PE - Civil exam

The Principles and Practice of Engineering (PE) exam tests for a minimum level of competency in a particular engineering discipline. It is designed for engineers who have gained a minimum of four years' post-college work experience in their chosen engineering discipline.

Application to the California board is not required prior to examination for NCEES exams, however some licensing boards may require you to file a separate application and pay an application fee as part of the approval process to qualify you for a seat for an NCEES exam. All candidates wishing to register for the exams will need to do so prior to NCEES's registration deadline. Your exam type, discipline, module, and/or site cannot be changed after the NCEES registration deadline. Exam fees are payable directly to NCEES.

Exam schedule

Beginning in 2022, the PE Civil exam transitioned to computer-based and is administered year-round at NCEES-approved Pearson VUE test centers. Register for the exam by logging in to your MyNCEES account.

Examinees work the breadth section in the morning and one of the five depth modules in the afternoon. The breadth section contains 40 questions from all five areas of civil engineering. The depth section focuses more closely on a single area of practice (40 questions):

- Civil: Construction
- Civil: Geotechnical
- Civil: Structural
- Civil: Transportation
- Civil: Water Resources and Environmental

For details on the format and length of the exam, the topics covered, and applicable design standards, download the exam specifications (https://ncees.org/engineering/pe/civil-cbt/). PE exam specifications and design standards are posted 6 months before the exam administration. Exam specifications change once every 5–7 years. Design standards change more frequently.

Reference material and exam prep

The computer-based exam is not an open book exam. You will be provided with an electronic NCEES *PE Civil Reference Handbook* as well as all design standards specified for your chosen civil discipline during the exam. This handbook and the standards listed on the exam specifications are the only reference material that can be used during the exam. You will not be allowed to bring personal copies of any material into the exam room. You can download a free electronic copy of the NCEES *PE Civil Reference Handbook* through your MyNCEES account. NCEES does not sell printed copies of the handbook. Design standards are available through the publisher, typically as both an electronic and printed copy.

The NCEES handbook and the design standards used on the exam are searchable pdf files with linked chapters for easy navigation. https://www.youtube.com/watch?v=oa-GthVuIx0

NCEES offers PE Civil practice exams to familiarize you with the exam format and content, including alternative item types (AITs). These practice exams contain questions that have been used on past exams and questions written just for study materials to give you extra practice. Learn more about NCEES exam prep materials (https://ncees.org/exams/exam-preparation-materials/).

To protect the integrity of its exams, NCEES limits the types of calculators examinees may bring to exam sites. The list of approved calculators is reviewed annually. Check NCEES website for a list of approved calculators (https://ncees.org/exams/calculator/).

Scoring and reporting

Computer-based exam results are typically available 7–10 days after you take the exam. You will receive an email notification from NCEES with instructions to view your results in your MyNCEES account.

Pass rates

PE pass rates are shown for the January–June or July–December population (updated in July and January, respectively). The pass rates below represent PE examinees who took the PE for the first time (updated June 2022).

Exam	Volume	Pass rate	Format	Availability
PE Civil: Construction	786	49%	CBT	Year-round
PE Civil: Geotechnical	388	49%	CBT	Year-round
PE Civil: Structural	1,233	54%	CBT	Year-round
PE Civil: Transportation	1,462	65%	CBT	Year-round
PE Civil: Water Resources and Environmental	1,380	64%	CBT	Year-round

Computer-based testing (CBT)

The PE-Civil CBT exam will be administered year-round. NCEES constructs these exams using a linear-on-the-fly (LOFT) algorithm. This means that all examinees for a particular exam are required to answer the same number of questions in the same topics; however, no examinees will have the same set of questions. The algorithm will assemble a unique exam within the same specification framework (i.e., the same number of questions per topic area) and the same relative level of difficulty.

CBT exams include traditional multiple-choice questions as well as alternative item types (AITs). AITs provide opportunities to assess the technical knowledge of examinees using methods not available through paper-based testing. AITs include but are not limited to the following:

- Multiple correct—allow examinees to select multiple answers
- Point and click—require examinees to click on part of a graphic to answer
- Drag and drop—require examinees to click on and drag items to match, sort, rank, or label
- Fill in the blank—provide a space for examinees to enter a response to the question

All questions, including AITs, are scored as either correct or incorrect. There is no partial credit

For more information, including YouTube videos demonstrating the Onscreen Line Tool and Alternative Item Types, please visit: https://ncees.org/exams/cbt/.

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NCEES Principles and Practice of Engineering Examination
CIVIL–CONSTRUCTION CBT Exam Specifications

Effective Beginning April 1, 2022

- The exam topics have not changed since April 2015 when they were originally published.
- The exam is computer-based. It is closed book with electronic references. Design standards applicable to the PE Civil–Construction exam are shown on the last page.
- Examinees have 9 hours to complete the exam, which contains 80 questions. The 9-hour time includes a tutorial and an optional scheduled break. Examinees work all questions.
- 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.
- The examples specified in knowledge areas are not exclusive or exhaustive.

