National Unit Specification: general information

UNIT Building Construction: Site Establishment and Substructure (Higher)

CODE DV3N 12

COURSE Building Construction (Higher)

SUMMARY

This Unit is a mandatory Unit of the *Higher Building Construction* Course, but may also be taken as a free-standing Unit.

This Unit introduces the methods and processes of substructure construction for low-rise housing on greenfield sites. The content of the Unit includes site investigation and the site establishment work carried out prior to the commencement of groundworks and excavations. Current methods in the construction of foundations and substructure are covered. Candidates will produce sketches of details of substructure construction.

The Unit is suitable for candidates who aim for a career in the construction industry as technicians, technologists and other construction professionals. The Unit may be undertaken by both full-time and part-time candidates in further education as well as candidates currently at school. Candidates may use this qualification to progress to further study at Higher National or Degree level.

OUTCOMES

1 Plan the establishment of a site to enable construction works to commence.
2 Explain the processes associated with substructure construction.
3 Produce annotated sketches to illustrate the construction of building substructure.

Administrative Information

Superclass: TK

Publication date: March 2006

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- An Intermediate 2 Course in Product Design, Graphic Communication or Technological Studies or their Units
- Two Standard Grades at Credit level, one from each of the following groupings:
  - Mathematics, Physics or Technological Studies
  - either Craft and Design or Graphic Communications

No prior knowledge of building technology is required of candidates undertaking this Unit, although building site experience will be of benefit.

CREDIT VALUE

1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

Achievement of this Unit gives automatic certification of the following:

Complete Core Skill	None
Core Skills components	Using Graphical Information at SCQF level 4 Critical Thinking at SCQF level 5

National Unit Specification: statement of standards

UNIT Building Construction: Site Establishment and Substructure (Higher)

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 the Scottish Qualifications Authority.

OUTCOME 1

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

Performance Criteria

(a) Temporary facilities required to safety, security, welfare and storage for a given site are planned correctly in accordance with current good practice and legislation.
(b) Temporary works for site establishment of a given site are selected correctly with regard to current good practice and safety.

OUTCOME 2

Explain the processes associated with substructure construction.

Performance Criteria

(a) The reasons for carrying out a site investigation for a given site are explained correctly in terms of function, economy and safety.
(b) Techniques of site investigation selected for a given construction project are justified correctly in terms of function, economy and safety.
(c) Methods of constructing foundations and underbuilding for domestic construction are described correctly in terms of current good practice.
(d) The sequence of substructure operations for a given construction project is selected correctly in terms of current good practice.
(e) Health and safety practices associated with excavation and earthworks for substructure are correctly described in terms of current good practice.

OUTCOME 3

Produce annotated sketches to illustrate the construction of building substructure.

Performance Criteria

(a) Annotated sketches produced contain correct detailing of substructure with respect to current building legislation and good practice.
(b) Annotated sketches of substructure produced are accurate and well proportioned.
(c) Annotations produced are correct with respect to the specification of materials and components.
(d) Annotation and presentation of sketches is in accordance with current industry practice.

National Unit Specification: statement of standards (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

EVIDENCE REQUIREMENTS FOR THIS UNIT

Written/oral and product evidence is required which demonstrates that the candidate has achieved all Outcomes in this Unit and all Performance Criteria within Outcomes. The content for this Unit is detailed in the Appendix.

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 3, produced in open-book conditions as a natural part of the learning and teaching process

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. Candidates will complete a practical exercise in planning a site layout for a given construction project. This will be carried out in controlled conditions: candidates 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. Candidates 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 candidates' folios contain their own work.

The assessment instruments will sample the content and skills detailed in the Appendix to the Unit. The assessment instruments must, taken together, cover all Outcomes and all Performance Criteria.

Achievement in the closed book test can be decided by the use of a cut-off score. The National Assessment Bank 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 the Performance Criteria in Outcome 3.

An exemplar for the folio of work for Outcome 3 can be accessed via the SQA Coordinator 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 candidates fail to reach the agreed threshold score, reassessment should follow using an alternative instrument of assessment.

For the folio of work for Outcome 3, where candidates fail to achieve the required performance, reassessment of one or more sub-tasks may be all that is required to bring the candidate's performance up to an acceptable standard.

National Unit Specification: statement of standards (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

APPENDIX

NB: All the content in this Section should be covered and is liable to sample through Unit and/or Course assessment.

Content to covered (Outcomes 1 and 2)

Candidates will have to be familiar with the establishment of a site, site investigation and the processes associated with substructure construction.

