



WACEL

STUDY GUIDE

CONCRETE II

APRIL 2011

Concrete II Study Guide

Examination: The Concrete II examination is based on the references cited in this document. It is 3 hours in length, is an open-book examination, and contains 75 questions (multiple choice). All of the required references can be used as long as there are no added markings. “Background” references are for information and training purposes.

Successful certification as a WACEL Level I Concrete Technician or an approved equivalent is a prerequisite to taking this examination. While the Concrete I certification focused on an introduction to concrete as a construction material as well as the more-common field quality control tests, Concrete II introduces a much more extensive range of related topics. These include:

- A review of topics addressed in Concrete I.
- Building code and standard specifications requirements for structural concrete.
- A comprehensive knowledge of reinforcing steel.
- An introduction to formwork.
- Numerous areas covering the placing, consolidation, and the curing of concrete.
- An ability to monitor, inspect, and prepare field test specimens for the construction of structural masonry building elements.
- A working knowledge of the International Building Code’s Special Inspection Program.

As previously mentioned, the examination is open-book. Candidates should be highly familiar with the required references listed below. The background references are excellent tools to assist both instructors and exam candidates. However, the use of the printed, background references during the examination is not recommended due to the large number of required references.

In addition, a significant number of the examination questions are based on actual project drawings related to the scope of this certification. Candidates should be capable of quickly and correctly extracting pertinent project information from such documents as structural drawings, reinforcing steel placing drawings, formwork shop drawings, and embed drawings.

The listed, printed references and a basic calculator (i.e., no printing or programming capabilities) are the only items that can be brought into the examination. Writing instruments and scratch paper will be provided; both must be turned in at completion of the examination.

Required References:

1. Chapter 17, "International Building Code," International Code Council, 2009.
2. ACI 301-10, "Specifications for Structural Concrete."
3. ACI 302.1R-04, "Guide for Concrete Floor and Slab Construction."
4. ACI 309R-05, Consolidation of Concrete.
5. ACI 318-08, "Building Code Requirements for Structural Concrete," Chapters 1-7 and Sections 12.14 and 12.15.
6. ACI 347-04, Guide to Formwork for Concrete.
7. CRSI "Manual of Standard Practice," 28th Edition: "Field Inspection of Reinforcing Bars," CRSI, 2009.
8. NCMA TR 156B, "Inspection and Testing of Concrete Masonry Construction," 2008.
9. ASTM C31-09a, Making and Curing Concrete Test Specimens in the Field.
10. ASTM C 94-09a, Standard Specifications for Ready-Mixed Concrete.
11. ASTM C 109-08, Compressive Strength of Hydraulic Cement Mortars.
12. ASTM C 138-09, Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
13. ASTM C 143-10, Slump of Hydraulic-Cement Concrete.
14. ASTM C 172-08, Sampling Freshly Mixed Concrete.
15. ASTM C 173-10, Air Content of Freshly Mixed Concrete by the Volumetric Method.
16. ASTM C 231-09, Air Content of Freshly Mixed Concrete by the Pressure Method.
17. ASTM C 270-08a, Mortar for Unit Masonry.
18. ASTM C 780-09, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
19. ASTM C 1019-09, Sampling and Testing Grout.
20. ASTM C 1064-08, Temperature of Freshly Mixed Hydraulic-Cement Concrete.
21. ASTM C 1314-09, Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
22. "Design and Control of Concrete Mixtures", Portland Cement Association, Fourteenth or Fifteenth Editions.

Background References:

1. "ACI Manual of Concrete Inspection," Publication SP-2 (07).
2. CRSI video, "Field Inspection of Reinforcing Bars", 25 minutes.
3. "Concrete Manual," International Code Commission, 2006.
4. "Concrete Manual Study Companion," International Code Council, 2006.

5. ICC on-line course: "Reinforced Concrete Special Inspector Certification Examination Practice Course."
6. "Concrete Inspection Handbook," Portland Cement Association, Fourth Edition, 2005.