	Number of Questions
1. Project Planning	**4–6**
A. Quantity take-off methods	
B. Cost estimating	
C. Project schedules	
D. Activity identification and sequencing	
2. Means and Methods	**3–5**
A. Construction loads	
B. Construction methods	
C. Temporary structures and facilities	
3. Soil Mechanics	**5–8**
A. Lateral earth pressure	
B. Soil consolidation	
C. Effective and total stresses	
D. Bearing capacity	
E. Foundation settlement	
F. Slope stability	
4. Structural Mechanics	**5–8**
A. Dead and live loads	
B. Trusses	
C. Bending (e.g., moments and stresses)	
D. Shear (e.g., forces and stresses)	
E. Axial (e.g., forces and stresses)	
F. Combined stresses	
G. Deflection	
H. Beams	
I. Columns	
J. Slabs	

K. Footings
L. Retaining walls

5. Hydraulics and Hydrology **6–9**
A. Open-channel flow
B. Stormwater collection and drainage (e.g., culvert, stormwater inlets, gutter flow, street flow, storm sewer pipes)
C. Storm characteristics (e.g., storm frequency, rainfall measurement and distribution)
D. Runoff analysis (e.g., Rational and SCS/NRCS methods, hydrographic application, runoff time of concentration)
E. Detention/retention ponds
F. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)
G. Energy and/or continuity equation (e.g., Bernoulli)

6. Geometrics **3–5**
A. Basic circular curve elements (e.g., middle ordinate, length, chord, radius)
B. Basic vertical curve elements
C. Traffic volume (e.g., vehicle mix, flow, and speed)

7. Materials **5–8**
A. Soil classification and boring log interpretation
B. Soil properties (e.g., strength, permeability, compressibility, phase relationships)
C. Concrete (e.g., nonreinforced, reinforced)
D. Structural steel
E. Material test methods and specification conformance
F. Compaction

8. Site Development **4–6**
A. Excavation and embankment (e.g., cut and fill)
B. Construction site layout and control
C. Temporary and permanent soil erosion and sediment control (e.g., construction erosion control and permits, sediment transport, channel/outlet protection)
D. Impact of construction on adjacent facilities
E. Safety (e.g., construction, roadside, work zone)

9. Earthwork Construction and Layout **5–8**
A. Excavation and embankment (e.g., cut and fill)
B. Borrow pit volumes
C. Site layout and control
D. Earthwork mass diagrams and haul distance
E. Site and subsurface investigations

10. Estimating Quantities and Costs **5–8**
A. Quantity take-off methods
B. Cost estimating
C. Cost analysis for resource selection
D. Work measurement and productivity

11. Construction Operations and Methods **6–9**

A. Lifting and rigging
B. Crane stability
C. Dewatering and pumping
D. Equipment operations (e.g., selection, production, economics)
E. Deep foundation installation

12. Scheduling **5–8**

A. Construction sequencing
B. Activity time analysis
C. Critical path method (CPM) network analysis
D. Resource scheduling and leveling
E. Time-cost trade-off

13. Material Quality Control and Production **5–8**

A. Material properties and testing (e.g., soils, concrete, asphalt)
B. Weld and bolt installation
C. Quality control process (QA/QC)
D. Concrete proportioning and placement
E. Concrete maturity and early strength evaluation

14. Temporary Structures **6–9**

A. Construction loads, codes, and standards
B. Formwork
C. Falsework and scaffolding
D. Shoring and reshoring
E. Bracing and anchorage for stability
F. Temporary support of excavation

15. Health and Safety **3–5**

A. OSHA regulations and hazard identification/abatement
B. Safety management and statistics
C. Work zone and public safety

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NCEES Principles and Practice of Engineering Examination
CONSTRUCTION Design Standards

Effective Beginning with the April 2022 Examinations

In addition to the *PE Civil Reference Handbook*, the following codes and standards will be supplied to examinees on exam day as a searchable, electronic pdf file with linked chapters for easy navigation. Solutions to exam questions that reference a standard of practice are scored based on this list and the revision year shown. Solutions based on other standards will not receive credit. NCEES does not sell printed copies of the handbook or design standards. Design standards are available through the publisher.

ABBREVIATION	DESIGN STANDARD TITLE
ACI 347R	*Guide to Formwork for Concrete,* 2014, American Concrete Institute, Farmington Hills, MI, www.concrete.org.
ACI SP-4	*Formwork for Concrete,* 8th ed., 2014, American Concrete Institute, Farmington Hills, MI, www.concrete.org.
AISC	*Steel Construction Manual,* 14th ed., 2011, American Institute of Steel Construction, Inc., Chicago, IL, www.aisc.org.
ASCE 37-14	*Design Loads on Structures During Construction*, 2nd ed., 2015, American Society of Civil Engineers, Reston, VA, www.asce.org.
CMWB	*Standard Practice for Bracing Masonry Walls Under Construction*, 2012, Council for Masonry Wall Bracing, Mason Contractors Association of America, Lombard, IL, www.masoncontractors.org.
MUTCD-Pt 6	*Manual on Uniform Traffic Control Devices for Streets and Highways — Part 6 Temporary Traffic Control,* 2009, including Revisions 1 and 2 dated May 2012, US Department of Transportation, Federal Highway Administration, Washington, DC, www.fhwa.dot.gov.
CFR TITLE 29	U.S. Department of Labor, Washington, D.C., July 2020.
Part 1903	Inspections, Citations, and Proposed Penalties
Part 1904	Recording and Reporting Occupational Injuries and Illnesses
Part 1926	Safety and Health Regulations for Construction
PCA EB001	*Design and Control of Concrete Mixtures*, 17th ed., 2021, Portland Cement Association, Skokie, IL, www.cement.org.

