SQA Advanced Unit Specification

General information for centres

Unit title: Railway Permanent Way Engineering: Computer Design

Unit code: HR61 48

Unit purpose: This Unit is designed to give the candidate an introduction to the use of computers in the application of the theory and practice of permanent way design. For candidates working in permanent way it will provide them with the opportunity to gain familiarity with software away from the work place, thus allowing them to understand the software beyond the immediate workplace needs. The Unit is geared specifically towards those working in permanent way design to help improve their software skills.

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

1   Manage survey data, and process into 3D model format
2   Carry out plain line horizontal and vertical curve design using a 3D model
3   Carry out switches and crossing design using a 3D model
4   Design a topographical corridor by 3D model
4   Process and produce drawings from 3D model outputs.

Credit points and level: 1 SQA 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 National 1 to Doctorates.

Recommended prior knowledge and skills: It is recommended that candidates undertaking this Unit will have will prior knowledge and skills as evidenced by completion of the following units:

♦   Railway Civil Engineering: An Introduction
♦   Railway Permanent Way Engineering

or equivalent prior knowledge and/or experience.

Core Skills: There are opportunities to develop the Core Skills of Communication, Numeracy, IT 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/project combining all Outcomes. The assessment paper/s should be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be conducted under supervised, controlled (and generally open-book/internet access) conditions. A single assessment covering all outcomes should not exceed three hours duration.

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.

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

An exemplar instrument of assessment and marking guidelines have been produced to provide an example 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.

SQA Advanced Unit specification: statement of standards

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Throughout the 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, the impact on the environment of not implementing sustainability, and the legislation promoting sustainability.

Outcome 1

Manage survey data and process into 3D model format

Knowledge and/or skills

- ♦ Error identification
- ♦ Error rectification
- ♦ Input and run of traverse data
- ♦ Survey reports
- ♦ Computer generated drawings

Evidence Requirements

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

- ♦ produce reports and prepare computer generated drawings from survey data

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 **three out of five** knowledge and/or skills items is 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 knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide satisfactory responses to all three items.

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

Assessment guidelines

Candidates may be asked to complete a number of tasks requiring the processing of survey data into 3D model format and the identification and correction of errors. Candidates may also be required to produce reports on completed surveys and to prepare drawings from survey data. Assessment may be combined with those for some or all of the other outcomes of this Unit.

Assessment should be conducted under open-book conditions.

Outcome 2

Carry out plain line horizontal and vertical curve design using a 3D model

Knowledge and/or skills

♦   3D design models of the principles of railway curve alignment design to current UK practice
♦   Design reports (computer outputs)

Evidence Requirements

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

♦   use current design procedures and a computer software package to prepare setting out data for plain line curve alignment

Evidence for the knowledge and/or skills for this Outcome will not be provided on a sample basis. In any assessment of this Outcome, both items should be sampled. Candidates must provide satisfactory responses to both items.

Evidence should be generated through assessment in controlled supervised conditions.

Assessment guidelines

Written evidence of the candidate's ability to use current design procedures and a computer software package to prepare setting out data for plain line curve alignment. Computer output evidence is also required of the candidate's ability to produce accurate design reports. Assessment may be combined with those for some or all of the other outcomes of this Unit.

Assessment should be conducted under open-book conditions with internet access.

Outcome 3

Carry out switches and crossing design using a 3D model

Knowledge and/or skills

♦   The principles of switches and crossing geometry as applied in 3D models
♦   Current UK design practice
♦   Design reports (computer outputs)

Evidence Requirements

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

♦   use a 3D model computer software package to complete switches and crossings designs and produce a detailed design report

Evidence for the knowledge and/or skills for this Outcome will not be provided on a sample basis. In any assessment of this Outcome, all items should be sampled. Candidates must provide satisfactory responses to all items.

Evidence should be generated through assessment in controlled supervised conditions.

