NCEES
advancing licensure for engineers and surveyors

Principles and Practice of Engineering
CIVIL BREADTH and STRUCTURAL DEPTH Exam Specifications
Effective Beginning with the April 2008 Examinations

- The civil exam is a breadth and depth examination. This means that examinees work the breadth (AM) exam and one of the five depth (PM) exams.
- The five areas covered in the civil examination are construction, geotechnical, structural, transportation, and water resources and environmental. The breadth exam contains questions from all five areas of civil engineering. The depth exams focus more closely on a single area of practice in civil engineering.
- Examinees work all questions in the morning session and all questions in the afternoon module they have chosen.
- The exam is an 8-hour open-book exam. It contains 40 multiple-choice questions in the 4-hour AM session, and 40 multiple-choice questions in the 4-hour PM session.
- The exam uses both the International System of Units (SI) and the US Customary System (USCS).
- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application. Some problems may require knowledge of engineering economics.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.
- The specifications for the **AM exam** and the **Structural PM exam** are included here. The **design standards** applicable to the Structural PM exam are shown on the last page.

CIVIL BREADTH Exam Specifications

		Approximate Percentage of AM Exam
I.	**Construction**	**20%**

A. Earthwork Construction and Layout
   1. Excavation and embankment (cut and fill)
   2. Borrow pit volumes
   3. Site layout and control

B. Estimating Quantities and Costs
   1. Quantity take-off methods
   2. Cost estimating

C. Scheduling
   1. Construction sequencing
   2. Resource scheduling
   3. Time-cost trade-off

D. Material Quality Control and Production
   1. Material testing (e.g., concrete, soil, asphalt)

E. Temporary Structures
   1. Construction loads

II. Geotechnical 20%

A. Subsurface Exploration and Sampling
   1. Soil classification
   2. Boring log interpretation (e.g., soil profile)

B. Engineering Properties of Soils and Materials
   1. Permeability
   2. Pavement design criteria

C. Soil Mechanics Analysis
   1. Pressure distribution
   2. Lateral earth pressure
   3. Consolidation
   4. Compaction
   5. Effective and total stresses

D. Earth Structures
   1. Slope stability
   2. Slabs-on-grade

E. Shallow Foundations
   1. Bearing capacity
   2. Settlement

F. Earth Retaining Structures
   1. Gravity walls
   2. Cantilever walls
   3. Stability analysis
   4. Braced and anchored excavations

III. Structural 20%

A. Loadings
   1. Dead loads
   2. Live loads
   3. Construction loads

B. Analysis
   1. Determinate analysis

C. Mechanics of Materials
   1. Shear diagrams
   2. Moment diagrams
   3. Flexure
   4. Shear
   5. Tension
   6. Compression
   7. Combined stresses
   8. Deflection

D. Materials
   1. Concrete (plain, reinforced)
   2. Structural steel (structural, light gage, reinforcing)

E. Member Design
   1. Beams
   2. Slabs
   3. Footings

IV. Transportation 20%

A. Geometric Design
   1. Horizontal curves
   2. Vertical curves
   3. Sight distance
   4. Superelevation
   5. Vertical and/or horizontal clearances
   6. Acceleration and deceleration

V. Water Resources and Environmental 20%

A. Hydraulics – Closed Conduit
   1. Energy and/or continuity equation (e.g., Bernoulli)
   2. Pressure conduit (e.g., single pipe, force mains)
   3. Closed pipe flow equations including Hazen-Williams, Darcy-Weisbach Equation
   4. Friction and/or minor losses
   5. Pipe network analysis (e.g., pipeline design, branch networks, loop networks)
   6. Pump application and analysis

B. Hydraulics – Open Channel
   1. Open-channel flow (e.g., Manning's equation)
   2. Culvert design
   3. Spillway capacity
   4. Energy dissipation (e.g., hydraulic jump, velocity control)
   5. Stormwater collection (e.g., stormwater inlets, gutter flow, street flow, storm sewer pipes)
   6. Flood plains/floodways
   7. Flow measurement – open channel

C. Hydrology
   1. Storm characterization (e.g., rainfall measurement and distribution)
   2. Storm frequency
   3. Hydrographs application
   4. Rainfall intensity, duration, and frequency (IDF) curves
   5. Time of concentration
   6. Runoff analysis including Rational and SCS methods
   7. Erosion
   8. Detention/retention ponds

