National Unit Specification: general information

UNIT Mechanics for Construction: An Introduction (SCQF level 6)

CODE F3JC 12

SUMMARY

This Unit is suitable for candidates who aspire to a career in the construction industry or related fields of endeavour as technicians, technologists or other related professions.

The Unit introduces the basic principles of mechanics relating to construction and develops skills in completing calculations in relation to these principles. It includes the understanding of units and quantities in mechanics and their application to basic problem solving. Candidates will be introduced to forces, stress and strain, and their application in elements of structural analysis.

OUTCOMES

1 Identify and apply the units and quantities used in mechanics in a construction context.
2 Explain the basic principles of structural analysis in a construction context.
3 Complete calculations related to forces in equilibrium.
4 Complete calculations involving direct stress and strain in a construction context.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained the following, or equivalent:

- Standard Grade Mathematics at General level

Administrative Information

Superclass: TK

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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

There is no automatic certification of Core Skills or Core Skill components in this Unit. Opportunities for developing aspects of Core Skills are highlighted in *Guidance on Learning and Teaching Approaches.*

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.

OUTCOME 1

Identify and apply the units and quantities used in mechanics in a construction context.

Performance Criteria

(a) Identify appropriate units and quantities for a given construction.
(b) Apply units and quantities correctly in solving basic problems in mechanics.
(c) Complete calculations correctly in mechanics using appropriate units and quantities.

OUTCOME 2

Explain the basic principles of structural analysis in a construction context.

Performance Criteria

(a) Identify the main types of structure and structural elements correctly.
(b) Identify correctly the main types of loading carried by structures.
(c) Identify correctly the load transfer paths through structures.

OUTCOME 3

Complete calculations related to forces in equilibrium.

Performance Criteria

(a) Identify conditions for and states of equilibrium correctly.
(b) Resolve forces accurately in two dimensions.
(c) Calculate resultants and equilibrants of coplanar force systems correctly.

OUTCOME 4

Complete calculations involving direct stress and strain in a construction context.

Performance Criteria

(a) Calculate direct tensile and compressive stresses in structural elements correctly.
(b) State the relationship between stress and strain accurately.
(c) Calculate strain and change of length correctly for structural elements subject to direct stress.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required which demonstrates that the candidate has achieved all Outcomes by meeting all the performance criteria within Outcomes.

Written and/or recorded oral evidence is required to demonstrate that the candidate has achieved all Outcomes to the standard stated in the performance criteria.

In this Unit an appropriate instrument of assessment would be a question paper consisting of short answer, restricted response question and a series of calculations. Assessment of this Unit should not exceed three hours. Evidence will be gathered at appropriate points throughout the delivery of the Unit. Assessments must be manageable and practicable for centres and candidates.

Although delivery of the Unit will cover all of the points below for each Outcome, assessment of these Outcomes must cover the following:

Outcome 1 — a minimum of five from seven

- Revision of basic units (mass, length, time) and their multiples and combinations
- Units of weight/force/load and momentum
- Units of stress and pressure
- Units of moment
- Units of work/energy
- Units of power
- Newton's Laws

Outcome 2 — a minimum of five from seven

- Beam and column structures
- Arch structures
- Cantilever structures
- Suspension structures
- Dead, imposed and wind loads
- Practical applications
- Load transfer paths in simple structures

Outcome 3 — a minimum of four from five

- Conditions for equilibrium
- Resolution of forces
- Combinations of forces
- Resultants and equilibrants
- Practical applications

National Unit Specification: statement of standards (cont)

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Outcome 4 — a minimum of five from seven

- Direct tension
- Direct compression
- Definition of strain
- Relation between stress and strain
- Hooke's Law
- Young's Modulus
- Situations of direct stress

The Assessment Support Pack for this Unit provides appropriate sample assessment materials. Where centres wish to develop their own assessment materials they should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

UNIT Mechanics for Construction: An Introduction (SCQF level 6)

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 of class contact time.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This Unit is a mandatory Unit in the National Certificate in Built Environment and Civil Engineering at SCQF level 6 and can also be taken as a freestanding Unit.

The Unit is set in the broadest context for construction and the principles to be illustrated will provide candidates with an appreciation of the application of mechanics in the whole range of construction endeavour. This Unit forms a basic introduction to the topic and candidates could go on to explore the subject and its applications in greater depth at Higher National level, in a degree programme or in employment.

Outcome 1 enables candidates to gain knowledge and understanding of the units and quantities associated with mechanics as applied to construction. The demonstration of that knowledge and understanding will be assessed by the completion of calculations relating to the range of items covered.

In Outcome 2, candidates will be introduced to the different types of structure and the loads that may occur in relation to them. The knowledge and understanding gained in this Outcome in relation to structural behaviour in load transfer will be demonstrated by the ability to describe the loads that would be present in a range of structures.