For site establishment an outline drawing of a site plan for a development of 15-20 houses will be given to candidates. Candidates 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, candidates will have to be able 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
  - bricks
  - aggregates
  - trussed rafters
  - plasterboard
  - timber
  - windows
  - doors
  - paint
  - plumbing and heating pipes and fittings
  - sanitary fittings
  - electrical fittings and cables
  - small tools

Candidates will also 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 sub-structure, including:

- The reasons for site investigation for the given site.
- Techniques of site investigation: justification of any two appropriate methods.
- 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. Candidates may refer to prefabrication techniques in assessment responses.

Open-book folio of work (Outcome 3)

A folio of work for the assignment will be prepared by each candidate individually. Centres will ensure that work submitted in the folio is the candidate'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

National Unit Specification: statement of standards (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

The sketches must:

- contain correct detailing with respect to current building legislation and good practice
- be accurate and well proportioned
- be in accordance with current good practice in the construction industry

The annotations must:

- include correct specifications of materials
- be in accordance with current good practice in the construction industry

National Unit Specification: support notes

UNIT Building Construction: Site Establishment and Substructure (Higher)

This part of the Unit Specification is offered as guidance. The support notes 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 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. The differences are sometimes quite marked in the area of substructures and foundations. No prior knowledge of building construction is required of candidates undertaking this Unit.

Corresponding to Outcomes 1-3:

Outcome 1 This Outcome provides candidates 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 the 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.

Outcome 2 This Outcome provides the candidate 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 candidate with a sound knowledge of the types and forms of foundations normally used in low-rise domestic buildings.

Outcome 3 This Outcome provides the candidate with the skills to produce well proportioned annotated sketches of substructure in low-rise building construction.

Candidates 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 candidate an appreciation of the purpose of the legislation, but to delve too deeply into specific legislation at this stage in a candidate's learning would be inappropriate.

Site establishment

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.

National Unit Specification: support notes (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

The specification of the temporary road material is part of the subject matter of the Unit. The candidate will study the different solutions commonly adopted to secure the site and protect the public during construction works. The candidate will also study the provision of temporary services such as electricity, water, telephones and foul drainage.

Site investigation

The subject of site investigation will include desk study, walk-over surveys and ground investigations.

Ground investigations will include trial pits and bore holes. It will also include in-situ testing and laboratory testing of soil samples. The subject of in-situ testing could include the Cone Penetration Test (CPT), Standard Penetration Test (SPT) and the field vane test. The subject of laboratory testing could be broken down to cover pH tests as well as sulphate, moisture content and particle size distribution tests. Candidates should be referred to current published standards for site investigation and in-situ tests (although these will not be the subject of specific assessment).

The in-situ and laboratory tests mentioned in the above paragraph are not intended to be a comprehensive list. Neither must a centre feel obliged to cover them all or indeed to demonstrate any of them. Candidates should be given an appreciation of the reasons for and techniques available for testing ground and soil samples. Candidates must learn where and when the different methods of site investigation and soil testing are appropriate.

Substructure construction

Throughout the study of this element of the building, function and functional requirements should be stressed.

Excavation and earthworks should include foundation trenches and pits. Techniques for excavating on sloping sites could be discussed as could the use of stepped foundations. (Sloping sites and stepped foundations are not, however, required to be covered for assessment purposes in this Unit).

Earthwork supports and preparation of the surfaces of excavations to receive concrete or other fill should be included. The importance of maintaining dimensional positioning of the foundations and their reinforcement is to be emphasised.

The subject of earthwork support is important from both a practical and a health and safety perspective. Reference should be made to the specification of fill materials and correct compaction techniques and equipment.

The study of foundations in this Unit incorporates the underbuilding up to damp-proof course level. This will include substructure brickwork and dwarf walls. It also includes the study of solum treatments. Candidates will focus their attention 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 ground floor construction with the substructure walls.

National Unit Specification: support notes (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

Simple foundation types should be limited to strip foundations, raft foundations, pad foundations, and short bored piles and ground beams. Candidates should consider these in the context of low-rise domestic buildings only. Steel reinforcement of foundations and in-situ concrete floors should be studied. The reasons for using reinforcement should be discussed.

The topic of concrete is an important part of this subject area. The topic of designed concrete and prescribed concrete could be covered. Specifications for concrete should be studied. Reference should be made to current standards for concrete. Methods of mixing, transporting, placing, compacting, curing and protecting concrete must be studied.

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

The study of substructure must include the external walling in the underbuilding. It should also include dwarf walls to support floors. The specification and positioning of damp-proof courses is an important aspect of this subject. Provision for incoming services must be covered; so too must sub-floor ventilation.

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 on substructure 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.

Annotated sketches

Regarding Outcome 3, which requires the sketching of details, the reasons for having standards in drawing layout and symbols should be emphasised.

