-SQA- SCOTTISH QUALIFICATIONS AUTHORITY

NATIONAL CERTIFICATE MODULE: UNIT SPECIFICATION

GENERAL INFORMATION

-Module Number- **2150186** **-Session-1996-97**

-Superclass- **RC**

-Title- **STRUCTURES AND MATERIALS 1**

-DESCRIPTION-

GENERAL COMPETENCE FOR UNIT: Applying the principles of static equilibrium to structural systems and calculating the effect of load on individual members.

OUTCOMES

1. use the conditions of static equilibrium to solve problems on concurrent force systems;

2. use the conditions of static equilibrium to solve problems on simple structural systems;

3. apply data from a test to establish properties of a material;

4. produce a specification for a structural component.

CREDIT VALUE: 0.5 NC Credit

ACCESS STATEMENT Access to this unit is at the discretion of the centre. No formal entry qualifications are required for this module.

For further information contact: Committee and Administration Unit, SQA, Hanover House, 24 Douglas Street, Glasgow G2 7NQ.

Additional copies of this unit may be purchased from SQA (Sales and Despatch section). At the time of publication, the cost is £1.50 (minimum order £5.00).

NATIONAL CERTIFICATE MODULE: UNIT SPECIFICATION

STATEMENT OF STANDARDS

UNIT NUMBER: 2150186

UNIT TITLE: STRUCTURES AND MATERIALS 1

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME

1. USE THE CONDITIONS OF STATIC EQUILIBRIUM TO SOLVE PROBLEMS ON CONCURRENT FORCE SYSTEMS

PERFORMANCE CRITERIA

(a) The conditions of static equilibrium are correctly stated.
(b) Force systems are correctly represented using free body diagrams.
(c) Forces are correctly resolved into horizontal and vertical components.
(d) Analytical solutions to force system problems are correct.

RANGE STATEMENT

Static equilibrium conditions: force equilibrium in the vertical plane; force equilibrium in the horizontal plane.

EVIDENCE REQUIREMENTS

Oral/written and graphic evidence showing that the candidate can use calculations to solve concurrent force system problems on a minimum of five occasions.

OUTCOME

2. USE THE CONDITIONS OF STATIC EQUILIBRIUM TO SOLVE PROBLEMS ON SIMPLE STRUCTURAL SYSTEMS

PERFORMANCE CRITERIA

(a) The conditions of static equilibrium are correctly stated.
(b) The effect of a reaction at a support is correctly identified.
(c) Analytical methods are correctly used in solving simple structural systems problems.

RANGE STATEMENT

Static equilibrium conditions: force equilibrium in the vertical and horizontal plane; moment equilibrium.

Support reactions: roller; hinge.

Structural systems: beams; simple frameworks.

EVIDENCE REQUIREMENTS

Oral/written and graphic evidence of the candidate's ability to analytically solve simple structural systems problems on a minimum of five occasions.

OUTCOME

3. APPLY DATA FROM A TEST TO ESTABLISH PROPERTIES OF A MATERIAL

PERFORMANCE CRITERIA

(a) Using data from a tensile test, a load extension graph is plotted correctly and to an appropriate scale.
(b) The effects of progressively loading a test piece are clearly described.
(c) Calculations to determine the effect of loading on a test piece are correct.
(d) The advantages of converting a load/extension graph into a stress/strain graph is clearly stated.
(e) The properties of a material are determined correctly using data.

RANGE STATEMENT

Progressive loading effects: elasticity; necking; fracture (cup and cone).

Loading effects: stress; strain.

Properties of a material: elasticity; plasticity; ductility; modulus; yield stress; ultimate stress.

EVIDENCE REQUIREMENTS

Oral/written and graphic evidence that the candidate can correctly process information from a tensile test and use the information to establish the main properties of a material on a minimum of one occasion.

OUTCOME

4. PRODUCE A SPECIFICATION FOR A STRUCTURAL COMPONENT

PERFORMANCE CRITERIA

(a) The design criteria for the component is correctly interpreted.
(b) Tubulated and graphical data are used correctly in selecting a material for a component.
(c) Calculations to determine a specification for the component are correct.
(d) The method used to represent the solution reflects engineering practice.
(e) The specification produced for the structural component accurately fits the design criteria.

RANGE STATEMENT

Calculations: force; cross-section; stress; strain; modulus; factor of safety.

EVIDENCE REQUIREMENTS

Oral/written and graphic evidence of the candidate's ability, to use graphical and tabulated data, to develop a specification from which a structural component could be manufactured on a minimum of one occasion.

