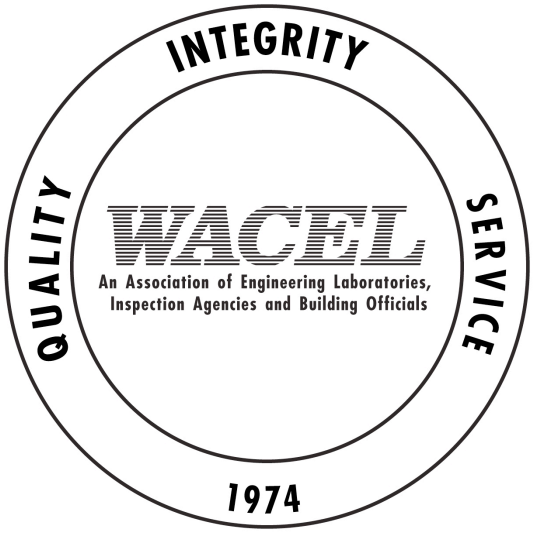

WACEL

Structural Concrete Inspector

Study Guide

(As of October 2013)

Structural Concrete Inspector

Study Guide

Scope:

A technician who has been certified at both the WACEL Concrete Level I and Reinforced Concrete/Masonry Inspector (RC/MI) (previously Concrete Level II) and who has attained the prerequisite experience is eligible for certification as a Structural Concrete Inspector.

This is the highest level of certification in concrete sponsored by WACEL. It presupposes a relatively advanced knowledge of basic concrete construction. This basis of knowledge includes materials behavior, plan reading, formwork, reinforcing steel and testing.

Concrete I introduced the entry-level technician to the basics of concrete as a construction material. It also concentrated on the more-common quality control tests that may be required.

Reinforced Concrete/Masonry Inspector expanded this information with basic plan reading; proper placement of reinforcing-steel; concrete placement; consolidation; curing; and structural masonry. More significantly, however, RC/MI starts to expose the technician to many of the publications that significantly contribute to their required knowledge as mid-level inspectors. These documents include applicable publications of the ASTM, ACI, NCMA, CRSI and the PCA. The careful integration of these industry standards with approved drawings and specifications was stressed.

Candidates for certification as Structural Concrete Inspectors expands the previously acquired body of knowledge even further. In addition, two specialty topics are introduced. They are post-tensioned concrete using unbonded tendons and tilt-up concrete construction. In both instances, inspection of these items should generally be limited to certified Structural Concrete Inspectors. Industry publications from the PTI and the TCA are also introduced.

Building on a philosophy introduced as part of RC/MI certification, a much greater reliance is placed on a knowledge of and the proper use of industry- approved reference documents. Structural Concrete Inspectors are expected to know how to research and resolve questions and technical issues that may be unfamiliar to them. The ability to properly and promptly use available information and resources is equally, if not more important, than rote memorization of a list of details and requirements.

Also, a working knowledge of the International Building Code's Special Inspection Program is required. This area of knowledge was introduced in RCMI and is being expanded on as a part of this certification.

Examination:

The Structural Concrete Examination is based on the following references. It will be 3 hours in length and is an open-book examination. A grade of 80 percent or better is required for passing. A basic, non-recording calculator is authorized.

All of the required references listed below can be used during the examination as long as they contain no marks, tabbing, or highlighting. The addition references are listed for the purpose of a more expanded background; their content is usually well addressed in the essential references.

No notes or working sheets may be removed from the examination area.

References:

Building Code (required):

A. Chapter 17, "Structural Tests and Special Inspections," 2009 or 2012 International Building Code.

Advanced Concrete Topics (required):

A. "Design and Control of Concrete Mixtures", Portland Cement Association, 15th Edition, 2011.

Post-tensioning (required):

A. "Instructional Manual for Training and Certification of Field Personnel for Unbonded Post-Tensioning," Post-Tensioning Institute, April 1999.
B. "Field Procedures Manual for Unbonded Single Strand Tendons," 3rd Edition, Post-Tensioning Institute, October 2000.

Tilt-up Construction (required):

A. "Tilt-Up Concrete Construction Guide," ACI 551.1R-05.
B. TCA's Guideline Specifications, Version 2003.1

Additional References (optional):

The following additional references are listed to provide more in-depth information on selected topics. Their use in assisting candidates in preparing for this examination is recommeneded. Use of these optional publications during the examination is not authorized.

A. "Manual of Standard Practice," Concrete Reinforcing Steel Institute, 10 MSP-PC-09-2009.

B. ASTM C94-13, “Specifications for Ready Mixed Concrete.”
C. ACI 305R-10, “Guide To Hot Weather Concreting.”
D. ACI 306R-10, “Guide to Cold Weather Concreting.”
E. ACI 308R-01 (Reapproved 2008), “Guide to Curing Concrete.”
F. ACI 309R-05, “Guide for Consolidation of Concrete.”
G. ACI 318-11, “Building Code Requirements for Structural Concrete.”

Learning Objectives: (see WACEL Skills Matrix for Concrete Inspectors).

?

I. Can perform unbonded, post-tensioned concrete inspections.

A. Understands the purposes of, the advantages of, and the more common uses of unbonded, post-tensioned concrete.
B. Is aware of the differences between pre-tensioned and post-tensioned concrete.
C. Understands the general terms used in post-tensioning operations.
D. Is familiar with post-tensioning drawings, symbols, notes and abbreviations, and basic components.
E. Is able to extract the necessary information from the approved plans and shop drawings and subsequently fill out the post-tensioning forms correctly.
F. Knows how to inspect the proper placement of tendons and related accessories and reinforcing elements prior to the placement of concrete.
G. Understands the proper techniques of concrete placement, consolidation and curing as it relates to post-tensioning.
H. Is familiar with the dangers associated with stressing operations.
I. Is knowledgeable of how to properly monitor and document stressing operations to include proper calibration of the required equipment.
J. Understands the need for turning in of complete and proper elongation reports in a timely fashion.
K. Is aware of common jobsite troubleshooting problems and corrective procedures.
L. Understands the purposes for, and special handling requirements for, encapsulated post-tensioning systems.

