

## Higher National Unit Specification

### General information for centres

**Unit title:** Construction Technology: Substructure

**Unit code:** DW57 34

**Unit purpose:** This Unit is designed to enable candidates to gain knowledge and understanding of substructure construction beginning with site investigation and continuing with the control of ground water, ground improvement techniques and finally the selection and construction of appropriate foundation forms.

On completion of the Unit candidates should be able to:

- 1 Describe the process of site investigation.
- 2 Describe methods of ground water control.
- 3 Describe methods of ground improvement.
- 4 Describe appropriate forms of foundation and basement construction.

**Credit points and level:** 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7\*).

*\*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.*

**Recommended prior knowledge and skills:** It would be an advantage for candidates to have a basic knowledge and understanding of substructure construction, although this is not essential because the unit covers all the basic principles. Possession of basic knowledge and understanding may be evidenced by possession of an appropriate Higher.

**Core Skills:** There are opportunities to develop the Core Skills of Communication and Problem Solving in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

**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.

**Assessment:** It is possible to assess candidates either on an individual Outcome basis, combinations of Outcomes or by a single holistic assessment combining all Outcomes. It is recommended that all outcomes be assessed by a question paper details of which are given at the end of each outcome under the heading 'Assessment guidelines'.

In this Unit it is proposed that Outcomes 2 and 3 may be combined into a single question paper assessment.

## **General information for centres (cont)**

The assessment paper should be composed of a suitable balance of short answer, restricted response and structured questions. Assessment should be conducted under controlled, supervised conditions. It should be noted that candidates must achieve all the minimum evidence specified for each Outcome in order to pass the Unit.

An exemplar instrument of assessment and marking guidelines has been produced to provide examples of the type of evidence required to demonstrate achievement of the aims of this Unit and to indicate the national standard of achievement at SCQF level 7.

## Higher National Unit specification: statement of standards

**Unit title:** Construction Technology: Substructure

**Unit code:** DW57 34

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Throughout this Unit emphasis will be placed where appropriate on the application of health and Safety and Sustainability. Safe working practices should be looked at in accordance with current safety codes of practice and regulations. Sustainability should include reference to criteria affecting sustainability, impact of not implementing sustainability on the environment and the legislation promoting sustainability.

### Outcome 1

Describe the process of site investigation

#### Knowledge and/or skills

- ◆ Desk studies
- ◆ Walk-over survey
- ◆ Direct ground investigations
- ◆ *In-situ* and laboratory testing
- ◆ Site investigation report

#### Evidence Requirements

Evidence for the knowledge and /or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome **two out of five** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of two out of five knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to the two items being assessed.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ describe the component parts of the site investigation process

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Construction Technology: Substructure

### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment of this Outcome should be a single assessment question paper. The assessment event should last one and a half hours and be carried out under supervised controlled conditions.

### Outcome 2

Describe methods of ground water control

#### Knowledge and/or skills

- ◆ Origins of water in the ground
- ◆ Permanent exclusion of groundwater
- ◆ Temporary exclusion of groundwater

#### Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that she/he can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome **two out of three** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of two out of the three knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to the two items being assessed.

Where an item is sampled, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain the origins of water in the ground
- ◆ describe a method of excluding ground water from a site

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

#### Assessment guidelines

The assessment of this Outcome should be combined with that for Outcome 3 to form one assessment paper. This single assessment paper should be taken at a single assessment event lasting one hour and carried out under supervised, controlled conditions. Such a paper should be composed of an appropriate balance of short answer, restricted response and structured questions.

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Construction Technology: Substructure

### Outcome 3

Describe methods of ground improvement

#### Knowledge and/or skills

- ◆ Refilling in thin layers with compaction
- ◆ Dynamic compaction
- ◆ Vibrated stone columns
- ◆ Vibrated concrete columns

#### Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that she/he can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome **two out of four** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of two out of the four knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to the two items being assessed.

Where an item is sampled, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ sketch and describe methods of ground improvement

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

#### Assessment guidelines

The assessment for this Outcome should be combined with that for Outcome 2 to form a single assessment event lasting one hour and carried out under supervised controlled conditions. Such a paper should be composed of an appropriate balance of short answer, restricted response and structured questions.