Reference categories for **Construction** depth module

- Construction surveying
- Construction estimating
- Construction planning and scheduling
- Construction equipment and methods
- Construction materials
- Construction design standards (see above)

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NCEES Principles and Practice of Engineering Examination
CIVIL–GEOTECHNICAL CBT Exam Specifications
Effective Beginning April 1, 2022

- The exam topics have not changed since April 2015 when they were originally published.
- The exam is computer-based. It is closed book with electronic references. Design standards applicable to the PE Civil–Geotechnical exam are shown on the last two pages.
- Examinees have 9 hours to complete the exam, which contains 80 questions. The 9-hour time includes a tutorial and an optional scheduled break. Examinees work all questions.
- 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.
- The examples specified in knowledge areas are not exclusive or exhaustive.

		Number of Questions
1.	**Project Planning**	**4–6**
	A. Quantity take-off methods	
	B. Cost estimating	
	C. Project schedules	
	D. Activity identification and sequencing	
2.	**Means and Methods**	**3–5**
	A. Construction loads	
	B. Construction methods	
	C. Temporary structures and facilities	
3.	**Soil Mechanics**	**5–8**
	A. Lateral earth pressure	
	B. Soil consolidation	
	C. Effective and total stresses	
	D. Bearing capacity	
	E. Foundation settlement	
	F. Slope stability	
4.	**Structural Mechanics**	**5–8**
	A. Dead and live loads	
	B. Trusses	
	C. Bending (e.g., moments and stresses)	
	D. Shear (e.g., forces and stresses)	
	E. Axial (e.g., forces and stresses)	
	F. Combined stresses	
	G. Deflection	
	H. Beam	
	I. Columns	
	J. Slabs	

K. Footings
L. Retaining walls

5. Hydraulics and Hydrology **6–9**

A. Open-channel flow
B. Stormwater collection and drainage (e.g., culvert, stormwater inlets, gutter flow, street flow, storm sewer pipes)
C. Storm characteristics (e.g., storm frequency, rainfall measurement and distribution)
D. Runoff analysis (e.g., Rational and SCS/NRCS methods, hydrographic application, runoff time of concentration)
E. Detention/retention ponds
F. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)
G. Energy and/or continuity equation (e.g., Bernoulli)

6. Geometrics **3–5**

A. Basic circular curve elements (e.g., middle ordinate, length, chord, radius)
B. Basic vertical curve elements
C. Traffic volume (e.g., vehicle mix, flow, and speed)

7. Materials **5–8**

A. Soil classification and boring log interpretation
B. Soil properties (e.g., strength, permeability, compressibility, phase relationships)
C. Concrete (e.g., nonreinforced, reinforced)
D. Structural steel
E. Material test methods and specification conformance
F. Compaction

8. Site Development **4–6**

A. Excavation and embankment (e.g., cut and fill)
B. Construction site layout and control
C. Temporary and permanent soil erosion and sediment control (e.g., construction erosion control and permits, sediment transport, channel/outlet protection)
D. Impact of construction on adjacent facilities
E. Safety (e.g., construction, roadside, work zone)

9. Site Characterization **4–6**

A. Interpretation of available existing site data and proposed site development data (e.g., aerial photography, geologic and topographic maps, GIS data, as-built plans, planning studies and reports)
B. Subsurface exploration planning
C. Geophysics (e.g., GPR, resistivity, seismic methods)
D. Drilling techniques (e.g., hollow stem auger, cased boring, mud rotary, air rotary, rock coring, sonic drilling)
E. Sampling techniques (e.g., split-barrel sampling, thin-walled tube sampling, handling and storage)
F. In situ testing (e.g., standard penetration testing, cone penetration testing, pressure meter testing, dilatometer testing, field vane shear)
G. Description and classification of soils (e.g., Burmeister, Unified Soil Classification System, AASHTO, USDA)
H. Rock classification and characterization (e.g., recovery, rock quality designation, RMR, weathering, orientation)
I. Groundwater exploration, sampling, and characterization

10. Soil Mechanics, Laboratory Testing, and Analysis **4–6**

A. Index properties and testing
B. Strength testing of soil and rock
C. Stress-strain testing of soil and rock
D. Permeability testing properties of soil and rock
E. Effective and total stresses

11. Field Materials Testing, Methods, and Safety **3–5**

A. Excavation and embankment, borrow source studies, laboratory and field compaction
B. Trench and construction safety
C. Geotechnical instrumentation (e.g., inclinometer, settlement plates, piezometer, vibration monitoring)

12. Earthquake Engineering and Dynamic Loads **2–4**

A. Liquefaction analysis and mitigation techniques
B. Seismic site characterization, including site classification using ASCE 7
C. Pseudo-static analysis and earthquake loads

13. Earth Structures **4–6**

A. Slab on grade
B. Ground improvement (e.g., grouting, soil mixing, preconsolidation/wicks, lightweight materials)
C. Geosynthetic applications (e.g., separation, strength, filtration, drainage, reinforced soil slopes, internal stability of MSE)
D. Slope stability and slope stabilization
E. Earth dams, levees, and embankments
F. Landfills and caps (e.g., interface stability, drainage systems, lining systems)
G. Pavement structures (rigid, flexible, or unpaved), including equivalent single-axle load (ESAL), pavement thickness, subgrade testing, subgrade preparation, maintenance and rehabilitation treatments
H. Settlement

