Professional qualification of construction contractors

Competency profile

2.6 - Contractor – Piles and special foundations

Régie du bâtiment Québec

This document was produced with the collaboration of the team of competency assessment advisors (Direction de la qualification) of the Régie du bâtiment du Québec.

In this document, the masculine gender is used without discrimination and solely for the sake of brevity.

Content may be amended at any time.

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Introduction

The person who passes the exam can act as a guarantor for construction work included in subclass 2.6 - Contractor – Piles and special foundations.

This competency profile is based on the scope of application of the *Building Act*, as well as on Section (21-22-23 or 24) of the *Regulation respecting the professional qualification of contractors and owner-builders*.

Subclass definition

2.6 - Contractor – Piles and special foundations

This subclass authorizes construction work relating to soil mechanics, such as piles and caissons, retaining excavations, deadman tie-back anchors, underpinning or injection into soil or rock.

It also authorizes construction work in subclass 2.5[1] of Schedule III.

Finally, it authorizes similar or related construction work.

[1] 2.5 - Contractor – Excavation and earthwork. Except for work included in subclasses 2.2 and 2.4 of Schedule II, this subclass authorizes construction work involving the digging, moving, compacting and levelling of earth or granular materials, including work relating to small engineering structures and similar or related construction work.

Module 1 – DEFINITIONS AND TYPES OF SYSTEMS

Elements of competency covered in this module:

1. Define concepts and terms related to piles and special foundations
2. Define and explain the main characteristics of materials used for piles and special foundations
3. Describe and explain the main characteristics of soils, standard piles and special foundations

Module 1 – DEFINITIONS AND TYPES OF SYSTEMS

Elements of competency	Skills required
1. Define concepts and terms related to piles and special foundations	1.1. Define the concepts of “shallow foundation,” “deep foundation” and “soil improvement”
	1.2. Define the different types of piles and caissons: H-piles, tubular piles, expanded base piles, etc.
	1.3. Define the different types of deep foundations: retaining walls, Berlin walls, diaphragm walls, steel piles, caisson foundations, pile foundations, etc.
	1.4. Define terms related to soil injection and compaction techniques: grouting, reflux, agitator, ramming, dynamic consolidation, mesh, etc.
	1.5. Define terms related to underpinning work: panel, support, etc.
	1.6. Define terms associated with the installation of piles and special foundations: socketing, embedment, hopper concreting, notching, refusal criterion, dynamic and hydraulic test, strut, temporary joint, temporary and permanent tie rod, tangent wall and secant wall, etc.
	1.7. Define the types of machinery and tools used to install piles and special foundations: jack, clamshell bucket, diesel, hydraulic or free-fall hammers, leader, drill bits, down-the-hole drills, etc.
	1.8. Define different pile testing methods (dynamic and static)
	1.9. Define the different soil classifications (clay, silt, sand, gravel, pebbles, boulders, etc.)
	1.10. Define the concepts of “differential settlement,” “refusal” (end bearing and friction), “service load,” “factored load” and “hydrostatic pressure balance”

Elements of competency	Skills required
2. Define and explain the main characteristics of materials used for piles and special foundations	2.1. List the main characteristics of concrete (aggregate, water, strength, dosage, temperature) Mastery of content
	2.2. List the main characteristics of bentonite
	2.3. List the main characteristics of steel (reinforcement, structure)
	2.4. Explain the use and effects of various admixtures (calcium, etc.) on concrete properties
	2.5. Identify factors or practices that can adversely affect material quality (freezing, W/C ratio, corrosion, etc.)
	2.6. Explain how to protect concrete, bentonite (powdered and hydrated) and steel
3. Describe and explain the main characteristics of soils, pile types and special foundations	3.1. Explain the impact of different soil types on the placement of piles or special foundations
	3.2. Explain the scope of application of different types of piles and caissons
	3.3. Explain retaining wall types, their components and scopes of application
	3.4. Explain the types of underpinning work (in section and with load transfer), their components and scopes of application
	3.5. Describe the types of special foundations and their components that use compaction and injection techniques

Module 2 – LEGISLATIVE, NORMATIVE AND REGULATORY FRAMEWORK

Elements of competency covered in this module:

