

SQA Advanced Unit Specification

General information for centres

Unit title: Structural Timber Design and Detailing

Unit code: HR68 48

Unit purpose: This Unit is designed to provide the candidate with a fundamental knowledge and understanding of the design methodology of the recognised Design Standards.

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

- 1 Analyse and design simply supported timber beams.
- 2 Design axially and eccentrically loaded timber columns.
- 3 Design structural members of timber frames.

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 would be an advantage for candidates to have a basic understanding and knowledge of structural mechanics, structural analysis, mathematics for construction and civil engineering materials and testing. The Unit includes all the basic principles necessary to allow candidates possessing relevant qualifications or experience to succeed in this Unit.

Core Skills: There are opportunities to develop the Core Skills of Numeracy 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, 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

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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.

SQA Advanced Unit specification: statement of standards

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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

Analyse and design simply supported timber beams

Knowledge and/or skills

- ◆ Loads on timber beams
- ◆ Analysis and design considerations
- ◆ Checks on suitability of standard timber beam sections

Evidence Requirements

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Candidates will need evidence to demonstrate their knowledge, in writing, and/or skills in:

- ◆ selecting the appropriate loading relevant to a particular design situation
- ◆ the design of timber joists and main beams by checking a standard timber section in accordance with recognised Design Standards

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

Assessment guidelines

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 and the candidates should be allowed to refer to standard/extracts and table(s) of standard section properties.

Outcome 2

Design axially and eccentrically loaded timber columns

Knowledge and/or skills

- ◆ Loads on timber columns
- ◆ Analysis and design considerations
- ◆ Checks on suitability of standard timber column sizes

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Evidence Requirements

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Candidates will need evidence to demonstrate their knowledge, in writing, and/or skills in:

- ◆ selecting the appropriate loading relevant to a particular design situation
- ◆ the design of timber columns and posts by checking a given solid section acting as a column under a given axial concentric or eccentric loading in accordance with recognised Design Standards

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

Assessment guidelines

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 and the candidates should be allowed to refer to standards/extracts and table(s) of standard section properties.

Outcome 3

Design structural members of timber frames

Knowledge and/or skills

- ◆ Details of timber frames
- ◆ Loads on timber framed structures
- ◆ Analysis and design considerations
- ◆ Check suitability of standard sections of elements making up a framed structure

Evidence Requirements

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to all items.

Candidates will need evidence to demonstrate their knowledge, in writing, and/or skills in:

- ◆ selecting the appropriate loading relevant to a particular design situation
- ◆ the design of timber framed elements by checking a given configuration under a given axial concentric or eccentric loading in accordance with recognised Design Standards

Candidates must provide a satisfactory response to all the Evidence Requirements, this must be provided by manual calculations.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under open-book conditions and the candidates should be allowed to refer to standards/extracts and table(s) of standard section properties

Assessment guidelines

Questions used to elicit candidate evidence should take the form of two structured questions. The assessment for this Outcome may be combined with Outcome 1 and/or 2 to form a single assessment paper using two structured questions. Alternatively, this Outcome could be delivered using case studies and evidence provided using well-planned assignments or projects.

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Administrative Information

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SQA Advanced Unit specification: support notes

Unit title: Structural Timber 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 a fundamental understanding and knowledge of the design methodology of Current Standards.

The opportunity to provide evidence of the achievement of a range of key skills will feature strongly in both formative and summative assessments. This Unit links with the Structural Mechanics, Civil Engineering Materials and Testing, Structural Analysis A & B, Reinforced Concrete Design and Detailing, Structural Masonry Design and Detailing and Structural Steel Design and Detailing Units in each occupational pathway.

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 SQA Advanced Diploma in Civil Engineering.

Throughout the Unit emphasis will be placed where appropriate on the application of Health & 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, 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. While 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 Analyse and design simply supported timber beams (20 hours)

Timber as a structural material: effects of physical characteristics, defects and environment on structural properties of timber: micro and macro structure of timber, brief description of cell structure, types of timber, natural characteristics, annual rings, sapwood, heartwood, natural, conversion and seasoning defects, slope of grain, hygroscopic characteristics (moisture content), density, load duration and creep effects.

Strength grading of timber for structural use: Visual grading, machine grading and strength classes.

Principles of permissible stress design in accordance with current code of practice: Permissible stress design philosophy and its difference with the limit states design methodology, modification factors.

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Analysis and design considerations: idealisation, simplification and distribution of floor or roof loadings, boundary conditions and effective span, determination of support reactions, maximum bending moment and shear force for a simply supported beam.

Design stresses: evaluation of bending, shear and bearing stresses.

