National Unit Specification: general information

UNIT Architectural Technology: Site Surveying (Higher)

CODE DV3W 12

COURSE Architectural Technology (Higher)

SUMMARY

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

This Unit introduces the principles of land surveying and the techniques adopted in the preparation of construction site plans. The Unit includes a consideration of site plans developed for individual building projects and Ordnance Survey maps and plans. Skills will be developed in the use of surveying equipment to gather survey data that will allow candidates to create site plans and contour plans. Candidates will also produce concise technical reports on their fieldwork and results.

Site Surveying requires candidates to carry out linear surveying by tape or other appropriate means and levelling with an automatic level or other similar equipment. The Unit allows candidates to acquire knowledge of basic land surveying techniques and an understanding of site plans and Ordnance Survey maps and plans. This knowledge will facilitate progression to further surveying Units, allowing candidates to build on this basic knowledge and extend the site survey process.

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 Interpret information from site plans and Ordnance Survey maps and plans.
2 Carry out a linear measurement survey, plot the results and produce a brief report.
3 Carry out a levelling survey, prepare a contour plan and section and produce a brief report.

Administrative Information

Superclass: TC

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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 Communication

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	Numeracy at SCQF level 5
Core Skills component	Critical Thinking at SCQF Level 5

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National Unit Specification: statement of standards

UNIT Architectural Technology: Site Surveying (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

Interpret information from site plans and Ordnance Survey maps and plans.

Performance Criteria

(a) Maps and locations within maps are identified correctly using the referencing system of the Ordnance Survey.
(b) Information from an Ordnance Survey plan is interpreted correctly in accordance with the referencing system of the Ordnance Survey.
(c) Information from a project site plan is extracted and interpreted accurately in accordance with current good practice and referencing systems for site plans.

OUTCOME 2

Carry out a linear measurement survey, plot the results and produce a brief report.

Performance Criteria

(a) A linear measurement survey of a site is carried out correctly and in accordance with current good practice.
(b) Linear measurement survey results are plotted on a plan to an accuracy of not less than 1 in 250.
(c) A survey report is produced which is accurate and in accordance with current good practice.

OUTCOME 3

Carry out a levelling survey, prepare a contour plan and section and produce a brief report.

Performance Criteria

(a) A levelling survey is carried out correctly and in accordance with current good practice.
(b) Levels are reduced accurately using a standard procedure.
(c) A contour plan is prepared to a specified standard using fieldwork results.
(d) A section through the contour plan is prepared accurately and to an appropriate scale.
(e) A survey report is produced which is accurate and in accordance with current good practice.

National Unit Specification: statement of standards (cont)

UNIT Architectural Technology: Site Surveying (Higher)

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

The Outcomes should be assessed with two assessments comprising:

- a 45 minute closed-book test for Outcome 1;
- an open-book integrated folio of work for Outcomes 2 and 3, produced as a natural part of the learning and teaching process

The closed-book test is on site plans and Ordnance Survey maps and plans and will comprise a series of short answer and/or restricted response questions. The test will be carried out in controlled conditions: candidates are not permitted to collaborate in their responses.

The folio of work is a collection of evidence brought together in open-book conditions. It will include evidence of practical surveying work and the production of two survey reports. The folio should include evidence of:

- correct carrying out of the survey work for linear measurement
- plotting of results from the linear measurement survey to the prescribed accuracy
- correct carrying out of the levelling work
- reducing of levels, carrying out of arithmetic checks and preparation of the contour plan
- preparation of an accurate section through the contour plan to appropriate horizontal and vertical scales

The production of the folio of work will be carried out in open-book, supervised conditions. Candidates must, of necessity, co-operate in practical surveying work. They must also share data obtained by the practical surveying work. Assessors must, nevertheless, satisfy themselves that candidates' folios contain their own work. In particular, candidates must carry out their own calculations, both in reducing levels and in arithmetic checking. Candidates must also draw up their own linear survey plan, contour plan and longitudinal section.

The report writing for the practical surveying work will be carried out in controlled conditions during which candidates will have access to their folio of work and the associated checklists. Candidates will not be permitted to confer with others in the drafting of their reports.

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 Unit, 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 2 and Outcome 3.

An exemplar for the folio of work for Outcomes 2 and 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.