4. Situate piles and special foundations work in relation to the legal and regulatory framework

Module 2 – LEGISLATIVE, NORMATIVE AND REGULATORY FRAMEWORK

Elements of competency	Skills required
4. Situate piles and special foundations work in relation to the legal and regulatory framework	4.1. Explain the roles and responsibilities of the contractor, the professional (engineer and geotechnician) and the project manager regarding piles and special foundations
	4.2. Explain the roles and responsibilities of the designer and contractor regarding soil and groundwater investigation
	4.3. Explain the importance of consulting municipal by-laws when carrying out piles and special foundations work (vibration, by-laws governing areas exposed to landslides, noise, etc.)
	4.4. Recognize the scope of the Québec Construction Code, Chapter I, Building, and the National Building Code of Canada: 1995 (amended) (NRC) in relation to piles and special foundations
	4.5. Recognize the scope of the various codes and standards applicable to the design or testing of piles and special foundations (*Canadian Foundation Engineering Manual*, CSA/CAN-S6, *Handbook of Steel Construction*, CAN 3-A231 and A23.3, ASTM A-252, ASTM D1143, etc.)
	4.6. Explain the importance of CSA W59-03 Welded Steel Construction (Metal Arc Welding) for piles and special foundations, define the mission of the Canadian Welding Bureau and the certification process

Module 3 – READING PLANS AND SPECIFICATIONS

Elements of competency covered in this module:

5. Read and interpret drawings and plans for piles and special foundations
6. Read and interpret the divisions of specifications for piles and special foundations
7. Adapt drawings and plans to reflect as-built work

Module 3 – READING PLANS AND SPECIFICATIONS

Elements of competency	Skills required
5. Read and interpret drawings and plans for piles and special foundations	5.1. Locate piles and special foundation elements on a plan, along with the required performances
	5.2. Explain the meaning of the main symbols used for piles and special foundations
	5.3. Locate, read and interpret the main dimensions and annotations of elements of piles and special foundations
	5.4. Locate, read and interpret cross-sections and details associated with elements of piles and special foundations
	5.5. Read and interpret general notes and tables associated with elements of piles and special foundations
	5.6. Read and interpret erection diagrams (or standard installation plans) for piles and special foundations
	5.7. Read and interpret workshop drawings for piles and special foundations
6. Read and interpret the divisions of specifications for piles and special foundations	6.1. Identify the divisions and sections of construction specifications associated with piles and special foundations
	6.2. Interpret general specifications associated with piles and special foundations
	6.3. Interpret information from geotechnical reports (soil surveys, boreholes, etc.)
	6.4. Interpret information relating to piles and special foundations (including welding information) in specifications
7. Adapt drawings and plans to reflect as-built work	7.1. Identify the information required in an as-built drawing or plan
	7.2. Adapt basic drawings and plans to reflect as-built work
	7.3. Explain the approval process for as-built plans and drawings
	7.4. Ensure that as-built plans and drawings comply with appropriate standards

Module 4 – ESTIMATES AND DESIGN OF WORK

Elements of competency covered in this module:

8. Estimate the work required on an existing building or structure and propose a technical solution (without drawings and specifications)
9. Estimate work based on plans and specifications issued for tender and propose a technical solution
10. Produce shop drawings, if required, from plans and specifications issued for construction