Strength criteria: factors affecting bending, shear and bearing stresses and the lateral stability of the joists: effects of form/shape of the cross-section, depth of the section, service class condition, load duration, load sharing system, position and width of a support or a concentrated load, and effects of a size, form and position of a notch.

Serviceability criteria: deformation limits for joists and beams: use of standard/simplified formulae for deflection due to bending and shear, current limits for deflection and vibration.

Selection of adequate member sizes.

Composite lamination technology: forms of lamination, finger jointing of lamina, possible shapes and sizes of glulam members and advantages and uses.

Horizontally and vertically glued laminated members: grade stresses for horizontally glued laminated members, grade stresses for vertically glued laminated members, glued end joint (finger jointing) requirements.

Single and combined grade members: advantages, limitations and the requirements of BS 5268.

Design stresses: evaluation of bending, shear and bearing stresses.

Strength criteria: factors affecting bending, shear and bearing strengths in horizontally and vertically laminated beams.

Serviceability criteria: use of standard/simplified formulae for deflection due to bending and shear, current limits for deflection and vibration and camber.

Selection and checking of adequate member sizes.

2 Design of axially and eccentrically loaded timber columns (6 hours)

Analysis and design considerations: idealisation, simplification and distribution of floor or roof loadings, boundary conditions and effective height, determination of axial loads, bending due to eccentric or applied lateral loadings.

Effective length and slenderness ratio: the relationship between the positional and directional restraints at each end, the lateral restraint along length and the cross-sectional dimensions of the member.

Design stresses: evaluation of applied axial and bending stresses due to eccentric and/or lateral loading.

Strength criteria: factors affecting axial and bending strengths and the lateral stability of the columns.

Serviceability criteria: lateral deformation of columns due to applied lateral loading.

Selection and checking of adequate member sizes.

3 Design of timber framed structural members (14hours)

Types of trusses and idealised truss behaviour.

Loading on trusses and analysis of pin-jointed frames (trusses).

Design criteria for compression members: effective length and slenderness ratio.

Design criteria for tension members: effective cross-sectional area.

Design stresses: evaluation of axial and shear stresses.

Strength criteria: Factors affecting axial tension, compression and shear strengths in members of a truss.

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Selection and checking of adequate member sizes.

Analysis and design considerations.

The design loadings: maximum bending moments and shear forces are evaluated on timber flooring systems (or configurations) for specified loading conditions.

The design vertical loadings and axial concentric and/or eccentric forces are evaluated on load-bearing stud-walls for specified loading conditions.

Strength criteria: factors affecting axial, bending, shear and bearing strengths and the lateral stability of the structural members.

Serviceability criteria: deformation of flooring systems and walls: use of standard/simplified formulae for deflection due to bending and shear, BS limits for deflection and vibration.

Selection and checking of adequate member sizes.

Guidance on the delivery and assessment of this Unit

This Unit should be studied in the second year of a two-year programme since it is important that candidates have already gained a sound understanding of the principles of Structural Mechanics, Structural Analysis and Mathematics that underpin the fundamentals of structural behaviour and design and provide a greater depth in analysis of the technical content of this Unit.

Case studies may be used in order to develop a working knowledge of the analysis and design process used in the construction industry.

Appropriate attention must be given to Health & Safety issues relating to design and subsequent construction throughout the delivery of this Unit.

It is recommended that evidence for learning Outcomes is achieved through well-planned course work, assignments and projects. Assessment may be formative and summative and both may feature as part of the process. Although assessments must be focused on the individual achievement of each candidate, group work and role-play activities may contribute to the assessment. Integrative assignments and project work will help to link this Unit with other related Units.

The volume of evidence required for each assessment should take into account the overall number of assessments being contemplated within this Unit and the design of the overall teaching programme.

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

Where available, evidence from the workplace can also be incorporated to enhance the learning Outcomes, provided that this evidence is appropriate and authenticated as the candidate's own work. The volume of evidence required for each assessment should take into account the overall number of assessments being contemplated within this Unit and the design of the overall teaching programme.

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.

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

Open learning

Provided that appropriate materials exist, this Unit could be delivered by distance learning, which should incorporate on-line support at all stages. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessment/s were conducted under controlled, supervised conditions.

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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General information for candidates

Unit title: Structural Timber Design and Detailing

On completion of the Unit you should be able to:

- 1 Analyse and design simply supported timber floor joists.
- 2 Analyse and design glued laminate timber beams.
- 3 Design axially and eccentrically loaded timber columns.
- 4 Analyse, design and detail standard roof trusses.
- 5 Design timber stud partition walls.

Evidence that you can satisfy the knowledge and skill elements of this Unit will be obtained by assessment in controlled, supervised conditions to which you will not be allowed to bring textbooks, handouts or notes other than the relevant Current Standards/extracts and tables of standard section properties.