

Unit 47: Structural Mechanics in Construction and Civil Engineering

Unit code: D/600/0228

QCF Level: 3

Credit value: 10

Guided learning hours: 60

Unit aim

The unit enables learners to develop an understanding of how structural elements behave under load, the skills needed to solve structural mechanics problems, design simple beams, columns and mass retaining walls, and understand how computer software is used in structural analysis and design. The focus of this unit is on understanding the forces in structures and the behaviour of common structural materials. Learners will develop an understanding of the forces that are created in the building framework and the structural elements, and will learn how to design simple structural units safely.

Learning outcomes and assessment criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria determine the standard required to achieve the unit.

Learning outcomes	Assessment criteria
1 Understand how structural elements behave under load	1.1 Explain the behaviour of beams and columns under load
2 Be able to solve structural mechanics problems	2.1 Determine reactive forces and plot shear force and bending moment diagrams for a simply supported beam
	2.2 Determine reactive forces and plot shear force and bending moment diagrams for a cantilever beam
	2.3 Determine the forces acting in a determinate frame using mathematical and graphical techniques

	2.4 Determine the maximum stress in a short column under axial and eccentric loads
3 Be able to design simple beams and columns	3.1 Produce suitable section sizes for axially loaded columns
	3.2 Produce suitable section sizes for simply supported beams subject to combined loading
4 Be able to design mass retaining walls to withstand pressure from water and soils	4.1 Produce a suitable section for a mass retaining wall that is safe in overturning, sliding and settlement
5 Understand the use of computer software in structural analysis and design	5.1 Explain the benefits of using computer software in structural analysis and design

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Unit content

1 Understand how structural elements behave under load

Behaviour of structural elements: beams in bending and shear; stresses and deflection; columns and struts under direct load and eccentric load; effect of restraint on members in compression

Combined behaviour: bracing of frameworks for stability; use of walls for stability

2 Be able to solve structural mechanics problems

Structural mechanics problems: relating to beams; columns; frames

Beams: point loads; uniformly distributed loads (UDLs); combined loads; reactions; shear force values; bending moment values; relationship between shear force and bending moment; point of contraflexure; simply supported beams with cantilever ends; simply supported beams without cantilever ends

Columns: axially loaded; eccentrically loaded; effective length; maximum stress; short columns; long columns

Frameworks: statically determinate; pin-jointed; subject to dead loads and wind load

3 Be able to design simple beams and columns

Beams: safe loading (for steel, reinforced concrete, timber); shear; bending; limit state design; British Standards

Columns: axial load capacity (for steel, reinforced concrete, timber); limit state design; British Standards

4 Be able to design mass retaining walls to withstand pressure from water and soils

Mass retaining walls: forces (soils, level surcharge, liquid); self-weight; stability; factors of safety eg sliding, overturning, ground bearing capacity, middle third rule

5 Understand the use of computer software in structural analysis and design

Types: spreadsheets; design packages eg STAAD.pro

Advantages: automated loading of structures; integration of CAD drawings; interoperability; section choices