Geotechnical Engineering Competencies.

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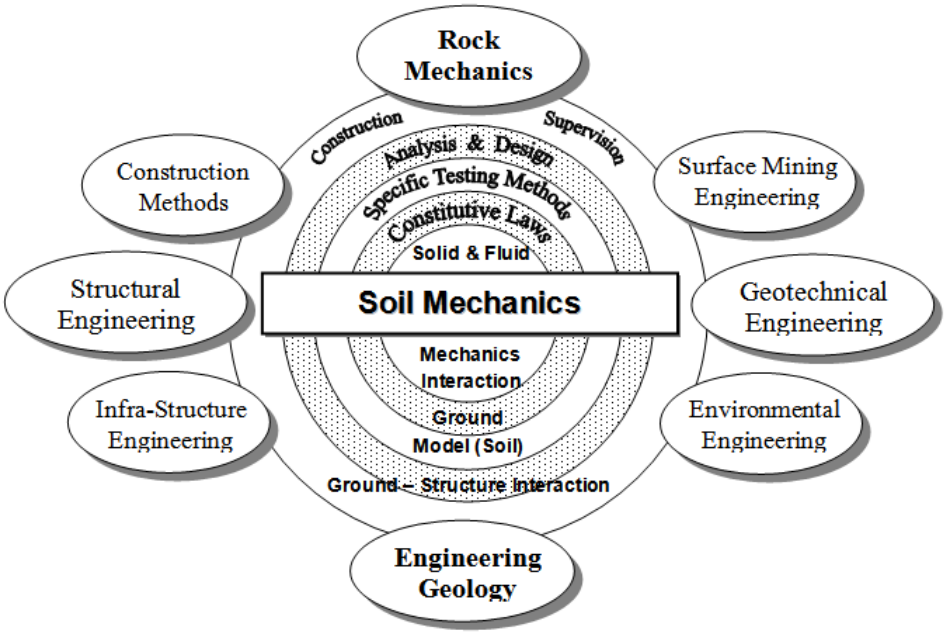
In this document a geotechnical engineer is defined as one who deals predominantly with soils.

Adapted from Rengers and Bock (2008).

	Geotechnical Engineer

Key Competencies	• Understanding of the mechanical behaviour of soil and granular masses (solid-fluid interaction)
	• Developing site-specific ground models, in particular with:
	  o soil parameters (information from lab / field / data base)
	  o knowledge of the degree of geotechnical uncertainty
	• Analysis and design of structures on, in or with soil
	• Soil improvement techniques
	• Construction supervision (soil)

General Competence	• Familiarity with the pertinent scientific methods in civil and structural engineering. • Basic knowledge of the geo-scientific terminology, working methods, geological processes and Quaternary Geology
Competence in Specialised Fields	• Laboratory and in situ testing methods to measure the natural characteristics of soils • Numerical modelling coping with the structural diversity of geology and being based on complex constitutive laws (e.g. non-linear, anisotropic and time-dependent material behaviour as well as plastification). • Design, construction and contractual procedures adjusted to incorporate geotechnical uncertainty (e.g. “Observational Design Method”).



Geotechnical engineering competency profiles (After Price, 1985 and Rengers and Bock, 2008)

Geotechnical Engineering Curriculum

MANDATORY TOPICS:

The Origin and Characteristics of Soils: Soil genesis; processes that form and alter soils; clay mineralogy; soil structure.

Soil Classification and Phase Relationships: Basic soil state definitions; phase relationships; grain size analyses; Atterberg limits; soil classification and description.

Vertical Stress in Soils: Soil suction; total vertical stress; pore water pressure; effective vertical stress.

Flow of Water Through Soils: Water flow; permeability and measurement; 2D seepage of water through soils; flow net construction and analyses; liquefaction.

Consolidation and Compressibility: Introduction to consolidation theory; oedometer test; overconsolidation ratio; consolidation settlement; time rate effects; sand drains.

Strength of Soils: Shear strength of sands and clays; Mohr-Coulomb failure criterion; direct shear test, triaxial test, stress paths, Skempton's pore pressure parameters.

Soil Improvement: Compaction – concepts, measurement and field techniques, overview of other soil improvement techniques.

Stability of Slopes: Landslides, Taylor's charts, Bishop's method of slices.

Lateral Earth Pressures and Retaining Wall Design: Rankine and Coulomb analyses; retaining wall design.

Site Investigations and Data Collection: Planning site investigations, techniques, in situ testing.

Loading Induced Stresses and Displacements: Changes in stress, strain and displacement due to surface loading, Boussinesq equations, Fadum's and Newmark's charts.

Foundation Design and Analysis: Overview of foundations and construction techniques; Bearing capacity of shallow foundations; Design of shallow foundations; Axial capacity of single pile foundations; Settlement of pile; Pile groups.

Pavements: Overview, Evaluation of load repetitions; Pavement design.

Environmental Geotechnics: Geoenvironmental regulation; Assessment and investigation of contaminated sites; Remediation of contaminated sites; Municipal solid waste and landfills.

OPTIONAL ADVANCED TOPICS (NOT EXCLUSIVE):

Critical State Soil Mechanics
Constitutive Modelling of Soils
Unsaturated Soils
Problematic Soils – Soft soils, Expansive soils, Collapsing soils, Acid-sulphate soils
Laboratory Testing of Soils
In Situ Testing of Soils
Site Investigations
Environmental Geotechnics
Geotechnical Engineering Finite Element Modelling
Advanced Numerical Analysis in Geotechnical Engineering
Advanced Pile Design and Analysis
Advanced Foundation Design and Analysis
Geotechnical Engineering Limit State Design

Reliability and Risk Analysis of Geotechnical Engineering Systems
Probabilistic Analysis of Geotechnical Engineering Systems
Stability of Slopes
Earth Retaining Structures
Advanced Soil Improvement
Geosynthetics
Dam Design
Dynamic Analysis of Soils
Geotechnical Earthquake Engineering
Soil Liquefaction
Forensic Geotechnical Engineering