



STUDY GUIDE

WACEL

FOUNDATIONS SPECIAL INSPECTOR

November 2022

Foundations Special Inspector Study Guide

Scope:

“WACEL Foundations Special Inspector” is an intermediate certification that builds on both “WACEL Soils Field Special Inspector” and “WACEL Concrete I.” Obtaining this certification demonstrates that the qualifying technician is capable of monitoring and inspecting building foundation systems – with a particular emphasis on shallow and intermediate foundations – as well as related sitework and structures.

The range of topics included in this certification includes:

- a. A comprehensive review of the basic soil topics and basic concrete topics addressed in Soils Field Special Inspector and Concrete I respectively.
- b. The ability to properly review typical geotechnical reports and extract relevant information.
- c. The skills necessary to properly monitor the proper installation of shallow foundation systems to include bearing capacity, footing dimensions, correct reinforcing steel placement, anchor rods, and concrete placement.
- d. The knowledge necessary to monitor the installation of rammed (densified) aggregate piers used as an intermediate foundation system.
- e. The knowledge necessary to correctly inspect the construction of segmental retaining walls.
- f. An understanding of the Special Inspection Program of the International Building Code and how it relates to the technical topics of this certification.

Many of the other-than-shallow foundation systems and segmental retaining wall systems are proprietary systems that have been developed and patented by geotechnical experts. This certification has selected two of these systems to standardize training and evaluation. They have been selected for their common usage, for the scope of their complexity, and for the availability of their installation manuals. A detailed understanding of the selected systems should be readily transferable to competing systems. It is not WACEL’s intent to endorse the selected systems over any competing systems.

Purpose:

The purpose of this study guide is twofold:

- a. To be an informational document to owners, engineers, and code officials describing the depth and breadth of knowledge expected of individuals in order to obtain the WACEL Foundations Special Inspector certification.

- b. To be a source document for individuals seeking this certification so they know the scope of the evaluation, the applicable references, and a clear delineation of the learning objectives that they are expected to master.

General:

Due to the lack of concise references that address the wide range of skills that are covered by this certification, the contents of this Study Guide take on a special significance. To a greater degree than most other WACEL Study Guides, the listed learning objectives serve as an outline of much of material that Foundations Special Inspectors are expected to know. This same approach has been taken for the Study Guide for WACEL's "Soils Field Special Inspector." Accordingly, both Study Guides have been added to the "Required References" list, and unmarked copies can be used during the examination.

The WACEL Foundations Special Inspector Certification Program is currently the only level of certification for foundations. This examination measures an individual's knowledge primarily of shallow foundations.

Prerequisites:

All candidates applying for the Foundations Special Inspector Certification must possess current certifications as both – Concrete Field Technician (or Inspector) and Soils Technician (Field). WACEL does not require candidates to possess these prerequisite certifications through WACEL – other certification programs deemed equivalent by the certification Committee (State DOT, ACI, etc.) are accepted. If the prerequisite certifications are obtained through a certification body other than WACEL, evidence of certification must accompany the application.

Evaluation:

The examination is a three-hour, open-book examination for in-person exams. The online exam is a three-and-a-half hour, open-book exam. It consists of 75 multiple-choice questions. The first section (approximately 25 questions) requires an understanding of general knowledge topics. The remaining sections (approximately 50 questions) are generated from an example geotechnical report, specifications, and sets of plans that are given as attachments with the examination.

An overall minimum score of 75 percent (with a minimum of 70 percent on the "plan reading" sections) is required for certification.

The drawings that will be provided for the plan-reading portion of the examination are a partial set of drawings from an actual project. Select sheets have been extracted from:

- a. Retaining wall plan – notes and details.
- b. Foundation plan, including footing schedule.
- c. Foundation section details.
- d. Rammed (densified) aggregate pier details and notes.

Each examination candidate is expected to bring their own copies of the required references and a non-programmable calculator. Cell phones are not permitted, and photo IDs will be checked prior to starting the examination. Note paper will be provided and must be turned in on completion.

Safety:

This certification program – to include the examination – does not address the safety issues or health hazards associated with testing or observations. It is the responsibility of each candidate and their employer to be knowledgeable and to comply with all health and safety requirements specified by code officials, governmental agencies, and their employer's health and safety program.

References:

a. Required:

1. "International Building Code," (Chapters 2 and 17), International Code Council, 2018.
2. "Field Inspection of Reinforcing Bars," Concrete Reinforcing Steel Institute Second Edition, 2019.
3. "Vane Shear and Cone Penetration Resistance Testing of In-Situ Soils," ASTM STP 399, 1966.
4. National Readymix Concrete Association (NRMCA) Publication, CIP 17, "Flowable Fill Materials," 2000.
5. "Inspection Guide for Segmental Retaining Walls," TEK 18-11B, National Concrete Masonry Association, 2012.
6. WACEL Study Guide for Basic Concrete Technician April 2021.
7. WACEL Study Guide for Soils Field Special Inspector, January 2022.
8. WACEL Study Guide for Foundation Special Inspector, September 2022.
9. "Quality Control and Construction Guidelines for Geopier® Soil Reinforcing Systems," September 2016. Available on request from Geopier® at <https://www.geopier.com/resources>.

b. Optional:

1. "International Building Code," (Chapters 18 and 19), International Code Council, 2018.
2. "Geotechnical Testing, Observation, and Documentation," Second Edition, ASCE Press, 2008.
3. "Soils, Earthwork, and Foundations – A Practical Approach," International Code Council, 2006.
4. "Keystone Construction Manual," Keystone Retaining Wall Systems, 2020 (available online).
5. "Segmental Retaining Wall Inspector Training Program," National Concrete Masonry Association (on-line), 2021.