Learning Objectives:

- I. Knowledge of ACI and ASTM concrete requirements.
 - A. Understand reasons for and criteria for maximum coarse aggregate size in a concrete mix.
 - B. Know how to evaluate proper consolidation techniques to include possible results of improper consolidation.
 - C. Knows the effects of ground granulated blast furnace slag (NewCem).
 - D. Know the various testing methods and acceptance criteria for evaluation and acceptance of deficient compressive strength cylinders to include acceptance as is, ACI 318 (paragraph 5.6.2.3), non-destructive testing, cores (ACI 318, paragraph 5.6.5.4), and structural modification.
 - E. Familiar with the standard specifications for ready-mixed concrete addressed in ASTM C 94 to include availability time, batch-to-placement time, slump and air content tolerances, maximum mixing revolutions, mixing requirements after water is added, sampling, minimum temperatures and testing frequencies.
 - F. Understands the reasons for and the requirements specified for durability in Chapter 4 of ACI 318.
 - G. Understands the basic principles of concrete floor and slab construction to include site preparation, proper placement of reinforcement and concrete, finishing and curing.
 - H. Understands the specific concrete requirements for structural concrete addressed in ACI 301 and Chapter 5 of ACI 318.
 - I. Can determine some of the detailed test requirements addressed in basic ASTMs introduced as part of Concrete I.
- II. Understands the basic principles of and can perform visual inspection of reinforcing steel 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. Demonstrate an ability to extract dimensions, placement and material requirements from plans and supporting tables and sections.
 - C. Have a working knowledge of the proper placement of reinforcing steel and welded wire fabric to include size, type, proper

- identification and placement tolerances, lap splices, cover, condition, and field bending.
 - D. Understands the specific reinforcing steel requirements for structural concrete addressed in Chapters 7 and Sections 12.14 and 12.15 of ACI 318.
 - E. Can easily convert reinforcing sized in the inch-pound system to the “soft metric” requirements, and from “soft metric” to inch-pounds.
- III. Has knowledge of proper handling and placement of corrosion-protected rebar.
- A. Knows the currently-authorized types of corrosion protected reinforcing steel.
 - B. Knows the purpose and intent of coated bars or mesh to include the need for compatible supports and wires and specialized storage and handling requirements.
 - C. Awareness of the need for and how damage occurs to the protective coating and how proper repairs are accomplished.
 - D. Is aware of the major specialized issues for corrosion-protected reinforcing that should be addressed in project specifications.
- IV. Can inspect reinforced masonry (storage & placement of materials, mixing, grout & mortar, reinforcement and anchorage).
- A. Know the different types and designations of masonry mortar including differences between laboratory-designed mortar and field-mixed mortar.
 - B. Demonstrate a knowledge of how to determine if the materials and components for structural masonry are in accordance with contract documents. This includes the proper proportioning and mixing of mortar and grout.
 - C. Have a working understanding of masonry placement requirements to include reinforcing steel and other embedded components, mortar thicknesses and tolerances, and requirements of grouting operations.
- V. Can properly monitor and test masonry grout, mortar, and prisms.
- A. Know the techniques and requirements for taking mortar cubes, grout prisms and masonry prisms.
 - B. Understand the storage and handling differences among mortar cubes, grout prisms and masonry prisms.

- VI. Can inspect basic vertical and horizontal formwork.
 - A. Demonstrate a knowledge of the basic criteria for suitable formwork construction to include inspection requirements.
 - B. Know the principles and criteria for early formwork removal to include reshoring.

- VII. Can determine requirements for a proper installation of anchor rods and dowel bars in foundation elements.
 - A. Can confirm proper quantity, grade, size, configuration, elevation, and relative alignment of anchor rods.
 - B. Can confirm required depth of embedment and end conditions of anchor rods.

- VIII. Has an overall knowledge of the Special Inspection Program as outlined in Chapter 17 of the International Building Code.
 - A. Understands the difference between periodic and continuous inspections.
 - B. Knows the specific cast-in-place inspection requirements of the International Building Code.
 - C. Is aware of the purpose, the submission requirements, and the general content of a schedule of special Inspections.
 - D. Is aware of who the Special Inspectors must be employed by and who must approve their qualifications.
 - E. Knows when Special Inspections are required.
 - F. Knows what "Fabricated Items" are.
 - G. Is aware of the reporting and notification requirements of the Special Inspection Program.

- IX. Can interpret reinforced concrete plans, specifications, shop drawings and details for materials, dimensions, sizes and locations.

- X. Can interpret reinforced masonry plans, specifications, and details for materials, dimensions, sizes, and locations.