Sketches should be well proportioned. This requires that each component of the detail being sketched is depicted in sensible proportion to the rest of the sketch. A particular scale is not prescribed for these sketches — the important thing is for the sketches to contain clarity of detail and for all parts of the sketch to be in proportion. This may require candidates to sketch certain details at a larger scale than others.

Candidates may refer to textbooks, technical literature and architectural drawings to gain an appreciation of the detail required for specific sketches. This may guide them as to the approximate scale to be adopted for their own sketches.

National Unit Specification: support notes (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The topic of substructure is logically taught in the order in which the construction of the underbuilding is carried out. This will help candidates to imagine or visualise the work being carried out on a building site. The process of constructing foundations and underbuilding can be made more visual by the use of construction drawings and by the use of traditional whiteboard and coloured whiteboard pens.

Use of electronic whiteboards, projectors, photographic images and computer-aided drawings is increasing in some centres to demonstrate the different stages of building work. Candidates who are remote from their centre will still benefit from these learning materials if they can be sent the files electronically. For those that have no access to such facilities, the use of hard copy resources will be appropriate.

Textbooks and videos 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. Centres could also arrange visits from consultants and contractors who are experts in the field of site investigation.

Field trips to building sites are always of benefit to candidates. On housing sites there are often several plots under development at any one time. In this way candidates can see at a glance the process of substructure construction in its various stages. Note could be taken of the plant and equipment being used in the construction of the foundations. Aspects of health and safety should be carefully noted. After visiting the site, candidates could be encouraged to write down a simple method statement for the construction of the underbuilding. This activity should reinforce their learning from the field trip.

A visit to a building site to study superstructure construction is also an opportunity to examine other aspects of building work which are covered by other Units in the *Higher Building Construction* Course:

- *Building Construction: Superstructure (Higher)* — candidates should note how superstructures are erected. Particular attention may be given to temporary works, the use of plant and equipment and prefabrication techniques.
- *Building Construction: Components and Finishes (Higher)* — candidates should examine how these aspects of a building are constructed and fit together. Particular note might be taken of the storage of components and materials as well as the precautions to protect the building's finishes.

Note could also be taken of the site layout and the planning of temporary works and installations such as site huts, concrete mixers, batching plant, temporary screens and materials storage facilities. Note should be taken too of how the existing contours of the site have dictated the layout of the development and the depth of excavations. Insight into these and other aspects of the project may best be provided by the site manager. Building companies are often willing to agree to site visits by groups of students if things are arranged through the proper channels and when groups are escorted round the site by the appropriate site personnel.

National Unit Specification: support notes (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

When learning about concrete work, candidates would likely benefit from practical exercises in making concrete cubes and carrying out destructive tests on these where possible.

In drawing and sketching work, emphasis should be given to good drawing practice, neatness, clarity and the layout of the drawings. Examples of good practice can be demonstrated by drawings carried out by professional draughts people and designers. The effective use of annotation can also be demonstrated by these drawings. Local designers and architects are often willing to contribute drawings from actual projects as long as copyright is not infringed by centres.

Techniques in planning the layout of drawings and sketches and the relationship between these and annotations should be discussed. The range of different scales employed in construction drawings can also be demonstrated. The use of graph paper as a template for sketching to approximate scale could be demonstrated.

Relating to Outcome 3, the reasons for standards and accepted good practice in drawing layout and symbols used could be covered, although not forming part of the assessment. Many of the published standards include practical examples of the uses of the symbols in a construction context.

Learning and teaching for Outcomes 2 and 3 may be integrated effectively. Candidates may learn about the sequence and processes involved in substructure construction by sketching details of substructure or by having details shown to them via whiteboard or other pictorial means. Indeed, details are often best explained by sketching or by reference to manufacturers' literature.

Whilst the sketching work that candidates undertake will be well proportioned, they will be made aware of the different scales that are commonly used in instrument-aided building drawings. This may be best demonstrated by displaying a range of drawings from an actual building project. Local designers and architects are as previously stated often happy to contribute drawings as long as copyright is not infringed.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

This Unit gives candidates experience of planning site establishment and detailing substructure construction. Although candidates will develop their knowledge and understanding of the factors and issues involved in planning site establishment, Unit assessment is focused on the application of this knowledge and understanding.

Candidates should achieve a satisfactory mark in the tests for Outcomes 1 and 2. The standard to be applied is detailed in the National Assessment Bank item for the Unit.

Candidates should produce a satisfactory folio of work for Outcome 3. The standard to be applied is exemplified in the exemplar provided. The folio of work will be assessed on an achieved/not achieved basis only.

National Unit Specification: support notes (cont)

UNIT Building Construction: Site Establishment and Substructure (Higher)

CANDIDATES WITH ADDITIONAL SUPPORT NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (SQA, 2004).