Higher National Unit Specification

General information for centres

Unit title: Structural Steel Design and Detailing

Unit code: DW4A 35

Unit purpose: This Unit is designed to provide the candidate with the ability to apply limit state design philosophy to the checking of structural steelwork elements in accordance with recognised Design Standards.

The Unit has been developed to enable candidates to demonstrate knowledge, comprehension and application of the design checking process.

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

1 Check the suitability of **statically determinate steel beams** with fully restrained, partially restrained and unrestrained compression flanges.
2 Check the suitability of **single-storey steel column sections in simple construction** subject to combined axial load, single and bi-axial bending and the design of baseplates with concentric axial loads.
3 Design **simple bolted and welded connections**.

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: Candidates must have an understanding and knowledge of the structural mechanics of statically determinate structures and distribution of structural loading. Such understanding and knowledge may be evidenced by the possession of a structural mechanics HN Unit or equivalent. The Unit includes all the basic principles necessary to allow candidates possessing other qualifications or experience to succeed in this Unit.

Core Skills: There are opportunities to develop the Core Skills of Numeracy and IT 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.

General information for centres (cont)

Assessment: It is possible to assess candidates either on an individual Outcome basis, a combination of Outcomes or by a single holistic assessment 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 conditions. A single assessment covering all Outcomes should not exceed 3 hours in duration. It should be noted that candidates must achieve all the minimum evidence requirements specified for each Outcome in order to pass this Unit.

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/Skill items should be sampled on each assessment occasion.

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: Structural Steel Design and Detailing

Unit code: DW4A 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.

Outcome 1

Check the suitability of **statically determinate steel beams** with fully restrained, partially restrained and unrestrained compression flanges

Outcome 2

Check the suitability of **single-storey steel column sections in simple construction** subject to combined axial load, single and bi-axial bending and the design of baseplates with concentric axial loads

Outcome 3

Design **simple bolted and welded connections**

Knowledge and/or skills for the Unit

- Design load effects on statically determinate structures at the ultimate and serviceability limit states, due to given applied characteristic loads
- Suitability of given steel Beam sections in accordance with recognised Design Standards
- Suitability of given steel Column sections in accordance with recognised Design Standards
- Suitability of given steel Base Plates in accordance with recognised Design Standards
- Design and detailing of typical steel connection details
- Computer software analysis

Evidence Requirements for the Unit

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

- select the correct partial safety factors for structural loading and evaluate the ultimate/serviceability design load effects for statically determinate structures. In the case of beams the types of loading to be considered are: point loads, uniformly distributed loads and combinations of both
- check the suitability of given steel sections in accordance with recognised Design Standards
- sketch details of a typical steel connections

Higher National Unit specification: statement of standards (cont)

Unit title: Structural Steel Design and Detailing

Evidence for the knowledge and/or skills for these Outcomes will be provided on a sample basis. In any assessment of these Outcomes a minimum of **three out of six** knowledge and/or skills items should be sampled two of which must include a design check on a beam and column.

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

Assessment guidelines for the Unit

Candidates must provide a satisfactory response to all the evidence requirements, this must be provided by manual calculations. Assessment should be conducted under open-book conditions.

Questions used to elicit candidate evidence should take the form of clearly defined structural steel elements eg in the case of beams, indicating support conditions, compression flange restraint conditions and structural loading; using sketches where appropriate. The elements may be specified individually as separate questions or may form part of a larger structure comprising several types of element.

Administrative Information

Unit code: DW4A 35

Unit title: Structural Steel Design and Detailing

Superclass category: TM

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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: Structural Steel Design and Detailing

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 ability to check the suitability of given structural steel elements in statically determinate structures, in accordance with recognised Design Standards and to sketch typical base to plate connection details.

The delivery of this Unit should emphasise the relevance of the syllabus content to overall structural design and to other Units in the program; particularly those relating to the structural design of reinforced concrete, masonry and timber.

Recommended time allocations to each Outcome are given as guidance towards the depth of treatment which might be applied to each topic. This guidance has been used in the design of the assessment exemplar material provided with the Unit.

This Unit is at SCQF level 8 and has been developed as part of the new HNC in Structural Engineering and HND Civil Engineering awards.

