process of house construction in its various stages. Note should be taken of all plant and equipment being used in construction works. Aspects of health and safety should be particularly noted. After visiting the site learners could be encouraged to write down a simple method statement for the construction of the building element(s) observed. This activity will reinforce learning from the field trip.

Examples of visit observations relevant to this Unit:

- Site layout and the planning of temporary works and installations such as site huts, concrete mixers and batching plant, temporary screens and materials storage facilities.
- Underground drainage and incoming services.
- Pouring of concrete (plain or reinforced) foundations.
- Storage of components and materials.

Talks by site managers can be useful in describing, for example, the site clearance and site scrape, levelling of land, traffic issues, as well as issues regarding handling and storage, use of prefabricated components, weather restrictions, etc. These talks can often be arranged through the construction company and allow a chance for learners to ask questions.

Freehand and instrument-aided sketching should take place throughout the Unit. Emphasis should be given to good drawing practice, neatness, clarity, the effective use of annotation and the layout of the drawings. Examples of good practice can often be obtained from drawings carried out by professional draughts people and designers. Displaying these will help illustrate good practice and the use of various drawing scales. These sketches will form the folio of work required for Outcome 2.

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.

This Unit gives learners experience of:

- planning site establishment.
- explaining and detailing substructure construction.

Although learners will develop their knowledge and understanding of the factors and issues involved in planning site establishment and substructure construction, Unit assessment is focussed on the application of this knowledge and understanding.

National Unit Support Notes (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

The Outcomes should be assessed with two assessments comprising:

- A 60 minute closed-book test for Outcomes 1 and 2.
- A folio of work for Outcome 2 (PC (b)) produced in open-book conditions as a natural part of the learning and teaching process.

The closed-book test for Outcomes 1 and 2 will include a series of short answer and/or restricted response questions on planning the establishment of a site and the site layout and explaining the processes associated with substructure construction. This test will be carried out in controlled conditions: learners are not permitted to collaborate in their responses.

The open-book assignment folio of work is a collection of annotated sketches of the construction of building substructure. The production of the folio of work will be carried out in open-book, supervised conditions. Learners are free to co-operate with colleagues in the researching of technical information and construction technology details. They may also confer with regard to drawing and sketching techniques and presentation. Assessors must, nevertheless, satisfy themselves that learners' folios contain the learner's own work.

Achievement in the closed-book test can be decided by the use of a cut-off score. Where learners fail to reach the agreed threshold score, reassessment should follow using an alternative instrument of assessment.

Achievement in the folio of work will be decided on an achieved/not achieved basis. Where learners fail to achieve the required performance, re-assessment of one or more sub-tasks may be all that is required to bring the learner's performance up to an acceptable standard.

The standard to be applied and the breadth of coverage are illustrated in the Assessment Support Pack available for this Unit. Where centres wish to develop their own assessment materials they should refer to the Assessment Support Pack to ensure a comparable standard.

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**.

National Unit Support Notes (cont)

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

Opportunities for developing Core and other essential skills

In this Unit learners will:

- plan the establishment of a site to enable construction work to commence.
- explain, with the aid of annotated details, common forms of domestic substructure construction and the associated processes.

These offer opportunities to develop aspects of the Core Skill components of:

- Using Graphical Information at SCQF level 4
- Critical Thinking at SCQF level 5

Throughout this Unit learners will be working to/learning national building standards and regulations.

This will offer opportunities to develop essential skills in employability.

History of changes to Unit

Version	Description of change	Date

General information for learners

Unit title: Construction Technology: Groundworks and Substructure (SCQF level 6)

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 is suitable for learners who have limited knowledge of the various factors which are involved with the groundworks and substructure of domestic buildings. Study of this Unit will contribute to the development of appropriate skills, eg sketching, drawing, detailing, and knowledge, eg familiarity with common materials used in the industry, for learners considering a career in the construction industry as technicians, technologists and other construction professionals.

The Unit introduces you to the principles, methods and processes of the site planning and construction of low rise building substructure on greenfield sites. The content of the Unit includes site investigation and preparation of the site for building purposes and the functional requirements and constructional detailing of the substructure of a building. You will produce sketches of details of substructure construction.

The assessment for this Unit is a combination of practical and knowledge-based activities. The Outcomes should be assessed with two assessments comprising:

- A 60 minute closed-book test for Outcomes 1 and 2, which will include a series of short answer and/or restricted response questions.
- A folio of work for Outcome 2 (PC (b)) produced in open-book conditions as a natural part of the learning and teaching process. The folio of work is a collection of annotated sketches of the construction of building substructure. The production of the folio will be carried out in open-book, supervised conditions.

Study of this Unit will also develop the Core Skills components of Using Graphical Information and Critical Thinking as well as essential skills in employability.

This Unit has been developed as a mandatory Unit in the National Certificate in Built Environment at SCQF level 6 and an optional Unit in the National Certificate in Civil Engineering at SCQF level 6 but may also be taken as a free-standing Unit. Attainment of one of these NC Awards may improve employment opportunities in a related field and will usually allow progression to a related HNC/HND course. This may, in turn, lead to a university degree course in a construction profession.