



## National Unit Specification: general information

**UNIT** Civil Engineering Technology (SCQF level 6)

**CODE** F3J7 12

### SUMMARY

This Unit is suitable for candidates who aspire to a career in the construction industry or related fields as a technician or technologist.

This Unit has been designed to provide the candidate with an understanding of the development of a major construction project from the initial sitework through to the completion of the skeleton frame of a building.

The candidate is required to describe the various forms of shallow foundations and their construction. Emphasis is placed on the candidates sketching skills as these often form a major method of communication on site and as such the candidate is required to sketch elements of structural steelwork frames, permanent elements and temporary support methods relating to reinforced concrete frame construction and the common form of retaining walls.

### OUTCOMES

- 1 Demonstrate an understanding of shallow foundations and their construction.
- 2 Demonstrate an understanding of structural steelwork frame construction.
- 3 Demonstrate an understanding of the permanent elements of *in-situ* reinforced concrete frames and temporary support methods used in their construction.
- 4 Describe the function and common forms of retaining walls.

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#### Administrative Information

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## **National Unit Specification: general information (cont)**

**UNIT**      Civil Engineering Technology (SCQF level 6)

### **RECOMMENDED ENTRY**

While entry is at the discretion of the centre, candidates would normally be expected to have attained the followings:

- ◆ Standard Grade Mathematics at General level

### **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**

There is no automatic certification of Core Skills or Core Skill components in this Unit. Opportunities for developing aspects of Core Skills are highlighted in *Guidance on Learning and Teaching Approaches*.

## **National Unit Specification: statement of standards**

### **UNIT      Civil Engineering Technology (SCQF level 6)**

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**

Demonstrate an understanding of shallow foundations and their construction.

##### **Performance Criteria**

- (a) Explain the function and form of various types of shallow foundations
- (b) Calculate a suitable width of foundation and sketch a suitable arrangement for a given task
- (c) Explain trench support methods required during the construction of the foundations
- (d) Explain de-watering methods and the position of the water table for shallow excavations

#### **OUTCOME 2**

Demonstrate an understanding of structural steelwork frame construction.

##### **Performance Criteria**

- (a) Identify structural elements of steel frame buildings.
- (b) Sketch structural steelwork connections in accordance with current practice.
- (c) Explain methods of steel frame erection.

#### **OUTCOME 3**

Demonstrate an understanding of the permanent elements of *in-situ* reinforced concrete frames and temporary support methods used in their construction.

##### **Performance Criteria**

- (a) Describe permanent elements of in-situ reinforced concrete frame buildings.
- (b) Explain the methods of fabricating, positioning and fixing reinforcements.
- (c) Explain the methods of providing temporary support to concrete elements during construction.
- (d) Explain the methods of constructing reinforced concrete frames.

#### **OUTCOME 4**

Describe the function and common forms of retaining walls.

##### **Performance Criteria**

- (a) Describe the function and form of various types of gravity retaining walls.
- (b) Describe the function and form of various types of cantilever retaining walls.

## National Unit Specification: statement of standards (cont)

### UNIT Civil Engineering Technology (SCQF level 6)

#### EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that the candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence is required to demonstrate that the candidate has achieved this Unit to the standard specified in the Outcomes and Performance Criteria. The evidence for this Unit should be obtained under controlled, supervised conditions. The assessment will be open-book and should last no more than two hours. Candidates will be permitted to take notes, formulae and calculators into the assessment.

Evidence is to be produced through a given set of case studies related to the Civil Engineering Industry. Evidence will be gathered at appropriate points through the delivery of the Unit. Assessment must be manageable and practicable for centres and candidates.

An appropriate instrument of assessment for this Unit would be a question paper comprising of a balance of short answer, restricted response questions, calculations and sketches.

The evidence should be knowledge based with the candidate demonstrating that they can:

- ◆ recognise the various forms of shallow foundations: strip, pad, raft and piled and the need for the various forms
- ◆ sketch practical arrangements of foundation given the load from the structure and safe bearing capacity of the soil
- ◆ recognise the importance of the position of the water table and the need for dewatering of excavations
- ◆ identify key elements from a drawing
- ◆ sketch, using current practice and terminology, the common forms of connection used in simple structural steelwork frames
- ◆ explain the erection sequence of structural steelwork frames including the need for temporary bracing, construction plant and safety considerations
- ◆ be conversant with the following terms or processes used in the erection of in-situ reinforced concrete frames
- ◆ explain construction sequence for major reinforced concrete elements including the plant requirements and safety considerations
- ◆ explain the need for the various forms retaining walls and their construction

The Assessment Support Pack for this Unit provides appropriate sample assessment materials. Where centres wish to develop their own assessment materials they should refer to the Assessment Support Pack to ensure a comparable standard.

## **National Unit Specification: support notes**

### **UNIT      Civil Engineering Technology (SCQF level 6)**

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 has been developed as a mandatory Unit in the National Certificate in Civil Engineering and an optional Unit in the National Certificate in Built Environment. It can also be taken as a freestanding Unit.

This Unit is intended to introduce the candidate to the work undertaken on Civil Engineering Construction Sites. The Unit introduces the candidate to the construction, fabrication and safety requirements of common forms of structure found in Civil Engineering. Emphasis should be placed on the candidates sketching skills as these often form a major method of communication on site.