14. Groundwater and Seepage **3–5**

A. Seepage analysis/groundwater flow
B. Dewatering design, methods, and impact on nearby structures
C. Drainage design/infiltration
D. Grouting and other methods of reducing seepage

15. Problematic Soil and Rock Conditions **3–5**

A. Karst; collapsible, expansive, and sensitive soils
B. Reactive/corrosive soils
C. Frost susceptibility

16. Earth Retaining Structures (ASD or LRFD) **4–6**

A. Lateral earth pressure
B. Load distribution
C. Rigid retaining wall stability analysis (e.g., CIP, gravity, external stability of MSE, crib, bin)
D. Flexible retaining wall stability analysis (e.g., soldier pile and lagging, sheet pile, secant pile, tangent pile, diaphragm walls, temporary support of excavation, braced and anchored walls)
E. Cofferdams

F. Underpinning (e.g., effects on adjacent construction)
G. Ground anchors, tie-backs, soil nails, and rock anchors for foundations and slopes

17. Shallow Foundations (ASD or LRFD) **4–6**

A. Bearing capacity
B. Settlement, including vertical stress distribution

18. Deep Foundations (ASD or LRFD) **4–6**

A. Single-element axial capacity (e.g., driven pile, drilled shaft, micropile, helical screw piles, auger cast piles)
B. Lateral load and deformation analysis
C. Single-element settlement
D. Downdrag
E. Group effects (e.g., axial capacity, settlement, lateral deflection)
F. Installation methods/hammer selection
G. Pile dynamics (e.g., wave equation, high-strain dynamic testing, signal matching)
H. Pile and drilled-shaft load testing
I. Integrity testing methods (e.g., low-strain impact integrity testing, ultrasonic cross-hole testing, coring, thermal integrity testing)

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NCEES Principles and Practice of Engineering Examination
GEOTECHNICAL Design Standards

Effective Beginning with the April 2022 Examinations

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ABBREVIATION	DESIGN STANDARD TITLE
ACI 360R-10	*Guide to Design of Slabs-on-Ground*, 2010, American Concrete Institute, Farmington Hills, MI, www.concrete.org.
ASCE 7-10	*Minimum Design Loads for Buildings and Other Structures,* 3rd printing, 2010, American Society of Civil Engineers, Reston, VA, www.asce.org.
EM 1110-2-1902	*USACE Engineering and Design: Slope Stability*, 2003, US Army Corp of Engineers, Washington D.C., www.publications.usace.army.mil.
FHWA NHI-05-037	*FHWA Geotechnical Aspects of Pavements*, 2006, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.
FHWA NHI-06-088	*FHWA Soils and Foundations Reference Manual – Volume I*, 2006, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.
FHWA NHI-06-089	*FHWA Soils and Foundations Reference Manual – Volume II*, 2006, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.
FHWA-NHI-11-032 GEC No. 3	*FHWA LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations Reference Manual*, 2011, Geotechnical Engineering Circulars, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.
FHWA NHI-16-009 GEC No. 12	*FHWA Design and Construction of Driven Pile Foundations – Volume I*, 2016, Geotechnical Engineering Circulars, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.
FHWA NHI-16-010 GEC No. 12	*FHWA Design and Construction of Driven Pile Foundations – Volume II*, 2016, Geotechnical Engineering Circulars, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.
FHWA NHI-16-072 GEC No. 5	*FHWA Geotechnical Site Characterization,* 2017, Geotechnical Engineering Circulars, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.

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FHWA NHI-18-024 **GEC No. 10**	*FHWA Drilled Shafts: Construction Procedures and Design Methods,* 2018, Geotechnical Engineering Circulars, US Department of Transportation, Federal Highway Administration, Washington, D.C., www.fhwa.dot.gov.
NAVFAC DM-7.02	*Foundations & Earth Structures, Design Manual 7.02*, 1986, US Army Corps of Engineers, Naval Facilities Engineering Command
CFR TITLE 29 **Part 1926**	U.S. Department of Labor, Washington, D.C., July 2020. Safety and Health Regulations for Construction • Subpart CC, Cranes and Derricks in Construction, Part 1926:1400–1926:1442 with Appendix A–Appendix C • Subpart E, Personal Protective and Life Saving Equipment, Part 1926.95–1926.107 • Subpart M, Fall Protection, 1926.500–1926.503 with Appendix A–Appendix E • Subpart P, Excavations, 1926.650–1926.652 with Appendix A–Appendix F
UFC 3-220-01	*Unified Facilities Criteria (UFC): Geotechnical Engineering*, 2012, US Army Corps of Engineers, Naval Facilities Engineering Command, Air Force Civil Engineer Center, Washington D.C.
UFC 3-220-05	*Unified Facilities Criteria (UFC): Dewatering and Groundwater Control*, 2004, US Army Corps of Engineers, Naval Facilities Engineering Command, Air Force Civil Engineer Center, Washington D.C.
UFC 3-220-10N	*Unified Facilities Criteria (UFC): Soil Mechanics*, 2005, US Army Corps of Engineers, Naval Facilities Engineering Command, Air Force Civil Engineer Center, Washington D.C.

