

Geotechnical Engineering

Introduction

The purpose of this document is to define the practice field of Geotechnical Engineering as it applies within the Chartered Professional Engineer (CPEng) assessment framework. It provides the indicative scope and intent of Geotechnical Engineering practice and outlines the key performance indicators relevant to this field.

These indicators are intended to support and guide professional judgement by applicants and assessment panels. They are not a prescriptive checklist, nor are they intended to be applied as minimum threshold requirements. Assessment of competence is holistic and contextual.

This document is supplementary to, and does not replace, the minimum standard for CPEng registration as defined in the CPEng Rules, which remain the primary and authoritative basis for assessment. Applicants must also demonstrate that their engineering practice meets the complexity requirements for Chartered Professional Engineer status, as defined in the CPEng Rules, regardless of practice field.

Definition

Geotechnical engineering applies the principles of soil and rock mechanics to the design, construction, and performance monitoring of ground and ground-interacting structures.

It encompasses investigation, interpretation, analysis, design, risk management, and performance verification of the ground and ground-related systems across all project phases, from initial option evaluation through to construction and post-construction performance. Geotechnical engineering involves managing the uncertainty in ground conditions through the development and iterative refinement of ground models, supported by investigation, monitoring, and engineering judgement. It delivers solutions aligned with New Zealand practice, the Building Code, and relevant New Zealand Geotechnical Society (NZGS) and Ministry of Business, Innovation, and Employment (MBIE) guidance. Geotechnical engineering integrates local knowledge, environmental stewardship, and ethical professional standards throughout the engineering process, while collaborating closely with other disciplines to ensure effective performance.

For further detail on the knowledge, skills, and competencies expected of a CPEng Geotechnical Engineer, applicants and assessors should refer to the [Chartered Professional Engineer \(Geotechnical\) Body of Knowledge and Skills](#).

Geotechnical Engineers perform activities such as:

- Desktop assessment of site ground conditions using existing and historical data.
- Planning and delivery of ground investigations and development of conceptual and detailed ground models.
- Design and assessment of ground engineering works (e.g. foundations, retaining structures, embankments, slopes etc) considering varying loading conditions (e.g. earthquakes, landslides, flooding, and extreme rainfall events).
- Analysis of the interaction between the ground and structures to understand implications for performance and serviceability.
- Application of empirical methods, analytical approaches, numerical modelling, and engineering judgement.
- Assessment and management of geotechnical risk and uncertainty, including development of mitigation strategies and contingencies.
- Technical advisory, peer review, and construction-phase support, including observation and verification of design intent.
- Performance monitoring, instrumentation, and interpretation of observed behaviour to inform design validation and adaptation.
- Infrastructure and asset resilience planning and management.
- Research and development of innovative geotechnical methods, materials, and digital tools.

Areas a Geotechnical Engineer might work in

- Transport infrastructure (roads, railways, bridges, airports).
- Buildings and vertical construction (commercial, industrial, residential).
- Civil infrastructure and utilities (water, wastewater, pipelines).
- Dams, embankments, and flood protection systems.
- Tunnelling and underground construction.
- Mining and quarry operations.
- Ports, coastal, and marine infrastructure.
- Land reclamation and ground improvement.
- Environmental geotechnics (contaminated land, waste management, landfills).
- Urban development and subdivisions.
- Energy sector (solar, wind energy, hydro-electric schemes, geothermal).

Key performance indicators

Engineering Knowledge

CPEng competence standard description

- Comprehend, and apply advanced knowledge of accepted principles underpinning:
 - i. widely applied good practice for professional engineering; and
 - ii. good practice for professional engineering that's specific to New Zealand.
- Undertake continuing professional development (CPD) activities to develop and maintain the currency of professional engineering knowledge and skills, and to adapt to emerging technologies and the changing nature of work

Performance indicators for Engineering Knowledge in Geotechnical Engineering

All applicants must hold a Washington Accord degree or demonstrated equivalence¹.

CPEng Geotechnical Engineers must be able to:

- Apply the principles of soil and rock mechanics to the assessment, design, construction, and performance monitoring of ground and ground-interacting structures.
- Understand the behaviour of soil, rock, groundwater, and geotechnical systems under static, cyclic, seismic, and temporary loading conditions.
- Plan, direct, and interpret ground investigations, including sampling, in situ and laboratory testing, and geological and geomorphological assessments to develop conceptual and detailed ground models.
- Undertake and critically review assessments for ground engineering works (e.g. foundations, retaining structures, slopes, embankments, excavations, earthworks, pavements, tunnels, ground improvement systems).
- Understand the principles, assumptions, limitations, and appropriate application of geotechnical software and numerical modelling.
- Critically review geotechnical reports, specifications, monitoring data, and construction observations to evaluate performance and risk.

CPEng Geotechnical Engineers must demonstrate:

- Knowledge of relevant New Zealand legislation, standards, guidance, and technical regulatory requirements.

¹ Equivalence can be demonstrated through the Knowledge Assessment process. Full knowledge assessment guidance is available on our [guidance page](#).

- Understanding of construction methods, including earthworks practice, groundwater control, and staged construction relevant to geotechnical performance.
- Awareness of sustainability, resilience, climate adaptation, and whole-of-life performance considerations.
- Ongoing professional development through technical practice, peer engagement, continuing education, and participation in professional organisations.