II. Can perform observations, inspections and testing for tilt-up concrete structures.

A. Is highly familiar with the Tilt-up Concrete Association’s “Guideline Specifications,” and can compare and contrast the TCA’s recommendations to a specific project’s requirements.
B. Using the ACI’s Publication “Tilt-up Concrete Construction Guide” (ACI 551.1R-05) is aware of the general considerations of tilt-up concrete construction.

C. Using approved design drawings and approved shop drawings, can monitor tilt-up formwork for proper openings and dimensions within allowable tolerances.
D. Using approved design drawings for structural reinforcement and approved shop drawings, placing drawings, and erection plans for reinforcement needed for erection and lifting, can inspect all reinforcing steel, embedded items, and lifting and bracing hardware for proper size, placement, and positioning.
E. Can monitor and evaluate the specific testing requirements that a tilt-up project requires prior to the erection of panels.

III. Understands Advance Topics for Concrete as a Construction Material.

All questions that support this Learning Objective are based on the Portland Cement Association publication "Design and Control of Concrete Mixtures." Individuals taking the Structural Concrete Inspector examination need to be highly familiar with this publication. Particular emphasis will be given to Chapters 1, 3-9, 11, 13-18 and 20.

A. Understands the advantages of low water-cement ratios for a concrete mix.
B. Knows what is meant by the workability of concrete and is familiar with the various factors that can influence it.
C. Is familiar with how concrete gains strength (hydration) and the curing conditions that can impact strength gain.
D. Knows the fundamentals of the following characteristics of concrete to include the factors that influence each of them:

1. Density.
2. Permeability and water-tightness.
3. Abrasion resistance.
4. Volume stability and crack control.
5. Freeze-thaw resistance.
6. Alkali-silica reactivity (ASR).
7. Chloride resistance and steel corrosion.
8. Chemical resistance.
9. Performance and durability.

E. Understands the various strength tests that can be accomplished or hardened concrete (compressive strength, flexural strength, direct tensile strength, splitting tensile strength, and shear strength) and their relationships.

F. Knows the different types of Portland Cement (types I, IA, II, IIA, III, IIIA, IV and V) and has a basic understanding of the characteristics of each.

G. Understands the effects of acceptability standards for mixing water in concrete mixtures.

H. Can discuss the basic physical properties of cement to include particle size and fineness, setting time, early stiffening, and compressive strength.

I. Can discuss the sources, properties, and advantages and disadvantages of mineral admixtures or “supplementary cementitious materials” such as fly ash; ground granulated blast furnace slab (GGBFS), silica fume and natural pozzolans.

J. Is familiar with the various types and sources of aggregates for concrete and a general description of acceptability.

K. Is knowledgeable of the basic characteristics of aggregates for concrete including grading, partical shape and surface texture.

L. Knows the general effects of air entrainment on concrete properties with particular emphasis on freeze-thaw resistance, deicer-scaling resistance, compressive and flexural strength, absorption and permeability, bleeding, sulfate resistance, workability, and finishability.

M. Understands the more-common factors that can affect air content including cement content, coarse and fire aggregate, mixing water and slump, vibration, concrete temperature, supplementary cementitious materials, admixtures and mixing action.

N. Knows the types of tests that are available to measure the air content of a concrete mixtures as well as the advantages and limitations of each.

O. Can discuss the general categories and properties of chemical admixtures that can be added to a concrete mix.

P. Is familiar with the reasons for using reinforcement in concrete, the basics of standard reinforcing steel, and the specialty reinforcing products that may be used for corrosion resistance (i.e., epoxy coated, stainless steel, galvanized, etc.).

Q. Understands the generally accepted practices governing the proper placement of concrete in various situations as presented by the American Concrete Institute (ACI) and the Portland Cement Association (PCA).

R. Knows all aspects of the consolidation of concrete by vibration to include how it works, types of vibrators, techniques for the proper use of vibrators, consequences of improper vibration, and indications of adequate vibration.

S. Has a detailed knowledge of how to properly cure concrete.

T. Is familiar with the precautions and techniques of both hot-weather and cold-weather concreting.

U. Can discuss the various destructive and non-destructive control tests to determine the quality and durability of concrete. Such tests are in addition to those required of a Concrete I Technician.

V. Is familiar with the characteristics of special types of concrete with particular emphasis on lightweight concrete, no-slump concrete, high-density concrete, and shotcrete.

IV. Special Inspection Program.

A. Has an overall knowledge of the Special Inspection Program as outlined in Chapter 17 of the International Building Code.
B. Understands the difference between periodic and continuous inspections.
C. Knows the specific cast-in-place inspection requirements of the International Building Code.
    1. Inspection of reinforcing steel and prestressing tendons.
    2. Inspection of bolts and anchors placed prior to concrete placement, during concrete placement, and in hardened concrete.
    3. Verifying use of required mix designs.
    4. Inspecting formwork for shape, locations, and dimensions.
    5. Providing specified quality control tests when sampled.
    6. Monitoring proper curing temperatures and techniques.
D. Is aware of the purpose, the submission requirements, and the general content of a Statement of Special Inspections.
E. Is aware of who the Special Inspectors must be employed by and who must approve their qualifications.
F. Knows when Special Inspections are required.
G. Knows what “Fabricated Items” are.
H. Is aware of the reporting and notification requirements of the Special Inspection Program.