



Higher National Unit specification

General information

Unit title: Construction Technology: Substructure (SCQF level 7)

Unit code: H72A 34

Superclass: TE

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Unit purpose

This Unit is designed to enable learners 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.

Outcomes

On successful completion of the Unit the learner will 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 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

It would be an advantage for learners to have a basic knowledge and understanding of substructure construction, although this is not essential, as the Unit covers all of the basic principles. Possession of basic knowledge and understanding may be evidenced by possession of an appropriate National Certificate Unit.

Higher National Unit Specification: General information (cont)

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Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

Higher 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.

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. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

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

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

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

Higher National Unit specification: Statement of standards (cont)

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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

Evidence Requirements for this Unit

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills across all Outcomes by showing that they can:

- ◆ describe the component parts of the site investigation process.
- ◆ explain the origins of water in the ground.
- ◆ describe a method of excluding ground water from a site.
- ◆ sketch and describe methods of ground improvement.
- ◆ select, describe and sketch forms of foundation and basement construction for a given situation including any ground support which may be required.

It is possible to assess learners either on an individual Outcome basis, combinations of Outcomes or by a single holistic assessment combining all Outcomes. In this Unit it is proposed that Outcomes 1, 2 and 3 may be combined into a single question paper assessment and Outcome 4 as an individual assessment.

The assessment papers 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 learners 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.

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. Items being assessed should not be known to learners in advance and different items should be sampled on each assessment occasion.



Higher National Unit Support Notes

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Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit has been written in order to allow learners to develop knowledge, understanding and skills in the following areas:

- 1 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

Higher National Unit Support Notes (cont)

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Guidance on approaches to delivery of this Unit

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. Delivering lecturers are advised to study this list of topics in conjunction with the assessment exemplar pack. This will provide a clear indication of the standard of achievement expected of learners undertaking this Unit.

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
- ◆ ground water observation

Higher National Unit Support Notes (cont)

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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.

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

Higher National Unit Support Notes (cont)

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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

Pile types:	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

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

Underpinning

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.

Higher National Unit Support Notes (cont)

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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 (3.5 hours total)

This takes the form of two assessment papers, one covering the content of Outcome 1, 2 and 3 and lasting two hours duration and the other covering the content of Outcome 4 and also of one and a half hours duration.

This Unit is designed to further develop knowledge and understanding of below ground construction. This Unit should also reinforce the importance of Health & Safety related to below ground construction.

Where possible, it is recommended that learners visit a local construction site to enhance the understanding of below ground construction.

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.

The assessment for all Outcomes may be undertaken separately or alternatively as integrated or combined Outcomes. This may be in the form of two or three assessment events.

Assessment should place emphasis upon description and sketching of the Outcome content.

Assessments should be conducted under supervised, controlled open-book conditions.

Total assessment duration for this Unit should not exceed 3.5 hours. It should be noted that learners must achieve all the minimum evidence specified for each Outcome in order to pass the Unit.

Evidence for the Knowledge and/or Skills in this Outcome will be provided on a sample basis as follows:

- Outcome 1 two from five Knowledge and/or Skills items should be sampled.
- Outcome 2 two from three Knowledge and/or Skills items should be sampled.
- Outcome 3 two from four Knowledge and/or Skills items should be sampled.
- Outcome 4 two from four Knowledge and/or Skills items should be sampled.

Higher National Unit Support Notes (cont)

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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. Items being assessed should not be known to learners in advance and different items should be sampled on each assessment occasion.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

There are opportunities to develop Core Skills in *Communication* and aspects of *Problem Solving*.

History of changes to Unit

Version	Description of change	Date

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General information for learners

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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.

The Unit will enable learners to develop a knowledge and understanding of the main aspects of preparing to build, through site and soil investigations, ground water control, ground improvement techniques and then constructing buildings up to ground level including selection of appropriate foundations and basement construction.

The principal aims are to:

- ◆ Prepare learners for employment as technicians in the construction industry with a range of disciplines, including, Architects, Civil Engineering, Contractors, Building Surveyors and Quantity Surveyors.
- ◆ Provide built environment and civil engineering learners with knowledge and understanding of common aspects of ground investigation, ground preparation and below ground construction.
- ◆ Enable learners to pursue appropriate professional body recognition, such as Chartered Institute of Building, Institute of Civil Engineers, Chartered Institute of Architectural Technologists, Royal Institute of Chartered Surveyors.
- ◆ Provide learners with knowledge and understanding of below ground construction work that will support further study of related construction technology Units.

The Unit is part of a group of Construction Technology Units within the Civil Engineering and/or Built Environment frameworks. The other Units are entitled *Construction Technology: Domestic Building*, *Construction Technology: Industrial and Commercial Superstructure* and *Construction Technology: Specialist Systems*.

There are opportunities to develop Core Skills in *Communication* and aspects of *Problem Solving*.