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

In designing this Unit, the Unit writer has identified the range of topics which would be expected to be covered by lecturers. Whilst it is not mandatory for a centre to use this list of topics it is strongly recommended that it does so.

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.

1 Statically determinate steel beams (13 hours)

Statically determinate steel beams: consideration of appropriate partial safety factors for serviceability and ultimate limit state conditions, analysis to determine design load effects (including the equivalent distributed load technique for deflection), flange restraint conditions, effective buckling lengths of compression flange, equivalent slenderness, section classification, shear resistance, buckling resistance moment, web bearing capacity, web buckling capacity and deflection.

Higher National Unit specification: support notes (cont)

Unit title: Structural Steel Design and Detailing

2 Single-storey, steel column sections in simple construction (17 hours)

Single-storey, steel column sections in simple construction: consideration of simple construction, eccentric connections, appropriate partial safety factors for serviceability and ultimate limit state conditions, analysis to determine design load effects, effective buckling lengths, slenderness, section classification, compression resistance, interaction equation for combined axial and bending effects in simple construction, effective area method for base plates, sketch details of typical column to base plate to pad foundation connection.

3 Simple bolted and welded connections (10 hours)

Simple bolted connections: consideration of appropriate partial safety factors for serviceability and ultimate limit state conditions, analysis to determine design load effects, types of bolt.

Non-preloaded bolts: bolt spacing, edge and end distances, bolt shear, bolt bearing, plate bearing, block shear and plate tension capacities, bolt tension capacity (simple method), interaction equation for combined shear and tension (simple method).

Simple welded connections: consideration of appropriate partial safety factors for serviceability and ultimate limit state conditions, analysis to determine design load effects, types of weld.

Fillet welds: end returns, effective lengths, throat size, design strength, weld capacity using the simple method.

Sketch details of typical beam to beam, beam to column and angle to gusset plate connections.

Guidance on the delivery and assessment of this Unit

The material in this Unit should be delivered in a manner which encourages students to develop a working knowledge and familiarity of recognised Design Standards and the style in which they are written. The teaching should be based, wherever possible, on real design office situations incorporating commercially available, practical design aids such as computer software, design charts and design tables where appropriate in addition to the direct use of recognised Design Standards.

Candidates should be encouraged to prepare calculations on formal ‘design calculation sheets’ in a manner similar to that found in practice. In addition they can also develop ‘flow charts’ to aid their understanding of design/checking procedures and which can be utilised in future summative assessments.

Candidate will usually work individually however, they should also be encouraged to work in small groups developing solutions to specific design problems; presenting and explaining the solutions to the remainder of their peer group.

It is recommended that knowledge/skills be developed by working through structured questions issued by the tutor or initiated by the candidates themselves. Where possible some of the questions should be based on real-life structures which can be viewed locally and discussed prior to analysis and design by the candidates.

In designing the assessment instrument opportunities should be taken to generate appropriate evidence to contribute to the assessment of Core Skills.

Higher National Unit specification: support notes (cont)

Unit title: Structural Steel Design and Detailing

Opportunities for developing Core Skills

Opportunities for the development of Core Skills at the output level are more fully identified in the Core Skills Sign Posting Guide. The grid below is indicative of the opportunities for Core Skills development within this Unit.

Core Skill	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5
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					

Open learning

Given that the materials exist this Unit could be delivered by distance learning which may incorporate some degree of on-line support. Arrangements would be required 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: Structural Steel Design and Detailing

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

1 Check the suitability of **statically determinate steel beams** with restrained, partially restrained and unrestrained compression flanges.
2 Check the suitability of **single-storey, steel column sections in simple construction**, subject to combined axial load, single and bi-axial bending and design a suitable base plate in the concentrically axially loaded case and sketch details of a typical column to base plate to pad foundation connection.
3 Design **simple bolted and welded connections** and sketch details of typical beam to beam, beam to column and angle to gusset plate connections.

Evidence that candidates can satisfy the knowledge and skill elements of this Unit will be obtained by assessment in controlled, supervised conditions.

The assessment will be open-book format in which candidates are permitted to access information which they consider relevant and have in their possession. No communication or transfer of materials between candidates is permitted.