Module 4 – ESTIMATES AND DESIGN OF WORK

Elements of competency	Skills required
8. Estimate the work required on an existing building or structure and propose a technical solution (without drawings and specifications)	8.1. Make a summary diagnosis of the symptoms affecting the foundation of the building or structure (soil behaviour, materials, structure, etc.)
	8.2. Determine the types of risks in relation to the soil and the surroundings of the building or structure
	8.3. Assess the load-bearing capacity of soil types for small buildings (allowable bearing pressure)
	8.4. Collect key design criteria (load, soil, etc.)
	8.5. Propose a technical solution (underpinning, retaining walls, etc.)
	8.6. Determine required resources (labour, equipment, materials), their availability and productivity rate (daily production per crew)
9. Estimate work based on plans and specifications issued for tender and propose a technical solution	9.1. Carry out a site visit to assess the impact of the work and validate compliance with the plans and specifications
	9.2. Produce design notes to specify design criteria
	9.3. Prepare the quantity survey[2] (number of components, quantity of concrete, etc.)
	9.4. Propose a technical solution (underpinning, retaining walls, etc.)
	9.5. Determine required resources (labour, equipment, materials), their availability and productivity rate (daily production per crew)
10. Produce shop drawings, if required, from plans and specifications issued for construction	10.1. Explain the shop drawing approval process
	10.2. Ensure production of structural and geotechnical calculations (refusal criteria, number of blows/inch, etc.)
	10.3. Ensure that shop drawings comply with plans and specifications
	10.4. Ensure that shop drawings comply with appropriate standards

[2] Prepare the survey: Measure a construction project and calculate the quantities of materials required.

Module 5 – STANDARDS AND EXECUTION OF WORK

Elements of competency covered in this module:

11. Planning and organizing piles and special foundations work
12. Manage the execution of foundation work with piles or caissons
13. Manage Berlin wall work (piles and timbering)
14. Manage the execution of steel piles work
15. Manage the execution of diaphragm wall work
16. Manage the execution of mud trenching work
17. Manage the execution of underpinning work
18. Manage the execution of piles and special foundations work using compaction and injection techniques
19. Ensure quality control of piles and special foundations work
20. Ensure health and safety in connection with piles and special foundations work

Module 5 – STANDARDS AND EXECUTION OF WORK

Elements of competency	Skills required
11. Planning and organizing piles and special foundations work	11.1. Determine the stages and logical order of execution of piles and special foundations work
	11.2. Explain the importance of properly coordinating work with the relevant site disciplines (excavation)
	11.3. Order and receive materials required for piles and special foundations work
	11.4. Obtain and forward certificates of conformity for steel and concrete where applicable
	11.5. Schedule work crews and equipment
	11.6. Establish safe work procedures
	11.7. Ensure the presence of a stable work platform
	11.8. Check for potential overhead and underground obstacles (wires, pipes) and take appropriate action
	11.9. Check operation of equipment (crane, hammer, etc.)
12. Manage the execution of foundation work with piles or caissons	12.1. Adjust work completion stages if necessary
	12.2. Determine reference points for positioning the centre of piles and caissons
	12.3. Carry out pre-drilling work where necessary
	12.4. Drive piles and caissons using the appropriate method
	12.5. Ensure socketing and sealing of caissons
	12.6. Verify pile driving depths and refusal criteria
	12.7. Verify hydrostatic pressure balance (caissons)
	12.8. Set up reinforcement cages
	12.9. Ensure concrete placement in piles and caissons (by hopper and other techniques, e.g. when there is water in a caisson)

Elements of competency	Skills required
	12.10. Explain methods of installing piles and caissons underwater (template, influence of current, etc.)
	12.11. Check piles and caisson installation tolerances
	12.12. Ensure compliance with performance specifications
13. Manage Berlin wall work (piles and timbering)	13.1. Adjust work completion stages if necessary
	13.2. Ensure placement of soldier piles (pipe sections, H-piles or drilled shafts), including rock drilling if required (bit, hammer) or embedment
	13.3. Ensure placement of woodwork
	13.4. Fill behind the woodwork
	13.5. Ensure that the restraint system is in place (ground or rock anchor, inclined or corner brace)
	13.6. Ensure placement of ledgers
	13.7. Ensure that the soil is excavated in phases, according to site conditions, and that the spoil is disposed of
	13.8. Check verticality of wall, tension of tie rods and other symptoms of wall movement (cracks, etc.)
	13.9. Explain how to lower the groundwater table
14. Manage the execution of steel piles work	14.1. Adjust work completion stages if necessary
	14.2. Prepare templates
	14.3. Thread and drive steel piles (vibratory hammer, free-fall, etc.)
	14.4. Ensure soil is excavated in phases, according to site conditions, and spoil is disposed of
	14.5. Ensure that the restraint system is in place (ground or rock anchor, inclined or corner brace)
	14.6. Ensure placement of ledgers

