NCEES
advancing licensure for engineers and surveyors

Principles and Practice of Engineering
CIVIL BREADTH and WATER RESOURCES and ENVIRONMENTAL 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. Depth results are combined with breadth results for final score.
- 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 **Water Resources and Environmental PM exam** are included here.

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–WATER RESOURCES and ENVIRONMENTAL Depth Exam Specifications

		Approximate Percentage of PM Exam
I.	**Hydraulics – Closed Conduit**	**15%**

A. Energy and/or continuity equation (e.g., Bernoulli)
B. Pressure conduit (e.g., single pipe, force mains)
C. Closed pipe flow equations including Hazen-Williams, Darcy-Weisbach Equation
D. Friction and/or minor losses
E. Pipe network analysis (e.g., pipeline design, branch networks, loop networks)
F. Pump application and analysis
G. Cavitation
H. Transient analysis (e.g., water hammer)
I. Flow measurement – closed conduits
J. Momentum equation (e.g., thrust blocks, pipeline restraints)

II. Hydraulics – Open Channel **15%**

A. Open-channel flow (e.g., Manning's equation)
B. Culvert design
C. Spillway capacity
D. Energy dissipation (e.g., hydraulic jump, velocity control)
E. Stormwater collection including stormwater inlets, gutter flow, street flow, storm sewer pipes
F. Flood plain/floodway
G. Subcritical and supercritical flow
H. Flow measurement – open channel
I. Gradually varied flow

III. Hydrology **15%**

A. Storm characterization including rainfall measurement and distribution
B. Storm frequency
C. Hydrographs application
D. Hydrograph development and synthetic hydrographs
E. Rainfall intensity, duration, and frequency (IDF) curves
F. Time of concentration
G. Runoff analysis including Rational and SCS methods
H. Gauging stations including runoff frequency analysis and flow calculations
I. Depletions (e.g., transpiration, evaporation, infiltration)
J. Sedimentation
K. Erosion
L. Detention/retention ponds

IV. Groundwater and Well Fields — 7.5%

A. Aquifers (e.g., characterization)
B. Groundwater flow including Darcy's Law and seepage analysis
C. Well analysis (steady flow only)
D. Groundwater control including drainage, construction dewatering
E. Water quality analysis
F. Groundwater contamination

V. Wastewater Treatment — 15%

A. Wastewater flow rates (e.g., municipal, industrial, commercial)
B. Unit operations and processes
C. Primary treatment (e.g., bar screens, clarification)
D. Secondary clarification
E. Chemical treatment
F. Collection systems (e.g., lift stations, sewer network, infiltration, inflow)
G. National Pollutant Discharge Elimination System (NPDES) permitting
H. Effluent limits
I. Biological treatment
J. Physical treatment
K. Solids handling (e.g., thickening, drying processes)
L. Digesters
M. Disinfection
N. Nitrification and/or denitrification
O. Operations (e.g., odor control, corrosion control, compliance)
P. Advanced treatment (e.g., nutrient removal, filtration, wetlands)
Q. Beneficial reuse (e.g., liquids, biosolids, gas)

VI. Water Quality — 15%

A. Stream degradation (e.g., thermal, base flow, TDS, TSS, BOD, COD)
B. Oxygen dynamics (e.g., oxygenation, deoxygenation, oxygen sag curve)
C. Risk assessment and management
D. Toxicity
E. Biological contaminants (e.g., algae, mussels)
F. Chemical contaminants (e.g., organics, heavy metals)
G. Bioaccumulation
H. Eutrophication
I. Indicator organisms and testing
J. Sampling and monitoring (e.g., QA/QC, laboratory procedures)

VII. Water Treatment — 15%

A. Demands
B. Hydraulic loading
C. Storage (raw and treated water)
D. Sedimentation
E. Taste and odor control
F. Rapid mixing
G. Coagulation and flocculation

H. Filtration
I. Disinfection
J. Softening
K. Advanced treatment (e.g., membranes, activated carbon, desalination)
L. Distribution systems

VIII. Engineering Economics 2.5%

A. Life-cycle modeling
B. Value engineering and costing