National Unit Specification: statement of standards (cont)

UNIT Architectural Technology: Site Surveying (Higher)

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

For the folio of work for Outcomes 2 and 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 Architectural Technology: Site Surveying (Higher)

APPENDIX

NB: This Appendix is within the statement of standards, ie the mandatory requirements of the Unit. All of the content in this section must be covered, but for assessment purposes it will be sampled as illustrated in the Evidence Requirements and the NABs.

Content to be covered for Outcome 1

Ordnance Survey maps and plans:

- scales
- sheet references
- grid references
- co-ordinates
- standard symbols
- depiction of surface relief

Site plans:

- scales
- levels
- site orientation
- conventional symbols

Open-book folio of work (Outcomes 2 and 3)

A folio of work for the Outcomes 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 for the *linear measurement survey:*

- A linear measurement survey of a site of not less than 0.25 hectares, based on:
  - trilateration
  - offsetting
  - measurement by tape or other means
  - siting of stations
  - ranging
  - booking and field notes
  - standardisation of instruments
  - slope corrections
  - accuracy of measurement
  - orientation

National Unit Specification: statement of standards (cont)

UNIT Architectural Technology: Site Surveying (Higher)

- A plot of the linear measurement survey results to an accuracy of not less than 1 in 250, including:
  - an appropriate scale
  - use of standard symbols
  - orientation
  - details of all stations
  - survey lines
  - checklines
  - offset measurements
  - a title box

- A copy of the linear measurement survey booking sheets.

- A survey report for the linear measurement survey.

The folio of work will include for the *levelling survey:*

- A levelling survey over a grid of minimum overall size 30x30 metres based on:
  - the indirect contouring method
  - at least two change points
  - a permissible closing error of +/- 20mm
  - use of level
  - use of staff
  - elimination of parallax
  - use of benchmark(s)
  - booking (Rise and Fall **or** Height of Collimation method — although both will be taught)
  - elimination of collimation error

- Results plotted using interpolation or other method with:
  - an appropriate scale (identical to the scale of the linear survey)
  - sufficiency of clearly identified contour lines
  - all gridlines
  - reduced levels
  - a title box (if appropriate)

- Longitudinal section through contour plan to appropriate horizontal and vertical scales.

- A copy of the levelling survey booking sheets with levels reduced and closing error distributed.

- Original arithmetic checks for the levelling survey results.

- A survey report for the levelling survey.

The survey reports for the linear measurement survey and the levelling survey will be drafted in supervised conditions after the satisfactory compilation and submission of the folio of work to the assessor. Candidates may refer to their folio of work and the assessor-prepared checklists for information during the writing of the reports, but must not confer with colleagues on the content of the report. Candidates will be given a standard survey report template or headings for the report sections (templates are included in the NABs for that purpose).

National Unit Specification: statement of standards (cont)

UNIT Architectural Technology: Site Surveying (Higher)

The drawing up of the linear measurement survey and contour plan may be done either manually or by computer-aided means. If completed by computer-aided means, the evidence for the folio may be presented and stored electronically (there being no requirement in such a case to produce hard copies of the linear survey plan and levelling survey and section).

National Unit Specification: support notes

UNIT Architectural Technology: Site Surveying (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

The *Site Surveying* Unit is set in the context of building sites for single buildings or small developments. Candidates will gain appreciation of the type of information that is required by design teams to plan the layout of building developments and the setting out of building works, roads and drainage installations. Candidates may go on to study the subject of site planning and setting out of building works at HN level, Degree level or in employment.

Corresponding to Outcomes 1-3:

Outcome 1 For this Outcome candidates will read and interpret site plans and Ordnance Survey maps and plans and extract information from them.

Outcome 2 This Outcome requires candidates to undertake, as part of a small team, a linear measurement survey. The candidate will plot the results to scale on a plan that is suitable for reproduction and write a brief survey report*. Emphasis should be given to sensible planning of surveying work and the layout of stations. The accuracy required for the overall linear survey is not less than 1 in 250.

Outcome 3 This Outcome requires candidates to undertake a levelling survey, reduce the levels, produce a contour plan which is suitable for reproduction and write a brief survey report*. Once again, emphasis should be given to planning the survey properly to minimise abortive work. Candidates will also be required to produce a longitudinal section through the surveyed site.

