Higher National Unit Specification

General information for centres

Unit title: Highway Engineering

Unit code: DW5N 35

Unit purpose: This Unit is designed to develop candidate knowledge and skills in the geometric design of roads, highway drainage, highway maintenance procedures and environmental aspects of road design and construction.

On completion of the Unit the candidate should be able to:

1 Carry out geometric design of roads.
2 Apply drainage principles to surface water removal and the control of groundwater.
3 Describe and explain road maintenance procedures.
4 Apply environmental criteria to road design and construction.

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

**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 is recommended that candidates undertaking this unit should have prior knowledge and skills as evidenced by the completion of the following units: Civil Engineering Specialisms; Construction Site Surveying A; Construction Site Surveying B; or equivalent prior knowledge and/or experience.

Core Skills: There are opportunities to develop the Core Skill of Numeracy, 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 on an individual outcome basis, by combinations of outcomes, or by a single holistic assessment encompassing all outcomes. Assessment should be conducted under supervised conditions. The assessment(s) should consist of an appropriate balance of restricted response and structured questions. If a single assessment covering all outcomes is used, it should not exceed three hours in duration. It should be noted that candidates must achieve all the minimum evidence specified for each outcome in order to complete the unit successfully.

General information for centres (cont)

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 knowledge and skills items should be sampled on each assessment occasion.

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

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 8.

Higher National Unit specification: statement of standards

Unit title: Highway Engineering

Unit code: DW5N 35

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 the unit emphasis will be placed where appropriate on the application of Health & 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, the impact on the environment of not implementing sustainability, and the legislation promoting sustainability.

Outcome 1

Carry out geometric design of roads

Knowledge and/or skills

- Design speed
- Visibility distance
- Horizontal curvature including transitions
- Vertical alignment
- Crossfall
- Types and location of safety fences/barriers

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- specify and analyse problems in road alignment
- apply appropriate design criteria to produce suitable elements in road geometry

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. In any assessment of this outcome, a minimum of **four out of six** knowledge and/or skills items should be sampled. Candidates must provide a satisfactory response in regard to all four knowledge and/or skills items.

Evidence should be generated through assessment undertaken in controlled supervised conditions. Assessment should be conducted under open book conditions.

Assessment guidelines

The assessment for this Outcome might be combined with those for some or all of the other outcomes in this Unit.

Higher National Unit specification: statement of standards (cont)

Unit title: Highway Engineering

Outcome 2

Apply drainage principles to surface water removal and the control of groundwater

Knowledge and/or skills

- Design rainfall
- Factors influencing gully spacing
- Design of gully layout
- Subdrain layout
- Filter material selection

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- specify and analyse problems in drainage design
- apply standard criteria to produce suitable drainage design elements

Evidence for the knowledge and/or skills for this outcome will be provided on a sample basis. In any assessment of this outcome, a minimum of **four out of five** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee which items they will be questioned on, a different sample of knowledge and/or skills items is required each time the outcome is assessed. Candidates must provide a satisfactory response in regard to all four knowledge and/or skills items.

Evidence should be generated through assessment undertaken in controlled supervised conditions. Assessment should be conducted under open book conditions.

Assessment guidelines

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

The assessment for this Outcome might be combined with those for some or all of the other outcomes in the Unit.

Outcome 3

Describe and explain road maintenance procedures

Knowledge and/or skills

- Road condition surveys
- Maintenance processes
- Selection of treatments
- Design of remedial elements

- Safety and traffic management at roadworks
- Legislative requirements

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- identify road defects and required responses
- apply given criteria to select and/or design remedial actions

Evidence for the knowledge and/or skills for this outcome will be provided on a sample basis. In any assessment of this outcome, a minimum of **four out of six** knowledge and/or skills items should be sampled. Candidates must provide a satisfactory response in regard to all four knowledge and/or skills items.

Evidence should be generated through assessment undertaken in controlled supervised conditions. Assessment should be conducted under open book conditions.

Assessment guidelines

The assessment for this Outcome might be combined with those for some or all of the other outcomes in the Unit.

Outcome 4

Apply environmental criteria to road design and construction

Knowledge and/or skills

- Environmental criteria
- Environmental effects of roads
- Environmental objectives
- Impact assessment
- Mitigation measures

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- identify appropriate environmental criteria in road design and construction
- apply appropriate criteria to assess and/or design impact mitigation measures

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. In any assessment of this outcome, a minimum of **four out of five** knowledge and/or skills items should be sampled. Candidates must provide a satisfactory response in regard to all four knowledge and/or skills items.

Higher National Unit specification: statement of standards (cont)

Unit title: Highway Engineering

Evidence should be generated through assessment undertaken in controlled supervised conditions.

Assessment guidelines

The assessment for this Outcome might be combined with those for some or all of the other outcomes in the Unit.

