SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Civil Engineering: Introduction to Fluid Mechanics (Advanced Higher)

NUMBER D335 13

COURSE Civil Engineering (Advanced Higher)

SUMMARY

Successful completion of this unit will demonstrate an understanding of the basic principles of fluid mechanics and the ability to solve mathematical problems in hydrostatics, in use of the equations of continuity and energy, and in energy losses in pipework.

The unit has been developed in order to introduce candidates to the application of fluid mechanics to the specialist areas of civil engineering.

The unit is a component of Advanced Higher Civil Engineering.

OUTCOMES

1 Solve problems relating to hydrostatic pressures on vertical submerged plane surfaces.
2 Apply the two fundamental fluid mechanics equations of continuity and energy.
3 Apply standard solutions to basic energy losses in pipework.

Administrative Information

Superclass: TL

Publication date: April 2000

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

UNIT Civil Engineering: Introduction to Fluid Mechanics (Advanced Higher)

RECOMMENDED ENTRY

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

- Higher Civil Engineering and Higher Construction
- a Higher Scottish Group Award in Construction
- appropriate units from the Design, Engineering and Technology: Construction framework at Higher level.

CREDIT VALUE

0.5 credit at Higher.

CORE SKILLS

Core skills for Advanced Higher remain subject to confirmation and details will be available at a later date.

National Unit Specification: statement of standards

UNIT Civil Engineering: Introduction to Fluid Mechanics (Advanced Higher)

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 the Scottish Qualifications Authority.

OUTCOME 1

Solve problems relating to hydrostatic pressures on vertical submerged plane surfaces.

Performance criteria

(a) Basic properties, flow patterns and definitions used in fluid mechanics are described correctly.
(b) Pressures due to static fluid heads are calculated correctly.
(c) The concepts of centre of pressure and centroid are explained correctly.
(d) The result of pressure on a plane surface is calculated correctly.

Note on range for the outcome

Definitions and terminology: density, viscosity, ideal fluid, compressibility, laminar and turbulent flow.
Pressures: gauge pressure, absolute pressure.

Evidence requirements

Written and/or oral evidence indicating a knowledge and understanding of:

- basic terminology used in fluid mechanics: this may be evidenced by the candidate correctly defining the properties commonly used in solving fluid mechanics problems
- pressures due to static fluid head: this may be evidenced by the correct calculation of pressure in gauge and absolute units
- the result of static pressure; this may be evidenced by the candidate correctly calculating the forces and/or moments for two civil engineering applications of plane surfaces, such as a sluice, a penstock, a dam or a cofferdam.

OUTCOME 2

Apply the two fundamental fluid mechanics equations of continuity and energy.

Performance criteria

(a) The three components of energy in a fluid system are explained correctly.
(b) The continuity and Bernoulli equations are applied correctly to the pressure and velocity changes in a pipe system.
(c) The variation in pressure head and total head along the pipe system is correctly shown.

Note on range for the outcome

Energy: total, potential, pressure, kinetic.

Evidence requirements

Written and/or oral evidence indicating a knowledge and understanding of:

- the energy components in a fluid system: this may be evidenced by the candidate correctly explaining the energy components that are used in the Bernoulli Equation
- the pressure and velocity conditions in pipes: this may be evidenced by the candidate correctly predicting the changes in pressure and velocity along a pipe system
- the pressure and total heads in pipes: this may be evidenced by the candidate showing diagrammatically the variation of pressure head and total head for the pipe system and indicating significant values.

OUTCOME 3

Apply standard solutions to basic energy losses in pipework.

Performance criteria

(a) Pipe flow problems for single pipe systems are solved correctly using the Moody Diagram and the Darcy-Weisbach Equation.
(b) Pipe flow problems for single pipe systems are solved correctly using the HRS charts/tables.

Note on range for the outcome

Flow: steady/uniform flow, laminar and turbulent flow, Reynolds' number, pipe roughness, energy losses.

Evidence requirements

Written and/or oral evidence indicating a knowledge and understanding of:

- steady/non-steady flow and uniform/non-uniform flow: this may be evidenced by the candidate correctly classifying the flow conditions for a given situation
- pipe friction losses: this may be evidenced by the candidate calculating energy losses using the Moody Diagram
- energy losses and flow rates: this may be evidenced by the candidate correctly answering a pipe flow question using the Moody Diagram and Darcy-Weisbach Equation and a further question using HRS charts/tables.

National Unit Specification: support notes

UNIT Civil Engineering: Introduction to Fluid Mechanics (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

When delivering the unit as a free-standing unit, refer to the Advanced Higher Civil Engineering course details for further information on the content of the unit.

Corresponding to Outcomes 1 to 3

1 This outcome should introduce candidates to the basic concepts of fluid mechanics and provide an understanding of and the ability to calculate pressures and forces on plane submerged surfaces.

2 This outcome should provide the candidate with the ability to apply the theories of continuity and Bernoulli to simple fluid mechanics problems. It should also introduce the concepts of total and pressure head diagrams.

3 This outcome should provide the candidate with the ability to calculate energy losses in simple pipe systems and with an understanding of the different flow conditions that can exist within systems.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates will have to spend most of the allocated time in solving fluid mechanics problems. It is therefore very important that the unit be delivered in the civil engineering industrial context. To help candidates apply the principles of fluid mechanics to practical industrial situations, the use of video presentations and practical laboratory demonstrations is encouraged.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Centres may use instruments of assessment which they consider to be most appropriate Examples of suitable instruments are provided below.

Outcome 1

(i) Five restricted response questions to determine a candidate's understanding of the basic terms used in fluid mechanics.

(ii) Three questions, possibly multiple choice, to determine a candidate's understanding of the difference between force, gauge pressure and absolute pressure.

(iii) Two structured numerical questions requiring the candidate to calculate the pressures and forces due to liquids on typical civil engineering structures.

Satisfactory achievement would be based on the production of four correct responses to (i), two correct responses to (ii) and two reasonably accurate answers to (iii).

National Unit Specification: support notes (cont)

UNIT Civil Engineering: Introduction to Fluid Mechanics (Advanced Higher)

Outcome 2

(i) One question requiring the candidate to explain the three constituent parts of the Bernoulli Equation and to indicate the output units.

(ii) One numerical question requiring the candidate to calculate pressures and/or velocities in a pipe system, using the Bernoulli Equation.

(iii) One question requiring the candidate to draw the total and pressure head lines for a pipe system.

Satisfactory achievement would be based on the correct definition of two of the terms in (i), and the production of reasonably accurate answers to (ii) and (iii).

Outcome 3

(i) Six restricted response questions to ascertain if the candidate understands the differences between steady and non-steady, uniform and non-uniform, and laminar and turbulent flows.

(ii) One structured numerical question requiring the candidate to determine the energy/head loss in a pipe system, using the Moody Diagram and Darcy-Weisbach formula.

(iii) One structured numerical question requiring the candidate to determine the energy/head loss in a pipe system, using the HRS charts/tables.

Satisfactory achievement would be based on correct responses to four questions in (i) and the production of a reasonably accurate answers to (ii) and (iii).

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).