**Candidates are to be given a template or headings upon which to base their survey reports. An example of such a template is given in the NABs for this Unit.*

The study of site surveying should include relevant health and safety issues. Candidate groups and individuals should consider the hazards encountered in practical surveying work, for example, manual handling, cuts from tapes and nipped fingers from staff work and tripods. The focus must be on how to remove hazards or minimise risks.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The topic of site surveying is most logically taught in the order of the Unit Outcomes. This permits candidates to first consider maps and plans. Candidates may already have a general familiarity with road maps, street maps, atlases and geographical maps.

Scale may be a new concept for some candidates, so it may be worthwhile devoting some time to this. Candidates who wish a career in the construction industry will need to be proficient in working with scale drawings both in surveying and in other areas such as building drawing.

National Unit Specification: support notes (cont)

UNIT Architectural Technology: Site Surveying (Higher)

OS maps and plans are readily available, both electronically and in hard copy. Candidates may be shown a series of maps that depict a location of interest such as an ancient monument, a sports stadium, their home town or even their own street and house. Once the candidate's interest is aroused, the mathematics of the OS grid and reference systems can be tackled, perhaps using the candidate's home town or other places of interest as a case study.

When candidates have successfully grasped the concept of OS maps and their symbols, the subject of site plans is relatively straightforward. Both OS maps and site plans are drawn to scale and incorporate the use of standard symbols.

Lessons can be reinforced by tutorial sessions involving short answer or multiple choice questions. The use of hard copy site plans and OS maps and plans in such tutorial sessions is to be encouraged. Tutorial periods on maps and plans could include sessions on the identification of standard symbols. These can be of short answer or multiple choice varieties and can be presented in either electronic form or hard copy.

Textbooks on site surveying generally are readily available as are a number of texts specialising in maps and plans. Centres may have their own learning packages on these subjects.

Field trips to sites depicted on OS maps, plans and site plans are always of benefit to candidates. During site visits, candidates can be asked to consider how they would have gone about gathering information for the preparation of a map or plan of the site. This will conveniently introduce the next subject in the study of site surveying — linear measurement surveys.

The use of trilateration in surveying and mapping can be readily depicted on a whiteboard, electronically or by handout materials. Convincing candidates that trilateration is an effective method of preparing site plans may be demonstrated by a small scale practical example: a lesson that involves candidates measuring the location of several trees and drawing up a scale plan of the trees' positioning. This will demonstrate that triangles are the most useful and reliable shape in reproducing locations accurately.

Although the small scale exercise outlined above can be carried out using a single sheet of paper and neat note taking, candidates should learn that such an approach would not work for larger or more detailed surveys. It is at this point that the use of standard linear survey booking sheets can be introduced. The candidates can now try using the booking sheets for the 'tree' exercise previously mentioned. Next a larger exercise, involving offset measurements can be tackled and the results drawn up to scale. The accuracy of the survey should at this stage be checked using the actual closing measurement and the corresponding measurement on the scale plan. The use of checklines should also be explained and demonstrated. These exercises prepare the candidate for the compilation of their folio of work for summative assessment.

The method of checking accuracy of survey results must be explained and demonstrated to candidates. A small scale exercise is just as effective as a large scale exercise in demonstrating how to compare the actual closing measurement with the closing measurement as scaled from the drawing up of the linear survey results. It must be made clear to candidates exactly what is meant by an accuracy of 1 in 250.

National Unit Specification: support notes (cont)

UNIT Architectural Technology: Site Surveying (Higher)

Candidates will benefit from reading good examples of previous linear [and levelling] survey reports. They must appreciate the benefits of clear and concise technical language, well presented under appropriate headings. Examples of report writing from fields outwith land surveying may also be used to illustrate effective report writing technique and language.

Short tutorial exercises in linear measurement surveying can focus on specific skills:

- planning the survey
- surveying over sloping ground
- offsets and locating specific objects
- measuring horizontal curves
- booking skills
- use of checklines
- drawing up results from booking sheets
- checks on accuracy
- report writing

Sites suitable for linear measurement and levelling surveys may be available within school or college grounds. Centres are reminded that if they intend to use private land or public open spaces such as parks, permission in writing should be obtained from the owners or departments responsible.

Once candidates are sufficiently confident with linear surveying they can be introduced to the subject of levelling. This can be done by referring again to OS maps and plans on which surface relief is depicted by spot heights and/or contours.