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NCEES Principles and Practice of Engineering Examination
CIVIL–STRUCTURAL CBT Exam Specifications
Effective Beginning April 1, 2022

- The exam topics have not changed since April 2015 when they were originally published.
- The exam is computer-based. It is closed book with electronic references. Design standards applicable to the PE Civil–Structural exam are shown on the last two pages.
- Examinees have 9 hours to complete the exam, which contains 80 questions. The 9-hour time includes a tutorial and an optional scheduled break. Examinees work all questions.
- 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.
- The examples specified in knowledge areas are not exclusive or exhaustive.

		Number of Questions
1.	**Project Planning**	**4–6**
	A. Quantity take-off methods	
	B. Cost estimating	
	C. Project schedules	
	D. Activity identification and sequencing	
2.	**Means and Methods**	**3–5**
	A. Construction loads	
	B. Construction methods	
	C. Temporary structures and facilities	
3.	**Soil Mechanics**	**5–8**
	A. Lateral earth pressure	
	B. Soil consolidation	
	C. Effective and total stresses	
	D. Bearing capacity	
	E. Foundation settlement	
	F. Slope stability	
4.	**Structural Mechanics**	**5–8**
	A. Dead and live loads	
	B. Trusses	
	C. Bending (e.g., moments and stresses)	
	D. Shear (e.g., forces and stresses)	
	E. Axial (e.g., forces and stresses)	
	F. Combined stresses	
	G. Deflection	
	H. Beams	
	I. Columns	
	J. Slabs	

K. Footings
L. Retaining walls

5. Hydraulics and Hydrology **6–9**

A. Open-channel flow
B. Stormwater collection and drainage (e.g., culvert, stormwater inlets, gutter flow, street flow, storm sewer pipes)
C. Storm characteristics (e.g., storm frequency, rainfall measurement and distribution)
D. Runoff analysis (e.g., Rational and SCS/NRCS methods, hydrographic application, runoff time of concentration)
E. Detention/retention ponds
F. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)
G. Energy and/or continuity equation (e.g., Bernoulli)

6. Geometrics **3–5**

A. Basic circular curve elements (e.g., middle ordinate, length, chord, radius)
B. Basic vertical curve elements
C. Traffic volume (e.g., vehicle mix, flow, and speed)

7. Materials **5–8**

A. Soil classification and boring log interpretation
B. Soil properties (e.g., strength, permeability, compressibility, phase relationships)
C. Concrete (e.g., nonreinforced, reinforced)
D. Structural steel
E. Material test methods and specification conformance
F. Compaction

8. Site Development **4–6**

A. Excavation and embankment (e.g., cut and fill)
B. Construction site layout and control
C. Temporary and permanent soil erosion and sediment control (e.g., construction erosion control and permits, sediment transport, channel/outlet protection)
D. Impact of construction on adjacent facilities
E. Safety (e.g., construction, roadside, work zone)

9. Analysis of Structures **13–20**

A. Loads and load applications 4–6
   1. Dead loads
   2. Live loads
   3. Construction loads
   4. Wind loads
   5. Seismic loads
   6. Moving loads (e.g., vehicular, cranes)
   7. Snow, rain, ice
   8. Impact loads
   9. Earth pressure and surcharge loads
   10. Load paths (e.g., lateral and vertical)
   11. Load combinations
   12. Tributary areas

B. Forces and load effects 9–14
   1. Diagrams (e.g., shear and moment)
   2. Axial (e.g., tension and compression)
   3. Shear
   4. Flexure
   5. Deflection
   6. Special topics (e.g., torsion, buckling, fatigue, progressive collapse, thermal deformation, bearing)

10. Design and Details of Structures 16–24

A. Materials and material properties 4–6
   1. Concrete (e.g., plain, reinforced, cast-in-place, precast, pre-tensioned, post-tensioned)
   2. Steel (e.g., structural, reinforcing, cold-formed)
   3. Timber
   4. Masonry (e.g., brick veneer, CMU)

B. Component design and detailing 12–18
   1. Horizontal members (e.g., beams, slabs, diaphragms)
   2. Vertical members (e.g., columns, bearing walls, shear walls)
   3. Systems (e.g., trusses, braces, frames, composite construction)
   4. Connections (e.g., bearing, bolted, welded, embedded, anchored)
   5. Foundations (e.g., retaining walls, footings, combined footings, slabs, mats, piers, piles, caissons, drilled shafts)

11. Codes and Construction 6–10

A. Codes, standards, and guidance documents 4–6
   1. International Building Code (IBC)
   2. American Concrete Institute (ACI 318, 530)
   3. Precast/Prestressed Concrete Institute (PCI Design Handbook)
   4. Steel Construction Manual (AISC)
   5. National Design Specification for Wood Construction (NDS)
   6. LRFD Bridge Design Specifications (AASHTO)
   7. Minimum Design Loads for Buildings and Other Structures (ASCE 7)
   8. American Welding Society (AWS D1.1, D1.2, and D1.4)
   9. OSHA 1910 General Industry and OSHA 1926 Construction Safety Standards