### Outcome 4

Describe appropriate forms of foundation and basement construction

#### Knowledge and/or skills

- ◆ Strip, raft, pad and pile foundations
- ◆ Temporary and permanent support to excavations
- ◆ Pile caps and ground beams
- ◆ Basement construction

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Construction Technology: Substructure

### Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that she/he can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome **two out of four** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of two out of the four knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to the two items assessed.

Where an item is sampled, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ select, describe and sketch forms of foundation and basement construction for a given situation including any ground support which may be required

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

### Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment of this Outcome should be a single assessment question paper. The assessment event should last one and half hours and be carried out under supervised controlled conditions.

## **Administrative Information**

<b>Unit code:</b>	DW57 34
<b>Unit title:</b>	Construction Technology: Substructure
<b>Superclass category:</b>	TE
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## **Higher National Unit specification: support notes**

### **Unit title:** Construction Technology: Substructure

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 written in order to allow candidates to develop knowledge, understanding and skills in the following areas:

- 1 The process of site investigation
- 2 Describing methods of ground water control.
- 3 Describing methods of improving the ground
- 4 Describing forms of foundation and basement construction.

This Unit has been developed as part of a group of construction technology units. There are three other units in the group entitled:

- ◆ Construction Technology: Domestic Construction,
- ◆ Construction Technology: Industrial/Commercial Superstructure
- ◆ Construction Technology: Specialist Systems

This Unit at SCQF level 7 is a mandatory unit within all the HNC and HND Built Environment and Civil Engineering awards.

The three Units mentioned in the previous paragraph have been developed as an integrated suite of units to meet all the construction technology requirements of the HNC and HND Built Environment awards. However, this does not preclude the use of one or more of these units in other awards where award designers feel this to be appropriate. As well as providing a substantial course in construction technology principles these units also provide important underpinning knowledge, understanding and skills for other parts of the HNC and HND Built Environment awards

In designing this Unit the unit writers have identified the range of topics they would expect to be covered by lecturers. The writers have also given recommendations as to how much time should be spent on each outcome. This has been done to help lecturers to decide what depth of treatment should be given to the topics attached to each of the Outcomes. Whilst it is not mandatory for a centre to use this list of topics it is strongly recommended that it does so to ensure continuity of teaching and learning across the Construction Technology units and because the assessment exemplar pack for this Unit is based on the knowledge and/or skills and list of topics in each of the Outcomes.

The list of topics is given below. Lecturers are advised to study this list of topics in conjunction with the assessment exemplar pack so that they can get a clear indication of the standard of achievement expected of candidates in this Unit.



## Higher National Unit specification: support notes (cont)

**Unit title:** Construction Technology: Substructure

### 1 Describe the process of site investigation. (10 hours)

#### Site investigation:

- ◆ Desk studies
- ◆ Walk-over survey (site reconnaissance)
- ◆ Direct ground investigation:
  - planning the investigation — extent, depth of exploration and choice of method
  - trial pits
  - auger holes
  - bore holes — light percussion boring
  - hollow stem auger
  - rotary core drilling

#### Soil mechanics:

This should be a brief introduction covering the topics below, however lecturers shall decide the depth of treatment required which may depend on the award programme.

- ◆ soil formation and nature
- ◆ soil description and classification — Rock, granular soils, cohesive soil, organic soil
- ◆ fill (or made ground): engineered and non-engineered fills

#### In-situ testing:

- ◆ probing, using lightweight dynamic penetrometers or cone penetration test
- ◆ the Standard Penetration test (SPT)
- ◆ the field vane test
- ◆ ground water observations

#### Laboratory testing

#### Site investigation reports

#### Note for tutors

There is no shortage of texts available on the subject of site investigation however, tutors should concentrate on the current British Standard *Code of practice for site investigations* and the guide to application of the code copies of which should be available for access by the students. This publication contains many on-line interactive links which students will find useful.

British Research Establishment (BRE) publications will also be useful in the delivery of this Outcome particularly those in the 'Digest' series.

Tutors, particularly those teaching on the HND Civil Engineering may wish to make students aware of the current Eurocode.

## Higher National Unit specification: support notes (cont)

**Unit title:** Construction Technology: Substructure

### 2 Describe methods of ground water control. (4 hours)

#### The origins of water in the ground

**Methods of permanent exclusion of ground water:** sheet piling, thin grouted membranes, slurry trench cut-off, diaphragm walls, contiguous piling.

**Methods of temporary exclusion of ground water:** Sump pumping, shallow wells with suction pumps, Wellpoint systems, Deep bored filter wells. Freezing.