Candidates may readily grasp the depiction of contours by examining maps of mountain ranges. They can then be introduced to the relatively more subtle slopes depicted on site plans. It would be useful for candidates to examine real examples of such site plans. Even better would be a visit to a construction site where candidates can view the contours and changes in height in real life and see how the site plan endeavours to depict them. If a site visit coincided with a practical demonstration of the use of levelling surveying this would be useful.

A candidate's first practical lesson in levelling should be on the safe use of the equipment employed in surveying work. Hazards that may be encountered in the carrying out of surveying include: manual handling, slips, trips and falls, contact with sharp edges of tapes. Injury may also occur due to the pinching of fingers in-between the legs of tripods when closing the legs and in raising or lowering them. The sharp ends of ranging rods are an obvious hazard. This list is not exhaustive. Candidates should be taught to recognise potential hazards that may be particular to any one survey site, for example a busy main road or overhead cables. Candidates should not, of course, be asked to survey on sites that are inherently dangerous.

After learning about the safety implications associated with levelling surveying, the candidate can proceed to use the instruments in practice. Candidates can learn how to set up correctly a tripod and an automatic or other level. This is best demonstrated by a tutor, or can be learned by watching a video. The use of textbook instructions or notes is not as effective as hands-on demonstrations and practice in this regard.

The reading of the standard measuring staff is a skill that may take some time to perfect. The concept of parallax should be explained and candidates should learn how to eliminate this from their readings.

National Unit Specification: support notes (cont)

UNIT Architectural Technology: Site Surveying (Higher)

Candidates can build up skills and confidence in the use of the levelling instrument by short practical exercises such as carrying out a survey around a single building. Candidates will be able to complete this in a few minutes, and at the same time be forced to carry out two or more change points in the survey. Correct booking of such a survey is a relatively easy task, but candidates must learn to carry this out correctly.

Candidates should learn that careful surveying leads to satisfactory results. They should also acknowledge that there will almost invariably be a closing error in all levelling surveys. A number of different methods are available to calculate an acceptable tolerance for a levelling survey in any one instance. For example, one method employs the following formula:

Allowable loop misclosure $C = 10mm\sqrt{n}$

Where n is the number of instrument set-ups.

For two change points therefore, this gives $C = 10mm\sqrt{3} = 17mm$.

For this Unit the closing error for assessment purposes has been set at +/- 20mm.

Wherever possible, candidates should practise carrying out levelling surveys on the same plot of land on which they carried out linear measurement surveys. Contours drawn up on tracing paper can be placed over the site plan, thus incorporating in one visual, the full range of information on the site.

Videos on the subjects of linear measurement surveying and levelling surveying can be made available to individuals studying on an open/distance learning basis as well as to the class group in general. They are no substitute, however, for practical, hands-on experience with surveying work. Actual practice can be reinforced by means of tutorial examples.

Short tutorial exercises in levelling measurement surveying can focus on specific skills:

- planning the survey
- levelling the instrument
- reading the staff
- how to deal with severely sloping areas within large grid intervals
- booking skills
- reducing the levels
- arithmetic checks and closing error
- drawing up results
- report writing

Manufacturers and suppliers of surveying instruments produce technical literature and posters that highlight how their products are to be used. Candidates will likely find such literature informative and visual. Technical literature often refers the reader to the company's website where even more information and drawn/photographic details are available.

National Unit Specification: support notes (cont)

UNIT Architectural Technology: Site Surveying (Higher)

Candidates should be made aware of the techniques and equipment to which they may progress as they study surveying further. The basic land surveying techniques that they acquire in this Unit will allow them in due course to extend the site survey process to full topographical surveys. They may progress in further Units to completing three-dimensional surveys and use EDM (electromagnetic distance measurement) and total station equipment. Candidates should be made aware of modern theodolites and the facility to ascertain both angular and linear measurement using such equipment. If time permits, centres may demonstrate the use of such equipment. Nevertheless, assessment in the unit *Site Surveying* requires the use of tapes and levels.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

This Unit gives candidates experience of practical surveying activity. Although candidates will develop their knowledge and understanding of maps, site plans and surveying techniques, Unit assessment is focused on the application of this knowledge and understanding.

Candidates should achieve a satisfactory mark in the closed-book test for Outcome 1. The standard to be applied is detailed in the National Assessment Bank item for the Unit.

Candidates should gather a folio of work which will provide evidence for Outcomes 2 and 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.

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).