Elements of competency	Skills required
	14.7. Check verticality of wall, tension of tie rods and other symptoms of wall movement (cracks, etc.)
15. Manage the execution of diaphragm wall work	15.1. Adjust work completion stages if necessary
	15.2. Ensure placement of guide walls
	15.3. Prepare bentonite storage basins and mixing systems, including pipelines for wall distribution
	15.4. Ensure excavation of overburden in panels (opening, closing) and rock in the presence of bentonite mud
	15.5. Ensure excavation and disposal of excavated material
	15.6. Ensure placement of jointed tubes and clean the panels
	15.7. Ensure placement of reinforcement steel with embedded parts
	15.8. Ensure placement of concrete by hopper
	15.9. Check verticality of wall, tension of tie rods and other symptoms of wall movement (cracks, etc.)
	15.10. Ensure continuous quality control (bentonite slurry, excavation, concrete, etc.)
16. Manage the execution of mud trenching work	16.1. Adjust work completion stages if necessary
	16.2. Prepare bentonite storage basins, bentonite cement containers and mixing systems, including pipelines for distribution to the trench (bentonite soil and bentonite cement)
	16.3. Excavate the overburden with an excavator and/or clamshell bucket under bentonite slurry (bentonite soil) or bentonite cement, if necessary
	16.4. Place excavated material along the trench and mix with a predetermined quantity of bentonite (bentonite soil) or manage and dispose of excavated material (bentonite cement)

Elements of competency	Skills required
	16.5. Ensure that the bentonite soil is placed in the trench when it is homogeneous, while avoiding segregation of the components (bentonite soil)
	16.6. Ensure continuous quality control (bentonite slurry, bentonite soil mix or bentonite cement, embedment depth, trench profile, etc.)
17. Manage the execution of underpinning work	17.1. Adjust work completion stages if necessary
	17.2. Ensure that building protection measures are in place around the work to be supported (pre-inspection, level survey)
	17.3. Determine the access ramp
	17.4. Ensure that the ground is excavated on the correct slopes and that the spoil is disposed of Mastery of procedures (continued)
	17.5. Ensure proper installation of piles and supports
	17.6. Ensure placement of formwork if necessary
	17.7. Ensure the production of concrete sections
	17.8. Ensure continuous monitoring of potential ground and structure movements
	17.9. Correct subsidence if necessary
	17.10. Explain the impact of the water table on underpinning work
18. Manage the execution of piles and special foundations work using compaction and injection techniques	18.1. Name the different soil reinforcement techniques (compaction, injection, consolidation)
	18.2. Explain the scope and techniques used to compact soil
	18.3. Explain the scope of application and the techniques used to install expanded base piles
	18.4. Explain the scope of application and techniques used to inject soil or rock
	18.5. Explain the scope and techniques of jet grouting

Elements of competency	Skills required
	18.6. Explain the impact of the water table on injection and soil compaction operations
19. Ensure quality control of piles and special foundations work	19.1. List the means of ensuring quality control of piles and special foundations work (verticality, inclination, refusal criteria, static or dynamic test, visual inspection, etc.)
	19.2. List the tests and trials to be carried out on materials used in piles and special foundations work
	19.3. Identify the persons responsible for the various stages of quality control of piles and special foundations work
	19.4. Ensure the quality of materials (upon receipt, but also according to optimal storage conditions)
	19.5. Interpret symptoms of soil movement during work and take appropriate action
	19.6. Solve problems related to piles and special foundations (technical solutions, etc.)
20. Ensure health and safety in connection with piles and special foundations work	20.1. Identify existing site conditions to ensure machinery stability
	20.2. Identify risks of interference with existing services and take steps to avoid conflicts
	20.3. Explain the risks associated with underpinning work
	20.4. Explain the risks associated with installing shoring and piles
	20.5. Explain the risks that may arise in the case of equipment or machinery breakdown
	20.6. Explain the risks associated with retaining wall failure
	20.7. Explain the risks associated with rock and soil compaction and injection
	20.8. Identify ways to control vibration during dynamic jacking

Elements of competency	Skills required
	20.9. Comply with and monitor noise standards