

**NCEES Principles and Practice of Engineering
CIVIL BREADTH Exam Specifications**

Effective Beginning with the April 2008 Examinations

The civil engineering examination is a breadth and depth examination. This means that **all** examinees work the breadth (AM) exam and **one** of the five depth (PM) exams. The five areas covered in the civil engineering exam 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.

The specifications for the **AM exam and the Water Resources and Environmental PM exam** are included here.

	Approximate Percentage of Examination
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

Notes

1. The examination is developed with questions that will require a variety of approaches and methodologies including design, analysis, and application. Some questions may require knowledge of engineering economics.
2. The knowledge areas specified under 1, 2, 3, etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
3. The breadth (AM) exam contains 40 multiple-choice questions. Examinee works all questions.
4. Score results are combined with depth exam results for final score.

**NCEES Principles and Practice of Engineering Examination
CIVIL–WATER RESOURCES and ENVIRONMENTAL Depth Exam Specifications**

Effective Beginning with the April 2008 Examinations

	Approximate Percentage of Examination
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

Notes

1. The examination is developed with problems that will require a variety of approaches and methodologies including design, analysis, and application. Some problems may require knowledge of engineering economics.
2. The knowledge areas specified under A, B, C, etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
3. Each depth (PM) exam contains 40 multiple-choice questions. Examinee chooses **one** depth exam and works all questions in the depth exam chosen.
4. Score results are combined with breadth exam results for final score.