B. Temporary structures and other topics 2–4
   1. Special inspections
   2. Submittals
   3. Formwork
   4. Falsework and scaffolding
   5. Shoring and reshoring
   6. Concrete maturity and early strength evaluation
   7. Bracing
   8. Anchorage
   9. OSHA regulations
   10. Safety management

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CIVIL–STRUCTURAL Design Standards
Effective Beginning with the April 2022 Examinations

In addition to the *PE Civil Reference Handbook*, the following codes and standards will be supplied to examinees on exam day as searchable, electronic pdf file with linked chapters for easy navigation. Solutions to exam questions that reference a standard of practice are scored based on this list and the revision year shown. Solutions based on other standards will not receive credit. All questions use the US Customary System (USCS) of units. NCEES does not sell printed copies of the handbook or design standards. Design standards are available through the publisher.

ABBREVIATION	DESIGN STANDARD TITLE
AASHTO	*AASHTO LRFD Bridge Design Specifications,* 7th edition, 2014, with 2016 Interim Revisions, American Association of State Highway & Transportation Officials, Washington, DC., www.transportation.org.
IBC	*International Building Code,* 2015 edition (without supplements), International Code Council, Falls Church, VA, www.iccsafe.org.
ACI 318	*Building Code Requirements for Structural Concrete and Commentary*, 2014, American Concrete Institute, Farmington Hills, MI, www.concrete.org.
AISC	*Steel Construction Manual,* 14th edition, 2011, American Institute of Steel Construction, Inc., Chicago, IL, www.aisc.org.
ASCE 7	*Minimum Design Loads for Buildings and Other Structures,* 3rd printing, 2010, American Society of Civil Engineers, Reston, VA, www.asce.org.
AWC NDS[1]	2015 Wood Design Package, 2015, American Wood Council, Leesburg, VA, www.awc.org. • *National Design Specification for Wood Construction with Commentary* • *National Design Specification Supplement, Design Values for Wood Construction* • *Special Design Provisions for Wind and Seismic with Commentary*
CFR TITLE 29 **Part 1910**	U.S. Department of Labor, Washington, D.C., July 2020. Occupational Safety and Health Standards • Subpart I, Personal Fall Protection Systems, 1910.140 • Subpart D, Walking-Working Surfaces, 1910.28–1910.30 • Subpart F, Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms, 1910.66–1910.68, with Appendix A–Appendix D to 1910.66
Part 1926	Safety and Health Regulations for Construction. • Subpart E, Personal Protective and Life Saving Equipment, 1926.104 • Subpart L, Scaffolding Specifications, Appendix A • Subpart M, Fall Protection, 1926.500–1926.503, Appendix B–Appendix D • Subpart Q, Concrete and Masonry Construction, 1926.703–1926.706, with Appendix A • Subpart R, Steel Erection, 1926.752 & 1926.754–1926.758

PCI	*PCI Design Handbook: Precast and Prestressed Concrete,* 7th edition, 2010, Precast/Prestressed Concrete Institute, Chicago, IL, www.pci.org.
TMS 402/602[2]	*Building Code Requirements and Specification for Masonry Structures* (and companion commentaries), 2013, The Masonry Society, Longmont, CO, www.masonrysociety.org.

Notes

1. Examinees will use only the Allowable Stress Design (ASD) method for wood design.
2. Formerly also called ACI 530. Examinees will use only the ASD method, except strength design Section 9.3.5 may be used for walls with out-of-plane loads.

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NCEES Principles and Practice of Engineering Examination
CIVIL–TRANSPORTATION CBT Exam Specifications

Effective Beginning April 1, 2022

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- The exam is computer-based. It is closed book with electronic references. Design standards applicable to the PE Civil–Transportation exam are shown on the last page.
- Examinees have 9 hours to complete the exam, which contains 80 questions. The 9-hour time includes a tutorial and an optional scheduled break. Examinees work all questions.
- 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.
- The examples specified in knowledge areas are not exclusive or exhaustive.

	Number of Questions
1. Project Planning	**4–6**
A. Quantity take-off methods	
B. Cost estimating	
C. Project schedules	
D. Activity identification and sequencing	
2. Means and Methods	**3–5**
A. Construction loads	
B. Construction methods	
C. Temporary structures and facilities	
3. Soil Mechanics	**5–8**
A. Lateral earth pressure	
B. Soil consolidation	
C. Effective and total stresses	
D. Bearing capacity	
E. Foundation settlement	
F. Slope stability	
4. Structural Mechanics	**5–8**
A. Dead and live loads	
B. Trusses	
C. Bending (e.g., moments and stresses)	
D. Shear (e.g., forces and stresses)	
E. Axial (e.g., forces and stresses)	
F. Combined stresses	
G. Deflection	
H. Beams	
I. Columns	
J. Slabs	

K. Footings
L. Retaining walls

5. Hydraulics and Hydrology **6–9**

A. Open-channel flow
B. Stormwater collection and drainage (e.g., culvert, stormwater inlets, gutter flow, street flow, storm sewer pipes)
C. Storm characteristics (e.g., storm frequency, rainfall measurement and distribution)
D. Runoff analysis (e.g., Rational and SCS/NRCS methods, hydrographic application, runoff time of concentration)
E. Detention/retention ponds
F. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)
G. Energy and/or continuity equation (e.g., Bernoulli)