Administrative Information

Unit code: DW5N 35

Unit title: Highway Engineering

Superclass category: TL

Date of publication: June 2006

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Highway Engineering

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 provides the candidate with the knowledge and skills to carry out basic designs of road alignment and drainage elements. It also introduces some of the key aspects of road maintenance practice and seeks to provide the candidate with a basic environmental awareness in relation to highway engineering. Attention should be paid in the delivery of this unit to the content of other related units in the programme. In particular, it should be noted that some roads design elements are featured in the Construction Site Surveying units and in the unit entitled Civil Engineering Specialisms. There is also a related unit in Traffic Engineering.

Recommended class time allocations to each outcome are given as guidance towards the depth of treatment that might be applied to each topic. This guidance has been used in the design of the assessment exemplar material for this unit.

1 Geometric design of roads (15 hours).

Design speed: factors influencing speed; alignment and layout constraints; selection of suitable design speed.

Visibility distance: relationship between speed and required forward visibility for turning, stopping and overtaking; design values from standards.

Horizontal curvature including transitions: analysis and design of circular, combined circular and transition curves, and wholly transition curves in plan.

Vertical alignment: design of summit and sag curves to comply with standard requirements.

Crossfall: relationship between design speed and superelevation; selection of suitable values from design charts; variation with changes in curvature.

Types and location of safety fences/barriers: suitable use for different barrier types; performance requirements; required locations.

2 Drainage principles and practice (5 hours).

Design rainfall: selection of appropriate design storm intensity.

Factors influencing gully spacing: crossfall; gradient; width of flow; surface character; gully type.

Design of gully layout: design charts; low points; junctions; changes in curvature.

Subdrain layout: configuration of drainage runs in relation to type of surface water removal, earthworks and eventual discharge.

Filter material selection: standard and designed filter media in subdrains.

3 Road maintenance (10 hours).

Road condition surveys: inspection, data collection, assessment and prioritisation for functional and structural evaluation.

Maintenance processes: standard practice in routine, remedial and winter maintenance.

Selection of treatments: recognition of defect types; residual life; critical and failure conditions; alternative maintenance responses.

Design of remedial elements: determination of requirements for surface dressings and overlays.

Safety and traffic management at roadworks: suitable equipment, signage, layouts and traffic control measures for footway, lane and carriageway closures.

Legislative requirements: requirements upon roads authorities, utility operators and contractors in road opening and reinstatement.

4 Environmental criteria in road design and construction (10 hours).

Environmental criteria: factors used in environmental assessments and the manner in which they can be measured.

Environmental effects of roads: air, noise, visual, ground, habitat and water pollution effects of roads; energy and other resource implications.

Environmental objectives: statutory and other requirements in the air, noise, soil and water environments.

Impact assessment: methods of conducting and reporting environmental impacts in relation to roads projects; relationship of environmental impacts to other project impacts.

Mitigation measures: noise mitigation measures; sustainable drainage systems; air quality management; environmental control in road construction.

Guidance on the delivery and assessment of this Unit

Since this unit relies in part on the candidate's knowledge from previously completed units, the unit should be studied in the second year of a two-year programme. Case studies could usefully be employed to illustrate the practical working context of the material delivered. This might involve practitioners to deal with some aspects of the content or site visits where these are possible. In addition, where the centre has access to road design software, this might be used to allow a broader application of the concepts.

Higher National Unit specification: support notes (cont)

Unit title: Highway Engineering

Candidates would normally work individually but should be encouraged to participate in group work and discussion in relation to their own studies or experiences. Assessment may be formative and summative and both may feature as part of the process. Although assessment must be focussed on the individual achievement of each candidate, group work may contribute as appropriate. Integrative project work might assist in linking this unit with other related units. Appropriate attention must be given to health and safety arrangements in relation to the topics covered.

The volume of evidence required for each outcome should take into account the overall number of assessments being contemplated within this unit and the design of the overall delivery programme. In designing the assessment instrument(s) opportunities should be taken to generate appropriate evidence to contribute to the development of core skills elements.

Where available, evidence from the workplace can also be incorporated to enhance the learning outcomes, provided that such evidence is appropriate and authenticated as the candidate's own work.

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

Higher National Unit specification: support notes (cont)

Unit title: Highway Engineering

Open learning

Where appropriate materials exist, this unit could be delivered by distance learning, which may incorporate some degree of online support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would need to be put in place to ensure that assessments were conducted under controlled supervised conditions.

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 SQA's website: **www.sqa.org.uk**.

General information for candidates

Unit title: Highway Engineering

On completion of the Unit you should be able to:

1 Carry out geometric design of roads.
2 Apply drainage principles to surface water removal and the control of groundwater.
3 Describe and explain road maintenance procedures.
4 Apply environmental criteria to road design and construction.

Evidence that you can satisfy the knowledge and skill elements of this Unit will be obtained by assessment in controlled supervised conditions in an open book context.