D. Wastewater Treatment
   1. Collection systems (e.g., lift stations, sewer networks, infiltration, inflow)

E. Water Treatment
   1. Hydraulic loading
   2. Distribution systems

CIVIL–STRUCTURAL DEPTH Exam Specifications

		Approximate Percentage of PM Exam
I.	**Loadings**	**12.5%**
	A. Dead loads B. Live loads C. Construction loads D. Wind loads E. Earthquake loads, including liquefaction, site characterization, and pseudo-static analysis F. Moving loads G. Snow loads H. Impact loads I. Load paths J. Load combinations	
II.	**Analysis**	**12.5%**
	A. Determinate analysis B. Indeterminate analysis	
III.	**Mechanics of Materials**	**12.5%**
	A. Shear diagrams B. Moment diagrams C. Flexure D. Shear E. Tension F. Compression G. Combined stresses H. Deflection I. Progressive collapse J. Torsion K. Buckling L. Fatigue M. Thermal deformation	
IV.	**Materials**	**12.5%**
	A. Concrete (plain, reinforced) B. Concrete (prestressed, post-tension) C. Structural steel (structural, light gage, reinforcing) D. Timber E. Masonry (brick veneer, CMU) F. Composite construction	

V. Member Design — 25%

A. Beams
B. Slabs
C. Footings
D. Columns
E. Trusses
F. Braces
G. Frames
H. Connections (bolted, welded, embedded, anchored)
I. Shear walls
J. Diaphragms (horizontal, vertical, flexible, rigid)
K. Bearing walls

VI. Design Criteria — 12.5%

A. International Building Code (IBC)
B. American Concrete Institute (ACI-318, 530)
C. Precast/Prestressed Concrete Institute (PCI Design Handbook)
D. Manual of Steel Construction (AISC) including AISC 341
E. National Design Specification for Wood Construction (NDS)
F. Standard Specifications for Highway Bridges (AASHTO)
G. American Society of Civil Engineers (ASCE-7)
H. American Welding Society (AWS D1.1, D1.2, and D1.4)

VII. Other Topics — 12.5%

A. Engineering properties of soils and materials
    1. Index properties (e.g., plasticity index; interpretation and how to use them)
B. Soil mechanics analysis
    1. Expansive soils
C. Shallow foundations
    1. Mat and raft foundations
D. Deep foundations
    1. Axial capacity (single pile/drilled shaft)
    2. Lateral capacity and deflections (single pile/drilled shaft)
    3. Settlement
    4. Behavior of pile and/or drilled shaft group
E. Engineering Economics
    1. Value engineering and costing
F. Material Quality Control and Production
    1. Welding and bolting testing
G. Temporary Structures
    1. Formwork
    2. Falsework and scaffolding
    3. Shoring and reshoring
    4. Concrete maturity and early strength evaluation
    5. Bracing
    6. Anchorage
H. Worker Health, Safety and Environment
    1. OSHA regulations
    2. Safety management

NCEES Principles and Practice of Engineering Examination

CIVIL—STRUCTURAL Design Standards[1]

These standards apply to the Structural afternoon module of the PE Civil exam.

Effective for the April and October 2012 Examinations

Revised January 6, 2012*

ABBREVIATION	DESIGN STANDARD TITLE
AASHTO	*AASHTO LRFD Bridge Design Specifications,* 5th edition, 2010, American Association of State Highway & Transportation Officials, Washington, DC.
IBC	*International Building Code,* 2009 edition (without supplements), International Code Council, Falls Church, VA.
ASCE 7	*Minimum Design Loads for Buildings and Other Structures*, 2005, American Society of Civil Engineers, Reston, VA.
ACI 318-08[2]	*Building Code Requirements for Structural Concrete*, 2008, American Concrete Institute, Farmington Hills, MI.
TMS 402/602-08[3] **ACI 530/530.1-08** **ASCE/SEI 5/6-08**	*Building Code Requirements* and *Specifications for Masonry Structures* (and related commentaries), 2008; American Concrete Institute, Detroit, MI; Structural Engineering Institute of the American Society of Civil Engineers, Reston, VA; and The Masonry Society, Boulder, CO.
AISC	*Steel Construction Manual,* 13th edition, American Institute of Steel Construction, Inc., Chicago, IL.
NDS[4]	*National Design Specification for Wood Construction ASD/LRFD,* 2005 edition & *National Design Specification Supplement, Design Values for Wood Construction,* 2005 edition, American Forest & Paper Association, Washington, DC.
PCI	*PCI Design Handbook: Precast and Prestressed Concrete*, 6th edition, 2004, Precast/Prestressed Concrete Institute, Chicago, IL.

Notes

1. Solutions to exam questions that reference a standard of practice are scored based on this list. Solutions based on other editions or standards will not receive credit. **All questions are in English units.**
2. Appendix C does not apply to the Civil Structural examination.
3. Examinees will use only the Allowable Stress Design (ASD) method, except strength design Section 3.3.5 may be used for walls with out-of-plane loads.
4. Examinees will use only the ASD method for wood design.

* *Building Code Requirements for Structural Concrete* (ACI 318) and *Building Code Requirements* and *Specifications for Masonry Structures* (TMS 402/602, ACI 530/530.1, and ASCE/SEI 5/6) were updated to the 2008 editions on January 6, 2012, to prevent conflicts with IBC 2009.