6. Geometrics **3–5**

A. Basic circular curve elements (e.g., middle ordinate, length, chord, radius)
B. Basic vertical curve elements
C. Traffic volume (e.g., vehicle mix, flow, and speed)

7. Materials **5–8**

A. Soil classification and boring log interpretation
B. Soil properties (e.g., strength, permeability, compressibility, phase relationships)
C. Concrete (e.g., nonreinforced, reinforced)
D. Structural steel
E. Material test methods and specification conformance
F. Compaction

8. Site Development **4–6**

A. Excavation and embankment (e.g., cut and fill)
B. Construction site layout and control
C. Temporary and permanent soil erosion and sediment control (e.g., construction erosion control and permits, sediment transport, channel/outlet protection)
D. Impact of construction on adjacent facilities
E. Safety (e.g., construction, roadside, work zone)

9. Traffic Engineering (Capacity Analysis and Transportation Planning) **10–15**

A. Uninterrupted flow (e.g., level of service, capacity)
B. Street segment interrupted flow (e.g., level of service, running time, travel speed)
C. Intersection capacity (e.g., at grade, signalized, roundabout, interchange)
D. Traffic analysis (e.g., volume studies, peak hour factor, speed studies, modal split)
E. Trip generation and traffic impact studies
F. Accident analysis (e.g., conflict analysis, accident rates, collision diagrams)
G. Nonmotorized facilities (e.g., pedestrian, bicycle)
H. Traffic forecast
I. Highway safety analysis (e.g., crash modification factors, *Highway Safety Manual*)

10. Horizontal Design **3–5**

A. Basic curve elements (e.g., middle ordinate, length, chord, radius)
B. Sight distance considerations
C. Superelevation (e.g., rate, transitions, method, components)
D. Special horizontal curves (e.g., compound/reverse curves, curve widening, coordination with vertical geometry)

11. Vertical Design **3–5**

A. Vertical curve geometry
B. Stopping and passing sight distance (e.g., crest curve, sag curve)
C. Vertical clearance

12. Intersection Geometry **3–5**

A. Intersection sight distance
B. Interchanges (e.g., freeway merge, entrance and exit design, horizontal design, vertical design)
C. At-grade intersection layout, including roundabouts

13. Roadside and Cross-Section Design **3–5**

A. Forgiving roadside concepts (e.g., clear zone, recoverable slopes, roadside obstacles)
B. Barrier design (e.g., barrier types, end treatments, crash cushions)
C. Cross-section elements (e.g., lane widths, shoulders, bike lane, sidewalks)
D. Americans with Disabilities Act (ADA) design considerations

14. Signal Design **3–5**

A. Signal timing (e.g., clearance intervals, phasing, pedestrian crossing timing, railroad preemption)
B. Signal warrants

15. Traffic Control Design **3–5**

A. Signs and pavement markings
B. Temporary traffic control

16. Geotechnical and Pavement **4–6**

A. Sampling and testing (e.g., subgrade resilient modulus, CBR, R-Values, field tests)
B. Soil stabilization techniques, settlement and compaction, excavation, embankment, and mass balance
C. Design traffic analysis and pavement design procedures (e.g., flexible and rigid pavement)
D. Pavement evaluation and maintenance measures (e.g., skid, roughness, rehabilitation treatments)

17. Drainage **2–4**

A. Hydrology (e.g., Rational method, hydrographs, SCS/NRCS method), including runoff detention/retention/water quality mitigation measures
B. Hydraulics, including culvert and stormwater collection system design (e.g., inlet capacities, pipe flow, hydraulic energy dissipation), and open-channel flow

18. Alternatives Analysis **1–3**

A. Economic analysis (e.g., present worth, lifecycle costs)

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ABBREVIATION	DESIGN STANDARD TITLE
AASHTO GDHS-7	*A Policy on Geometric Design of Highways and Streets,* 7th edition, 2018 (including October 2019 errata), American Association of State Highway & Transportation Officials, Washington, DC, www.transportation.org.
AASHTO GDPS-4-M	*Guide for Design of Pavement Structures*, 4th edition, 1993 with 1998 supplement, American Association of State Highway & Transportation Officials, Washington, DC, www.transportation.org.
AASHTO GPF-1	*Guide for the Planning, Design, and Operation of Pedestrian Facilities,* 1st edition, 2004, American Association of State Highway & Transportation Officials, Washington, DC, www.transportation.org.
AASHTO HSM-1	*Highway Safety Manual,* 1st edition, 2010, with 2014 Supplement (including September 2010, February 2012, and March 2016 errata), American Association of State Highway & Transportation Officials, Washington, DC, www.transportation.org.
AASHTO MEPDG-2	*Mechanistic-Empirical Pavement Design Guide: A Manual of Practice,* 2nd edition, August 2015, American Association of State Highway & Transportation Officials, Washington, DC, www.transportation.org.
AASHTO RSDG-4	*Roadside Design Guide,* 4th edition, 2011 (including February 2012 and July 2015 errata), American Association of State Highway & Transportation Officials, Washington, DC, www.transportation.org.
FHWA HIF-12-026	*Hydraulic Design of Highway Culverts,* Hydraulic Design Series Number 5, 3rd edition, April 2012, U.S. Department of Transportation, Federal Highway Administration, Washington, DC, www.fhwa.dot.gov.
HCM	*Highway Capacity Manual*, 6th edition, 2016, Transportation Research Board, National Research Council, Washington, DC, www.mytrb.org.
MUTCD	*Manual on Uniform Traffic Control Devices for Streets and Highways,* 2009, including Revisions 1 and 2 dated May 2012, U.S. Department of Transportation, Federal Highway Administration, Washington, DC, www.mutcd.fhwa.dot.gov.