ASSESSMENT

In order to achieve this unit, candidates are required to present sufficient evidence that they have met all the performance criteria for each outcome within the range specified. Details of these requirements are given for each outcome. The assessment instruments used should follow the general guidance offered by the SQA assessment model and an integrative approach to assessment is encouraged. (See references at the end of support notes).

Accurate records should be made of the assessment instruments used showing how evidence is generated for each outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

SPECIAL NEEDS

In certain cases, modified outcomes and range statements can be proposed for certification. See references at end of support notes.

NATIONAL CERTIFICATE MODULE: UNIT SPECIFICATION

SUPPORT NOTES

UNIT NUMBER: 2150186

UNIT TITLE: STRUCTURES AND MATERIALS 1

SUPPORT NOTES: This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

NOTIONAL DESIGN LENGTH: SQA allocates a notional design length to a unit on the basis of time estimated for achievement of the stated standards by a candidate whose starting point is as described in the access statement. The notional design length for this unit is 20 hours. The use of notional design length for programme design and timetabling is advisory only.

PURPOSE To develop the ability to apply equilibrium conditions to structural systems and use design data and calculations to determine a specification for a structural component.

SQA publishes summaries of NC units for easy reference, publicity purposes, centre handbooks, etc. The summary statement for this unit is as follows:

On completion of this module you will be able to understand and apply basic equilibrium conditions in the analysis of a force system and use materials data and calculations in designing a structural component.

CONTENT/CONTEXT

Corresponding to outcomes 1-4:

1-2. Problems should be set in a structural/civil engineering context. The loading applied to structures should, where possible, should reflect engineering practice.

Concurrent force systems should be limited to problems involving three forces. A typical example could involve a load suspended from two cables.

Simple structural systems could involve the analysis of the reactions to a simply supported beam. The analysis may include the application of an inclined force. Similar techniques could be applied to determine the external loading effects on a frame structure. Candidates could also be asked to solve statics problems involving lever systems such as the bell crank.

3. Candidates should conduct a tensile test on a number of common materials using a tensometer. The use of spread sheets and graph drawing application is to be encouraged. Access to a tensile testing system which can be linked to a microcomputer and directly process results would be advantageous.

4. A short assignment could be set to design a structural component for a specific purpose. The applied loading and context of the assignment should reflect engineering practice. Students would be expected to use tabulated data and complete calculations in determining a specification for the component.

   A typical assignment might involve the candidate in the design of a tensile or compressive component such as a bolt to be fitted to a pressurised flange. The candidate may be expected to use graphical and/or tabulated data to identify the most suitable material for the component. Calculations could then be completed to determine the cross-sectioned of the required bolt. The calculations may involve the use of tabulated data and the application of Factions of Safety, Young's Modulus, Stress and Strain.

APPROACHES TO GENERATING EVIDENCE A candidate centred, resource based approach to learning should be adopted in which students are encouraged to complete assignments in an independent manner.

Corresponding to outcomes:

1-2. The candidate could be given a series of tutorial exercises of increasing level of difficulty structured to develop their capability in handling the concepts outlined in the PC's.

3. The candidate would be expected to keep a record, in the form of a report, of the work undertaken in recording test data, interpreting test data and using test data as the basis of calculations.

4. The candidate should record in a structured manner the method of analysis applied in the solution of the design problem.

ASSESSMENT PROCEDURES Example of instruments of assessment which could be used for each outcome are as follows:

1-4. A combination of short answer questions and structured questions could be used to assess knowledge and understanding, ability to interpret data and ability to calculate as indicated in the range statement for each PC. Typically, between 6-8 short answer questions could be set testing one PC and 3-4 more complex structured questions, of an integrated manner, testing more than one PC.

3. A laboratory report should be produced by the student as evidence of actual materials testing having been done. This would be confirmed by an observation checklist completed by the tutor.

PROGRESSION This unit forms part of the GSVQ in Engineering at level III.

Candidates successfully completing the GSVQ in Engineering at level III will be able to progress to an HNC/D programme.

RECOGNITION Many SQA NC units are recognised for entry/recruitment purposes. For up-to-date information see the SQA guide 'Recognised Groupings of National Certificate Modules'.

REFERENCES

1. Guide to unit writing. (A018).
2. For a fuller discussion on assessment issues, please refer to SQA's Guide to Assessment. (B005).
3. Procedures for special needs statements are set out in SQA's guide 'Candidates with Special Needs'. (B006).
4. Information for centres on SQA's operating procedures is contained in SQA's Guide to Procedures. (F009).
5. For details of other SQA publications, please consult SQA's publications list. (X037).