Application:

The exam candidate must submit a completed WACEL Examination application prior to taking the exam. The individuals who are cleared to take this examination are expected to be experienced construction inspectors and/or should have relevant education/training background.

A section of the application requires a Professional Engineer who is knowledgeable of the candidate's skills, knowledge, and abilities to formally confirm and document the individual's eligibility to take this examination as well as attest that the candidate has access to the necessary reference materials.

Learning Objectives:

The learning objectives listed below are topics which successful candidates will have thorough knowledge. They are intended to provide candidates with a relatively definitive outline of what is expected from them.

- A. Basic Soil Characteristics: See Study Guide for WACEL Soils Field Special Inspector.
- B. Basic Concrete: See Study Guide for WACEL Concrete I.
- C. Specialized Topics:
 1. Has a basic knowledge of the characteristics of, use of, and advantages of controlled, low-strength material (also known as flowable fill).

2. Understands the different types of and use of geosynthetics.
 3. Knows how to express soil slopes using H:V ratios and generally describe slope stability as a result of steepness.
- D. Knowledge of Geotechnical Reports:
1. Knows how to read and interpret a boring log to find:
 - a. Boring elevation.
 - b. Groundwater elevation.
 - c. Soil type for each strata.
 - d. SPT blow counts and N value (sum of 2nd and 3rd increments if not provided directly).
 2. Can locate foundation recommendations in report:
 - a. Understands the differences between shallow and deep foundations.
 - b. Can locate the recommended soil bearing pressure.
 - c. Can locate the recommended footing frost depth.
 - d. Understands what type of soils strata the foundations should be founded.
 3. Can locate the earthwork recommendations in the report.
 - a. What type of soils are suitable for structural fill.
 - b. What are the compaction requirements.
 - c. Can determine if any undercuts are recommended.
- E. Evaluation of Shallow Foundations:
1. Can identify different types of soil in the field.
 - a. Able to differentiate between coarse and fine grained soils.
 - b. Understands high plasticity vs. low plasticity.
 2. Verify recommended soil bearing.
 - a. Know how to use a Dynamic Cone Penetrometer.
 - b. Know how to locate soft spots in the foundation subgrade.
 - c. Use boring logs to be aware of possible deeper, unsuitable soils.
 3. Knows that excavation for foundation elements need to be free of standing water, debris, and organics; surrounding soil should not be frozen at time of concrete placement.

4. Reinforcing steel and dowel bar/anchor rod placement:
 - a. Understands the differences between and the applicability of design drawings and placing drawings to determine the complete and proper installation of reinforcing steel.
 - b. Demonstrates an ability to extract dimensions, placement and material requirements from plans and supporting tables and sections.
 - c. Has a working knowledge of the proper placement of reinforcing steel to include size, condition, type, proper identification and placement tolerances, lap splices, lap splice tolerances, cover, condition, bar supports, tying, and field bending.
 - d. Understands the criticality of the proper verification and installation of anchor rods or dowel bars in foundation elements as far as grade, size, end conditions, embedment length, location, and exposed length.

F. Segmental Retaining Walls.

1. Is familiar with the major components of most retaining walls and how they work within the overall system; and can follow manufacturer's installation instructions to monitor correct construction. These components include:
 - a. Construction of the foundation/leveling pad.
 - b. Required embedment depth.
 - c. Facing block orientation and levelness.
 - d. Pin location to establish setback or batter.
 - e. Installation of unit drainage fill (when necessary).
 - f. Reinforced zone geogrid, backfill material specifications and compaction.
 - g. Proper orientation and installation of geogrid used as reinforcement.
 - h. Retained soil.
 - i. Correct installation of top-of-wall finishes and other accessories.
2. Knows the criticality of proper construction and inspection of segmental retaining walls to ensure they function as intended without failure.
3. Can extract necessary inspection requirements and standards using a representative set of segmental retaining wall drawings.

G. Rammed (Densified) Aggregate Piers:

1. Understands Rammed (Densified) Aggregate Piers as a method of reinforcing or replacing a compressible soil stratum with compacted aggregate in order to improve footing bearing conditions and control settlement.
2. Understands the general concept of the ramming process displacing aggregate laterally into the more compressible soils and thereby strengthening these soils.
3. Understands the general installation procedure, i.e., drilled excavation or probe sufficiently penetrates the compressible soils to predetermined depths and then aggregate materials are placed from the bottom and either vibrated or compacted to create a stiff/compact aggregate pier element.
4. Can interpret plans and determine Rammed (Densified) Aggregate Piers element diameter, length and bottom elevation.
5. Understands the requirement that exposed footing subgrade soil and tops of Rammed (Densified) Aggregate Piers elements must be compacted prior to footing concrete placement.
6. Understands importance of modulus test and can interpret plans and notes to determine the location of the modulus test and the nearby boring.
7. Can determine from the project drawings the quality control and quality assurance requirements of the Rammed (Densified) Aggregate Pier system being installed.

H. Special Inspections:

1. Has an overall knowledge of the Special Inspection Program as outlined in Chapter 17 of the International Building Code.
2. Understands the difference between periodic and continuous inspections.
3. Is aware of the purpose, the submission requirements, and the general content of a schedule of special inspections.
4. Is aware of who the Special Inspectors must be employed by and who must approve their qualifications.
5. Knows when Special Inspections are required.
6. Is aware of the reporting and notification requirements of the Special Inspection Program.

I. Plan Reading:

1. Knows to check a specific project's structural notes (typically sheet S-1) to identify any inspection requirements or criteria applicable to the scope of this certification.
2. Is familiar with the plan reading or specialized drawing of the other functional topics addressed in this study guide such as reinforcing steel placing drawings, geotechnical report boring log diagrams, etc.
3. Knows the appropriate course(s) of action if questions arise when reading project drawings, plans, or specifications.