SQA Advanced Unit Specification

Assessment guidelines

Written evidence that the candidate can use a 3D model computer software package to complete switches and crossing designs. Written and graphical evidence (computer based) is also required that the candidate can produce an accurate detailed design report. Assessment may be combined with those for some or all of the other outcomes of this Unit.

Assessment should be conducted under open-book conditions with internet access.

Outcome 4

Design a topographical corridor by 3D model

Knowledge and/or skills

♦   Corridor characteristics
♦   Outputs from corridor characteristics
♦   Generation of quantities from models
♦   Design report production (computer output)

Evidence Requirements

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

♦   produce computer design output from corridor characteristics and quantitative computer analysis

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 **three out of four** knowledge and/or skills items is 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 knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide satisfactory responses to all three items.

Evidence should be generated through assessment in controlled supervised conditions.

Assessment guidelines

Written evidence that the candidate is aware of corridor characteristics and can take account of such characteristics in corridor design by computer. Written and graphical evidence (computer based) is also required that the candidate can produce an accurate detailed design report. Assessment may be combined with those for some or all of the other outcomes of this Unit.

Assessment should be conducted under open-book conditions with internet access.

Outcome 5

Process and produce drawings from 3D model outputs

Knowledge and/or skills

♦   3D design models
♦   Computer drawing packages
♦   Drawing techniques and accepted conventions related to alignment
♦   Drawing presentation formats

Evidence Requirements

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

♦   produce models using computer drawing packages
♦   produce computer generated drawings to various formats

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 **three out of four** knowledge and/or skills items is 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 knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide satisfactory responses to all three items.

Evidence should be generated through assessment in controlled supervised conditions.

Assessment guidelines

Written and graphical evidence that the candidate can transfer a 3D design model to a drawing package and prepare acceptable drawings in a number of presentation formats. Assessment may be combined with those for some or all of the other outcomes of this Unit.

Assessment should be conducted under open-book conditions with internet access

Administrative Information

Unit code: HR61 48

Unit title: Railway Permanent Way Engineering: Computer Design

Superclass category: VF

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Unit specification: support notes

Unit title: Railway Permanent Way Engineering: Computer Design

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 builds on the knowledge and skills gained in completion of the SQA Advanced Unit in Railway Permanent Way Engineering. The candidate will be provided with the knowledge and skills to design permanent way/ track for a range of applications.

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 **Handle survey data, and process into 3D model format (8 hours)**

The source of any design work on computer is the base data from surveys in electronic format. This outcome should provide the candidate with practical experience of handling, checking data, running reports and outputting basic drawings of the existing topography/railway. Errors: misalignment; mis-recording.

Traverse: calculation; checking. Reports: outputs of levels; radii; vertical curves. Drawings: longitudinal sections; cross-sections; plans.

2 **Carry out plain line horizontal and vertical curve design using a 3D model (8 hours)**

Design rules: cant; cant deficiency; rate of change of cant; vertical curves. Awareness of other disciplines. Report: output of radii; gradients; six foots.

3 **Carry out switches and crossing design using a 3D model (8 hours)**

Designs: horizontal; vertical. Design rules: crossings; tangents; radii. Awareness of other disciplines. Report (computer based): output of switch types; crossing points; intersections.

4 **Design a topographical corridor by 3D model (8 hours)**

Corridor characteristics: cuttings/embankments slopes; clearance to structures envelopes; water courses. Application: generation of cross-sections and longitudinal sections Quantities: generation of earthworks quantities for corridor. Report: computer outputs

5 **Process and produce drawings from 3D model outputs (8 hours)**

3D design models transferred correctly into computer drawing packages. Drawing techniques and accepted conventions related to alignment used correctly. Drawings are produced correctly in various presentation formats. Transfer to 3D model: software transfer files. Drawings techniques: different styles of presentation. Drawings: plans; elevations; longitudinal sections; cross-sections.

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.

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

Open learning

This Unit could be undertaken with open and flexible learning and could be underpinned by internet resources.

Given that appropriate learning materials exist 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 was conducted under controlled, supervised conditions.

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

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.

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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.