

Unit 21: Geotechnics & Soil Mechanics

Level:	4
Credits:	15
Ofqual Code:	L/618/8101

Introduction

This unit explores the essential relationship between the things we construct and the capacity of the ground to support these constructions. The ability to understand, analyse and develop solutions related to soil and rock is a key aspect of the design and construction of buildings and infrastructure.

Topics included in this unit are: rock type; soil description and classification; methods and techniques used when undertaking site investigations and laboratory testing; determination of soil properties; the importance of these geotechnical procedures and resultant findings to civil engineers.

On successful completion of this unit, students will be able to analyse and evaluate modern geotechnical methods and apply these skills and knowledge to the initial design of infrastructure.

Learning Outcomes

By the end of this unit, students will be able to:

- LO1 Discuss rock types, their formation and uses in civil engineering and building projects
- LO2 Explain the description and classification of soils using current codes of practice
- LO3 Analyse soil properties determined by geotechnical procedures
- LO4 Produce proposals to address identified geotechnical weaknesses and problems.

Essential Content

LO1 Discuss rock types, their formation and uses in civil engineering and building projects

Rock types, formation, and classification

Types (e.g., igneous, sedimentary, metamorphic)

Formation (e.g., lithification, crystallisation and fractional crystallisation)

Classification systems

Weathering and weathering processes

Physical (e.g., freeze-thaw, exfoliation)

Chemical (e.g., rainwater reactions, clays, soluble salts)

Biological (e.g., trees, roots, animals, algae, lichen, bacteria)

Discontinuous nature of rock mass

Mechanical vs Integral discontinuity

Types of discontinuity (e.g., bedding, schistosity, foliation, joint, cleavage, fracture, fissure, folds, faults)

The use of rock in civil engineering and construction

Foundations

Walls and retaining walls

Bridge piers and abutments

Cement and mortars

Erosion protection

Filtration

Pavements, roads

Flooring, cladding, tiles

Uncemented sediments

Earthen dams

Railway ballast

Fill materials

Concrete aggregates

Other

LO2 Explain the description and classification of soils using current codes of practice

Soil sampling

Types of sampling (e.g., disturbed, undisturbed)

Soil types

Very coarse (e.g., boulders, cobbles)

Coarse (e.g., sand, gravel)

Fine (e.g., clays, silts)

Organic (e.g., organic clay, sand, silt, peat)

Other (e.g., calcareous, plastic, sediments)

Soil description and classification

Soil analysis

Particle analysis (e.g., sieve, hydrometer)

Particle size distribution

Soil specific gravity

Soil plasticity index

LO3 Analyse soil properties determined by geotechnical procedures

Shear strength

Cohesion

Internal friction and angle of internal friction

Mohr's Circle of Stress

Coulomb's Strength Theory

Tests (e.g., direct shear, triaxial compression, unconfined compression, vane shear)

Stages (e.g., consolidation stage, shear stage)

Tests based on drainage conditions

Compressibility and consolidation

Stages (e.g., initial, primary, secondary)

Moisture content (e.g., effect on compression/compaction, effect on bearing capacity)

Soil density

Bulk density

Dry density

Density of solids

Saturated density

Submerged density

Density index

Moisture content

Void ratio

Liquid and plasticity indices

Atterberg limits test

California bearing ratio (CBR)

LO4 Produce proposals to address identified geotechnical weaknesses and problems

Project type (e.g., building, infrastructure)

Embankment design

Shear strength

Soil compaction

Road requirements

Rail requirements

Foundation design

Loading

Foundation type (e.g., pad, piling, strip, deep strip, raft)

Soil compressibility

Liquid and plasticity indices

Bearing capacity

Highway design

Highway/road type (e.g., residential, industrial, motorway)

Paving type (e.g., flexible, rigid)

California bearing ratio

Health and safety requirements

Site safety

Temporary works safety

Incident reporting

Certification

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
L01 Discuss rock types, their formation and uses in civil engineering and building projects		D1 Evaluate case studies that address problems caused by the discontinuous nature of rock mass when tunnelling and constructing bridges.
P1 Explain rock type formation and classification. P2 Analyse the discontinuous nature of rock mass and the impact of weathering.	M1 Analyse the use of rock and uncemented sediments in civil engineering and building projects.	
L02 Explain the description and classification of soils using current codes of practice		D2 Assess the importance of site investigation, soil sampling and determination of soil properties for infrastructure projects.
P3 Discuss the description and classification of soils based on particle size, specific gravity and plasticity indices, using current codes of practice. P4 Describe the processes and techniques used in soil sampling and site investigation.	M2 Analyse methods and techniques used in ground and site investigation, and soil sampling.	
L03 Analyse soil properties determined by geotechnical procedures		D3 Integrate test data to inform the development of design proposals to address identified geotechnical weaknesses in a given site.
P5 Explain different types of analysis used to measure soil properties. P6 Analyse soil properties, including moisture content, density, specific gravity, shear strength compressibility, liquid and plasticity indices, and California bearing ratio.	M3 Evaluate results from soil properties testing.	
L04 Produce proposals to address identified geotechnical weaknesses and problems		
P7 Identify geotechnical weaknesses and issues for a given site. P8 Present design proposals to address geotechnical problems for a given site.	M4 Justify the approach to a design proposal in meeting identified geotechnical weaknesses.	

Recommended Resources

Print resources

CHUDLEY, R., GREENO, R. (2006), *Advanced Construction Technology*, Pearson Education

GREENO, R. (2014), *Mitchell's Introduction to Building*, Routledge

GRIBBLE, C., MCLEAN, A. (2017), *Geology for Civil Engineers*, CRC Press

Web resources

<https://bit.ly/3i91LdB>

Chartered Institute of Building
(Professional Body)

<https://bit.ly/2Vj23pc>

Geology.com – Geology News and Information
(General Reference)

<https://bit.ly/3fsrTP1>

Institution of Civil Engineers
(Professional Body)

<https://bit.ly/3zMLmRZ>

Thomas Telford
(General Reference)

Links

This unit links to the following related units:

- Unit 2: Construction Technology
- Unit 3: Science & Materials
- Unit 7: Surveying, Measuring & Setting-out
- Unit 8: Mathematics for Construction
- Unit 32: Advanced Construction Drawing & Detailing
- Unit 33: Construction Technology for Complex Buildings Projects
- Unit 41: Highway Engineering
- Unit 42: Hydraulics.