In Outcome 3, with reference to practice-based applications, candidates will gain knowledge and understanding of the concepts of equilibrium and forces. Equilibrium may be tested for a range of force combinations and the consequent resultants and equilibrants determined by resolution. This process may be achieved by calculation and/or graphically. The knowledge and understanding will be demonstrated by the ability to complete calculations correctly.

In Outcome 4, candidates will explore the relationships between stress and strain. The calculations required for this Outcome should be based only upon the linear stress/strain relationship. The demonstration of the knowledge and understanding gained in this arena will be assessed by the ability to perform calculations related to stress and strain in a practice-based context.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

For such a Unit as this, a suitable approach would be the use of illustrative methods, citing as many in-service structures as possible. The approach should be practice-based with, where possible, a considerable practical demonstration element in the teaching framework. Where laboratory testing facilities are not available, profitable use of video, DVD, or online resources could be made. At this level, the use of computer based teaching packages may be advantageous as a back-up to tutor/lecturer-candidate interaction.

National Unit Specification: support notes (cont)

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In Outcome 1, the classroom is likely to be the focus of attention and key elements involve the correct use of terminology (for example in the use of mass as opposed to weight), the mastering of definitions, and concept of dimensional consistency in formulae.

It should be noted that Outcome 2 does not require the solution of numerical problems in relation to the types of structures mentioned. The concept of standard loadings for different circumstances in regard to buildings, bridges and other structures should be introduced. Allied to this, the notion of point loads, uniformly distributed loads and other forms should be derived. Load transfer paths may be demonstrated with simple models and, at this stage, use could be made from visit(s) to a number of structures of different types.

Mathematical rigour and practical demonstration can proceed together in relation to Outcome 3. Equilibrium of forces may be demonstrated by a series of strings with weights. Moment equilibrium, likewise, may be demonstrated by a fulcrum arrangement. A practice-based application of a form of plane frame may be used, for example a roof truss or a lattice girder bridge. However, at this level, a full analysis would not be expected.

A good environment for delivering the content of Outcome 4 would be by demonstration in a laboratory testing context, where load, stress, strain and their interrelationship may be illustrated by practical work. It is unlikely that time would allow formal candidate participation in the testing process, but this section of the Unit might be integrated with units relating to built environment and civil engineering materials. Completion of calculations should draw upon practice-based examples.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

In this Unit candidates will be:

- extracting, analysing, interpreting and applying complex information through calculations

These offer opportunities to develop aspects of the Core Skills of:

- *Numeracy*
- *Problem Solving*

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of 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 communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003), SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

National Unit Specification: support notes (cont)

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The assessment instruments for each Outcome in this Unit may be offered separately, or it may be possible to integrate the assessments to encompass more than one Outcome. One possibility might be to take the example of one or more structures with given loading systems and to build an integrated assessment around such examples. The total amount of time dedicated to assessment should not exceed three hours. Candidates will be permitted to take class notes, formula and calculators into the assessment and all calculation methods should be demonstrated.

This Unit gives candidates an introductory experience in the principles of mechanics as applied to construction. Candidates will develop their knowledge and understanding of basic units, forces, stress and strain, and elements of structural mechanics; however, the assessment instruments for this Unit will focus upon the application of that knowledge and understanding in completion of calculations and description of load transfer patterns.

Candidates should achieve a satisfactory mark in the open-book assessments for each of the Outcomes. The standard to be applied is shown in the assessment support pack. In the event that assessment instruments are given for combinations of Outcomes, candidates must demonstrate that they have met the performance criteria for each Outcome. Sampling of material from the lists of content for each Outcome will be carried out, the range of topics selected being appropriate to ensure that the performance criteria related to each Outcome will be achieved if the pass mark is met or exceeded.

Outcome 1 should be assessed through a series of short answer and/or restricted response questions involving the determination of quantities and the expression of units, together with completion of calculations.

Outcome 2 should be assessed through a series of short answer and/or restricted response questions involving loads, structural types and structural behaviour, and the identification of the way in which loads travel through a structure.

Outcome 3 should be assessed through a series of short answer and/or restricted response questions involving the determination of conditions for equilibrium, resolution of forces and determination of resultants.

Outcome 4 should be assessed through a series of calculations to solve problems related to the topic and thus to demonstrate the required knowledge and understanding.

In the event of reassessment being required, a candidate should be assessed using an alternative instrument for any Outcome not achieved.

Assessment will be carried out in controlled and supervised conditions and will involve combinations of short answer and/or restricted response questions appropriate to the four Outcomes: appropriate understanding and basic problem solving in Outcome 1; identification of structural forms, elements and load transfer paths in Outcome 2; basic problem solving in relation to force equilibrium in Outcome 3; and problem solving in relation to direct stress and strain at Outcome 4. It is possible to envisage integrated assessments for more than one Outcome.

National Unit Specification: support notes (cont)

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CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

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. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.