### 3 Describe methods of ground improvement. (4 hours)

#### Choice of method:

- ◆ refilling in thin layers with compaction
- ◆ dynamic compaction
- ◆ rapid impact compaction
- ◆ vibrated stone columns (*Vibro*) compaction and vibroplacement
- ◆ vibrated concrete columns

### 4 Select and describe appropriate forms of foundation. (18 hours)

#### Principles of foundation design

**Concrete strip foundations:** deep strip (trench fill), wide strip and reinforced strip

#### Temporary and permanent support to excavations

**Concrete raft foundations:** flat raft and raft with down-stand beams

#### Concrete pad foundations

**Pile foundations:** classification of piles — Replacement and displacement  
Friction and end bearing

<b>Pile types:</b>	Displacement	Continuous Helical Displacement Tubular Steel Precast Concrete Driven in-situ
	Replacement	Short bored Mini Small diameter Large diameter Continuous Flight Auger

The use of Bentonite or equivalent

**Pile testing:** Static Load  
Sonic Integrity  
Dynamic Load

## Higher National Unit specification: support notes (cont)

**Unit title:** Construction Technology: Substructure

**Pile caps and ground beams:** methods of construction.

**Single storey basement construction:** Slab and wall construction  
Forms of construction — according to grade  
Waterproofing options and materials  
Methods of construction

### Excavation plant

#### Note for tutors

Many standard texts are available covering foundation design and construction. Tutors should refer students to BRE publications particularly in the 'Good Building Guide' series for simple foundations of low rise buildings. Many Contractor's web sites are available and students should be encouraged to search these web sites and examine the case studies available.

The current British Standards are a useful reference when covering basement construction. A copy of the British Standards should be available for access by the students.

#### Unit Assessment (4 hours total)

This takes the form of three different assessment papers, one covering the content of Outcome 1 and lasting one and half hours duration, one covering the content of Outcome 2 and Outcome 3 and lasting one hour duration and finally an assessment paper covering the content of Outcome 4 and lasting one and half hours duration.

## Guidance on the delivery and assessment of this Unit

As this Unit provides core construction technology which underpins much of the studies done in other areas of HNC and HND Built environment awards it is recommended that the Unit be delivered towards the start of these awards.

Where this Unit is incorporated into other Group Awards it is recommended that it be delivered in the context of the specific occupational area(s) that the award is designed to cover.

Details on approaches to assessment are given under Evidence Requirements and Assessment guidelines under each Outcome in the Higher National Unit specification: statement of standards section. It is recommended that these sections be read carefully before proceeding with assessment of candidates.

## Higher National Unit specification: support notes (cont)

**Unit title:** Construction Technology: Substructure

### *Opportunities for developing Core Skills*

The following grid provides a general guide to opportunities for the development of Core Skills in this Unit. Opportunities for the development of Core Skills at the output level are more fully identified in the Core Skills Signposting Guide.

Core Skill	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5
<b>1 Communication</b>					
Reading					
Writing	✓	✓	✓	✓	
Oral					
<b>2 Numeracy</b>					
Using Number					
Using Graphical Information					
<b>3 IT</b>					
Using Information Technology					
<b>4 Problem Solving</b>					
Critical Thinking				✓	
Planning and Organising					
Reviewing and Evaluating					
<b>5 Working with Others</b>					

### **Open learning**

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangement would be required to be put in place to ensure that the assessment, which is required to be at a single event, was conducted under controlled, supervised conditions.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning* (SQA 2000).

## **Higher National Unit specification: support notes (cont)**

**Unit title:** Construction Technology: Substructure

### **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 SQA document *Guidance on Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website **[www.sqa.org.uk](http://www.sqa.org.uk)**.

## **General information for candidates**

### **Unit title:** Construction Technology: Substructure

This Unit has been designed to allow you to develop knowledge, understanding and skills in substructure construction beginning with site investigation and continuing with the control of ground water, ground improvement techniques and finally the selection and construction of appropriate foundation and basement forms.

The formal assessment for this Unit takes the form of three different assessment question papers, one covering the content of Outcome 1 and lasting one and a half hours duration, a combined assessment question paper covering the content of Outcome 2 and Outcome 3 and lasting one hour duration and finally a single assessment paper covering the content of Outcome 4 and lasting one hour and half hours duration.

The assessment will be conducted under closed-book conditions in which you will not be allowed to take notes, textbooks etc into the assessment.