Managing Engineering Work

CPEng Competence Standard criteria

- Recognise complexity and assess alternatives in light of competing requirements and incomplete knowledge. Exercise sound judgement in the course of complex activities
- Be responsible for making decisions on part or all of one or more complex engineering activities.
- Manage part or all of one or more complex engineering activities in accordance with good engineering management practice.
- Identify, assess, and manage engineering risk, meeting relevant legal and regulatory requirements and cultural considerations, and protecting public health and safety in the course of professional engineering activities

Performance Indicators for Managing Engineering Work in Geotechnical Engineering

CPEng Geotechnical Engineers must be able to:

- Exercise sound professional judgement in situations involving uncertainty, incomplete information, and evolving risks.
- Define project objectives, scopes, investigation strategies, and deliverables appropriate to project complexity.
- Plan and coordinate investigations, testing, monitoring, and specialist inputs while managing programme, resources, safety, and quality.
- Apply structured risk management processes to address geotechnical risks (e.g. groundwater, contamination, seismic, construction, and long-term performance).
- Manage uncertainty through appropriate ground investigation density, verification processes, engineering judgement, and observational methods.
- Ensure data quality, traceability, interpretation, and integration into design and construction decisions.
- Verify and validate designs through construction observations, instrumentation, monitoring, and comparison of predicted and observed performance.
- Monitor construction of ground and ground-interacting structures for compliance with design intent and specifications.
- Respond appropriately to non-conformances, unexpected ground conditions, and construction-related risks while maintaining clear communication and records.
- Communicate geotechnical risk, uncertainty, construction requirements, and performance expectations effectively to stakeholders
- Apply quality assurance and peer review processes appropriate to project complexity and risk.

CPEng Geotechnical Engineers must demonstrate:

- Knowledge of New Zealand contract administration and construction management practices relevant to geotechnical engineering.
- Understanding of project governance, procurement, quality management, and professional accountability requirements relevant to geotechnical practice.
- Commitment to continuous improvement through lessons learned, post-construction review, technical development, and knowledge sharing.

Professional Acumen

CPEng Competence Standard Description

- Conduct their professional engineering activities to an ethical standard at least equivalent to the Code of Ethical Conduct.
- Evaluate the outcomes and impacts of complex engineering activities, recognise the reasonably foreseeable economic, social, cultural, and environmental effects of professional engineering activities and seek to achieve sustainable outcomes
- Communicate and collaborate clearly and inclusively with engineers and stakeholders in the course of professional engineering activities.

Performance Indicators for Professional Acumen in Geotechnical Engineering

CPEng Geotechnical Engineers must be able to:

- Apply ethical principles with integrity, transparency, independence, and technical rigour.
- Clearly communicate geotechnical risks, assumptions, limitations, and recommendations to technical and non-technical audiences.
- Prepare accurate, defensible reports, specifications, assessments, and professional advice.
- Contribute to safety in design by identifying and communicating geotechnical risks.
- Work collaboratively across disciplines to support integrated project outcomes.
- Engage appropriately with mana whenua, stakeholders, regulators, and affected communities.
- Support the development of less experienced engineers through mentoring, peer review, and constructive feedback.
- Consider cultural, environmental, societal, and intergenerational impacts in engineering decision-making.
- Take professional responsibility for the quality, limitations, and implications of engineering advice and decisions.

CPEng Geotechnical Engineers must demonstrate:

- Awareness of legal, regulatory, ethical, and professional obligations associated with engineering practice.
- Awareness of Te Ao Māori perspectives and their relevance to geotechnical engineering practice.
- Commitment to health, safety, and environmental stewardship throughout investigation, design, construction, monitoring, and maintenance activities

Developing Technical Solutions

CPEng Competence Standard Description

- Define, investigate, and analyse complex engineering problems in accordance with good practice for professional engineering.
- Design or develop solutions to complex engineering problems in accordance with good practice for professional engineering, considering a variety of perspectives and taking account of stakeholder views where relevant

Performance Indicators for Developing Technical Solutions in Geotechnical Engineering

CPEng Geotechnical Engineers must be able to:

- Identify and evaluate geotechnical design options considering feasibility, constructability, cost, programme, risk, resilience, sustainability, environmental impacts, and whole-of-life performance.
- Develop conceptual and preliminary designs informed by ground models, geological interpretation, groundwater conditions, risk assessments, and construction effects.
- Identify risks, uncertainties, and critical assumptions and incorporate these into engineering solutions and mitigation measures.
- Develop detailed designs, specifications, calculations, drawings, monitoring requirements, and construction sequencing recommendations.
- Apply appropriate analytical, empirical, and numerical methods to the design and assessment of ground and ground-interacting structures.
- Evaluate post-construction performance relative to design expectations and operational requirements.
- Incorporate durability, inspection, maintenance, asset management, and long-term monitoring considerations into geotechnical solutions.

CPEng Geotechnical Engineers must demonstrate:

- Understanding of the limitations and uncertainty inherent in geotechnical data, analysis, and modelling.
- Competently apply digital engineering tools, geotechnical modelling software, and geospatial technologies in the development of engineering solutions.
- Understanding of sustainability and resilience principles in materials selection, construction methods, and lifecycle management.
- Awareness of innovation in geotechnical methods, materials, monitoring systems, and (digital) workflows, while maintaining appropriate engineering judgement and verification processes.