WACEL SOILS I

Study Guide

(Updated July 2014)

Soils I

Study Guide

Scope:

Soils I is the first certification in the area of geotechnical testing and observations that most engineering field technicians must complete. Although the scope of knowledge required is fairly large, it is intended to prepare an entry-level technician to operate in the field with minimum on-site supervision.

Successful completion of this certification examination does not validate that the candidate is an experienced technician. At best, that individual should be considered to be an apprentice field technician who must broaden his or her experiences under the tutelage of experienced technicians or field engineers.

The general scope of this certification includes:

1. Can visually identify soil in accordance with the USCS, and is familiar with general properties.
2. Is familiar with some ASTM laboratory tests used for classification and quality control purposes (grain size, Atterberg limits, moisture content & Proctor).
3. Can obtain, identify, label, and transport representative samples.
4. Can understand and interpret basic earthwork specifications and geotechnical recommendations.
5. Understands the roles and responsibilities of project personnel (technician, geotechnical engineer, contractor, owner, government agency).
6. Understands the principles of density testing.
7. Can perform, and evaluate compaction by, the nuclear density gauge and sand cone methods.
8. Can perform, and understands the uses and limitations of one-point Proctor test and a "family of curves."
9. Is familiar with effects of and corrections for micaceous soils and testing in trenches using nuclear gauges.
10. Is familiar with the types, uses and suitability of various types of compaction equipment.
11. Understands site plans typical field stake-out, cut/fill, and off set markers.
12. Can prepare written field reports and test summaries correctly and completely to include supporting plans or specifications.
13. Can perform basic observations of topsoil stripping, the removal of unsuitable materials, and proofrolling.
14. Is familiar with field equipment calibration and leak testing of nuclear gauges.
15. Is familiar with excavation safety and OSHA requirements.
16. Completed basic radiation safety training and has certification (for Nuclear Gauge users only).

Examinations:

Written Exam:
The Soils I Examination is a 60-question test (40 academic, 20 plan reading) based on the references listed below. 2 hours are allowed to complete this examination, and it is a closed–book examination. An overall grade of 80 percent or better is required for passing; with a score of at least 70% on the plan reading section of the exam (20 questions). Although this scenario is not common, a strong understanding of both – academic and plan reading questions is imperative for a field technician to be self sufficient and competent in the field. A non-graphing calculator is authorized.

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

Practical (Performance) Exam:
The Soils I Practical Examination is conducted "in-house" by either a licensed P.E. or a WACEL Approved Examiner. A copy of the practical examination is available on the WACEL website (www.wacel.org) in the 'Members Only' section, as well as by contacting WACEL and requesting a copy if you do not have access to the 'Members Only' section or have problems accessing it. Detailed instructions are given on the cover page of the practical examination for administration of it. If there are any questions on becoming an Approved Examiner or how to administer the practical examination, please contact WACEL.

References:

1. ASTM D422-63 (2007) – Standard Test Method for Particle Size Analysis of Soils.
2. ASTM D698-12e1 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (600 kN-m/m^3).
3. ASTM D1556-07 - Standard Test Method for Density of Soil by the Sand-Cone Method.
4. ASTM D1557-12 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (56,000 ft-lbf/ft^3) (2,700 kN-m/m^3).
5. ASTM D2487-11 - Standard Practice for Classification of Soil for Engineering Purposes (USCS).
6. ASTM D2488-09a - Standard Practice for Description and Identification of Soil (Visual – Manual Produce).
7. ASTM D 4318-10e1 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
8. ASTM D4718-87 (2007) - Standard Practice for Correction of Unit Weight and Water Content for Soil Containing Oversize Particles.
9. ASTM D4959-07 - Standard Test Method for Water Content of Soil By Direct Heat Methods.

10. ASTM D6938-10 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depths)
11. AASHTO T272-10 – Family of Curves – One Point Method.
12. VTM - 12 - Virginia Test Method For Use of One-Point Proctor Density.
13. WACEL Soils I Workbook, dated June 2002.
14. OSHA Excavation Regulations: 29 CFR 1926.650 to 1926.652 (Subpart P).
15. Geotechnical Testing, Observation, and Documentation – Second Edition, Tim Davis (Author), published by ASCE.

Learning Objectives:

To assist candidate soil technicians and their employers in preparing individuals and training programs for this certification, the following primary and supporting learning objectives have been developed. They are intended to focus on what is considered important, what must be addressed in training and preparation programs, and what will be the basis for evaluation.

Classification & Soil Characteristics:

1. Can visually identify soil in accordance with the USCS, and is familiar with general properties, characteristics, and uses of soil types. Including nomenclature and symbols.
   a. Know the sieve sizes that differentiate the various particle sizes.
   b. Understands plasticity concepts to include liquid limit, plastic limit, plasticity index, shrinkage limit, and the ranges of plasticity.
   c. Can complete a basic soil classification given select data.
   d. Knows the nomenclature and symbols identified soils.
   e. Knows what soil types are best for drainage.
   f. Knows what soil types are best for structures, fill for buildings, and pavement structures.
   g. Knows what soil types are best to limit the migration of water.

2. Is familiar with some ASTM laboratory tests used for classification and quality control purposes (grain size, Atterberg limits, moisture content & Proctor).
   a. Knows the purposes of obtaining Atterberg limits.
   b. Understands the meaning of the Atterberg terms (LL, PL, PI).
   c. Has general knowledge of the various "Proctor" procedures.
   d. Knows how particle sizes are determined.
   e. Can identify sands and gravels based on estimated percentages of size of the particles.
   f. Understands what the "Zero Air Voids Curve" on most moisture – density reports represents.