Outcome 1 requires the candidate to recognise the various forms of shallow foundations: strip, pad, raft and piled and the need for the various forms. Given the load from the structure and safe bearing capacity of the soil the candidate should be able calculate practical dimensions for strip and pad foundations both in mass and reinforced concrete and should be capable of sketching practical arrangements. The position of the water table and the need for dewatering of excavations should be discussed as part of the Outcome.

Outcome 2 requires the candidate to sketch the common forms of connection used in simple structural steelwork frames. Current practice should be adopted in the sketching of the steelwork connections; this requires the candidate to be conversant in the terms used. Terms to be introduced should include: welding, bolting, fasteners, plates, cleats, splices, edge distances, end distances, pitch and cross-centres. When considering the methods of erection the candidate should be aware of the erection sequence, the need for temporary bracing, construction plant and safety considerations.

Outcome 3 should be limited to the construction of in-situ reinforced concrete frame. The candidate should be conversant with the following terms or processes: reinforcement bar shaping, reinforcement bar scheduling, fixing reinforcement, falsework, formwork, spacers. The candidate should also be aware of the construction sequence for bases, columns, beams and slabs including the plant requirements and safety considerations.

Outcome 4 requires the candidate to be introduced to the various forms, uses and construction of retaining walls. The various forms of retaining wall should include, mass concrete, masonry, gabions, reinforced earth, reinforced concrete cantilevered (including counterfort and buttressed) and steel sheet piling.

The study of the Unit should include relevant health and safety issues. Candidates should be introduced to the concept of method statements for construction sequencing.

## National Unit Specification: support notes (cont)

### UNIT Civil Engineering Technology (SCQF level 6)

#### GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is important that the delivery of this Unit is related to an industrial context. As part of the learning and teaching, candidates should be exposed to the working environment through site visits, video presentations, investigation of existing projects etc. The main aim of this Unit should be to enable candidates relate the construction principles learned to industrial situations and to help them gain an appreciation of the overall construction process.

##### Outcome 1

The need for the various forms of foundation should be related to type of structure required and the ground conditions specifically the safe bearing pressure. Given the load from a structure and a simplified arrangement of ground conditions the width of the foundation under a wall or the plan area of foundation under a column should be determined together with a discussion of the practicality of the arrangement. Using this information a suitable arrangement of foundation arrangement should be sketched for a range of loads and soil types. Starting with simple strip and pad foundations which can be developed for various forms of raft and short piled foundations.

##### Outcome 2

The main structural elements of structural steelwork elements should be identified from drawings, site visits, video presentations. This should lead on to discussions on the fabrication of elements, connection of the elements together and the erection of the steelwork skeleton. These discussions should be further developed by explain the need for a standard detailing practice and sketches of simple connections.

The terms used and the requirements of the erection process should be discussed together with respect to the need for temporary bracing, plant requirements and safety considerations.

##### Outcome 3

The processes required prior to the construction of a reinforced concrete frame should be explained by means of handouts, site visits, video presentations etc and should encompass:

- ◆ reinforcement bar shaping
- ◆ reinforcement bar scheduling
- ◆ fixing reinforcement
- ◆ formwork and falsework

Simple arrangements of beam, slab, column and pad base reinforced concrete elements should be sketched in accordance with current practice.

The candidate should also be aware of the construction sequence for bases, columns, beams and slabs including the plant requirements and safety considerations.

## National Unit Specification: support notes (cont)

### UNIT Civil Engineering Technology (SCQF level 6)

#### Outcome 4

The need for retaining walls should be discussed based on site topography, subsurface soil strata or final construction arrangements. This may be achieved by means of handouts, site visits, video presentations etc. The various forms of retaining wall should be discussed together with the advantages or disadvantages in specific locations.

### OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

In this Unit candidates will be:

- ◆ completing calculations
- ◆ reading drawings and completing sketches

These offer opportunities to develop aspects of the Core Skills of:

- ◆ *Numeracy*
- ◆ *Problem Solving*

### GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

#### Opportunities for the use of 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 communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Candidates should be provided with appropriate case studies for the assessment of this Unit.

Typical forms of assessment may involve the following:

#### Outcome 1

The candidate should be given the loading on a wall or column and the safe bearing pressure of a soil stratum below existing ground level and will be required to calculate a suitable practical width of foundation and sketch a suitable arrangement, explain any trench support methods that may be required during the construction of the foundation and explain how water may be excluded from the excavation.

#### Outcome 2

The candidate should be given a general arrangement drawing of a structural steel frame and is asked to identify key elements on the drawing, sketch a typical connection between a beam and column in accordance with current practice and explain how a typical element may be erected in practice.

## **National Unit Specification: support notes (cont)**

### **UNIT**      Civil Engineering Technology (SCQF level 6)

#### Outcome 3

The candidate should be asked to describe the function of a reinforced concrete element, explain/sketch the methods of fixing or fabricating or positioning reinforcement in the element and asked to explain the methods of temporary or permanent construction.

#### Outcome 4

The candidate should be asked to describe a particular form of gravity or cantilevered retaining wall and its function.

### **CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS**

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. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* ([www.sqa.org.uk](http://www.sqa.org.uk)).