3. Can obtain, identify, label, and transport representative samples.
    a. Is aware of how to obtain and properly label soil samples.
    b. Has a basic understanding of how to obtain a representative sample.

4. Can understand and interpret basic earthwork specifications and geotechnical recommendations.
    a. Knows what to do if unanticipated materials are encountered.
    b. Can determine if geotechnical recommendations appear to have been incorporated into a project's drawings and specifications.
    c. Can determine what materials are unsuitable for use and which on-site materials may be used.
    d. Can properly identify other, proper construction quality control information from project specifications.

Roles of Project Personnel:

5. Understands the roles and responsibilities of project personnel (technician, geotechnical engineer, contractor, owner, government agency).
    a. Understands when actual site conditions require the involvement of the geotechnical engineer of record.
    b. Understands the role of a project's geotechnical engineer and its geotechnical report.
    c. Knows that the general contractor's designated representative must be notified immediately of any deficient test results

Field Observations, Compaction, and Oversize Corrections:

6. Understands the principles of density testing, including weight/volume and moisture/density relationships.
    a. Knows how to interpret and apply Proctor data.
    b. Can compute and evaluate moisture content data, optimum moisture contents (OMC), and moisture effects on compaction.
    c. Can compute the dry density of a soil sample given the wet density and the moisture content.
    d. Knows the difference between compaction and consolidation.

7. Can perform, and evaluate compaction by, the nuclear density gauge and sand cone methods.
    a. Knows the proper use of the equipment and supporting documentation necessary for either system.
    b. Knows how to address and evaluate failing compaction test results and who must be provided this information.
    c. Given nuclear gauge or sand cone field data, can compute percent compaction and moisture content.

d. Can adjust compaction and moisture content data based on oversized material using the appropriate formulae.
e. Can compare computed results with specifications to confirm acceptability using the formula.
f. Is aware of the probable or specified testing frequency for compacted fill.
g. Understands the advantages and limitations of using either nuclear gauge equipment or the sand cone.
h. Familiar with trench corrections for nuclear density gauges.

One Point Proctor:

8. Can perform, and understands the uses and limitations of one-point Proctor test and a "family of curves."
   a. Understands when it is appropriate to accomplish a one-point Proctor test.
   b. Understands the limitations of the results of a one-point Proctor tests.
   c. Understands the differences in using the AASHTO and the VTM-12 ("Ohio Curves") family of curves (moist density vs. dry density).
   d. Can properly accomplish a one-point Proctor test.
   e. Given wet density and moisture content test results, can determine the dry density and the optimum moisture content of a soil sample.

Moisture Corrections:

9. Is familiar with effects of and corrections for micaceous soils and testing in trenches using nuclear gauges.
   a. Understands the different times that moisture content corrections may be required when using portable nuclear gauges.
   b. Has a basic knowledge of how these situations produced distorted results.

Proctor Compaction Equipment:

10. Is familiar with the types, uses and suitability of various types of compaction equipment.
    a. Type for soil type.
    b. Size vs. lift thickness.

Construction Information and Stakes:

11. Understands site plans typical field stake-out, cut/fill, and off set markers.
    a. Can correctly identify cut, fill, off set, and centerline stakes.
    b. Understands and can compute distances and locations specified in "stations."

c. Can correctly extract other pertinent information from project drawings to support construction observations, testing, and documentation.

Proper Reporting:

12. Can prepare written field reports and test summaries correctly and completely to include supporting plans or specifications.

Topsoil Stripping & Proofrolling

13. Can perform basic observations of topsoil stripping, the removal of unsuitable materials, and proofrolling.
    a. Can identify what is generally classified as top soil.
    b. Knows the limitations if topsoil is used as structural fill.
    c. Understands the purposes and limitations of proofrolling.

Calibration:

14. Is familiar with field equipment calibration and leak testing of gauges.
    a. Understands the importance of only using clean, serviceable, calibrated equipment.
    b. Knows the range and interval of tests and checks that apply to portable nuclear gauges to include standardization, calibration, and leak tests.
    c. Knows the difference between calibration and standardization when using portable nuclear gauges.
    d. Knows the calibration intervals for scales, sand cone components, proctor molds, etc.

Safety:

15. Is familiar with excavation safety and OSHA requirements.
    a. Knows the deepest excavation that can be entered without benching, shoring, or sloping.
    b. Knows that stairs or ladders can be no further away than 25 feet from workers on technicians in a trench 4 foot or deeper.
    c. Knows how often a competent person must inspect excavations and adjacent areas.
    d. Knows how far stockpiles of excavated material must be kept away from trenches.
    e. Knows general trench box safety issues.

WACEL Certification:

16. Scope of Soils I.

Site Plan Reading:

17. Is familiar with and able to read earthwork site plans.
    a. Able to read contour lines – existing grades and proposed grades.
    b. Able to determine when cut or fill operations are necessary based on grades/contour lines.
    c. Knows how to become directionally oriented based on the North Arrow shown on the plans.
    d. Able to read and decipher information shown on a profile, including (but not limited to) existing grade lines, proposed grade lines and invert elevations.
    e. Familiar with symbols and common abbreviations used on plans.
    f. Can determine distances based on station numbers.