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NCEES Principles and Practice of Engineering Examination
CIVIL–WATER RESOURCES AND ENVIRONMENTAL CBT Exam Specifications
Effective Beginning April 1, 2022

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- The exam is computer-based. It is closed book with electronic references. Design standards applicable to the PE Civil–Water Resources and Environmental exam are shown on the last page.
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- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.
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E. Foundation settlement	
F. Slope stability	
4. Structural Mechanics	**5–8**
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C. Bending (e.g., moments and stresses)	
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K. Footings
L. Retaining walls

5. Hydraulics and Hydrology **6–9**
A. Open-channel flow
B. Stormwater collection and drainage (e.g., culvert, stormwater inlets, gutter flow, street flow, storm sewer pipes)
C. Storm characteristics (e.g., storm frequency, rainfall measurement and distribution)
D. Runoff analysis (e.g., Rational and SCS/NRCS methods, hydrographic application, runoff time of concentration)
E. Detention/retention ponds
F. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)
G. Energy and/or continuity equation (e.g., Bernoulli)

6. Geometrics **3–5**
A. Basic circular curve elements (e.g., middle ordinate, length, chord, radius)
B. Basic vertical curve elements
C. Traffic volume (e.g., vehicle mix, flow, and speed)

7. Materials **5–8**
A. Soil classification and boring log interpretation
B. Soil properties (e.g., strength, permeability, compressibility, phase relationships)
C. Concrete (e.g., nonreinforced, reinforced)
D. Structural steel
E. Material test methods and specification conformance
F. Compaction

8. Site Development **4–6**
A. Excavation and embankment (e.g., cut and fill)
B. Construction site layout and control
C. Temporary and permanent soil erosion and sediment control (e.g., construction erosion control and permits, sediment transport, channel/outlet protection)
D. Impact of construction on adjacent facilities
E. Safety (e.g., construction, roadside, work zone)

9. Analysis and Design **4–6**
A. Mass balance
B. Hydraulic loading
C. Solids loading (e.g., sediment loading, sludge)
D. Hydraulic flow measurement

10. Hydraulics–Closed Conduit **4–6**
A. Energy and/or continuity equation (e.g., Bernoulli, momentum equation)
B. Pressure conduit (e.g., single pipe, force mains, Hazen-Williams, Darcy-Weisbach, major and minor losses)
C. Pump application and analysis, including wet wells, lift stations, and cavitation
D. Pipe network analysis (e.g., series, parallel, and loop networks)

11. Hydraulics–Open Channel **4–6**

A. Open-channel flow
B. Hydraulic energy dissipation
C. Stormwater collection and drainage (e.g., culvert, stormwater inlets, gutter flow, street flow, storm sewer pipes)
D. Sub- and supercritical flow

12. Hydrology **6–9**

A. Storm characteristics (e.g., storm frequency, rainfall measurement, and distribution)
B. Runoff analysis (e.g., Rational and SCS/NRCS methods)
C. Hydrograph development and applications, including synthetic hydrographs
D. Rainfall intensity, duration, and frequency
E. Time of concentration
F. Rainfall and stream gauging stations
G. Depletions (e.g., evaporation, detention, percolation, and diversions)
H. Stormwater management (e.g., detention ponds, retention ponds, infiltration systems, and swales)

13. Groundwater and Wells **3–5**

A. Aquifers
B. Groundwater flow
C. Well analysis–steady state

14. Wastewater Collection and Treatment **5–8**

A. Wastewater collection systems (e.g., lift stations, sewer networks, infiltration, inflow, smoke testing, maintenance, and odor control)
B. Wastewater treatment processes
C. Wastewater flow rates
D. Preliminary treatment
E. Primary treatment
F. Secondary treatment (e.g., physical, chemical, and biological processes)
G. Nitrification/denitrification
H. Phosphorus removal
I. Solids treatment, handling, and disposal
J. Digestion
K. Disinfection
L. Advanced treatment (e.g., physical, chemical, and biological processes)

15. Water Quality **3–5**

A. Stream degradation
B. Oxygen dynamics
C. Total maximum daily load (TMDL) (e.g., nutrient contamination, DO, load allocation)
D. Biological contaminants
E. Chemical contaminants, including bioaccumulation

16. Drinking Water Distribution and Treatment **5–8**

A. Drinking water distribution systems
B. Drinking water treatment processes
C. Demands
D. Storage
E. Sedimentation
F. Taste and odor control
G. Rapid mixing (e.g., coagulation)
H. Flocculation
I. Filtration
J. Disinfection, including disinfection byproducts
K. Hardness and softening

17. Engineering Economics Analysis **1–3**

A. Economic analysis (e.g., present worth, lifecycle costs, comparison of alternatives)

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WATER RESOURCES AND ENVIRONMENTAL Design Standards
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ABBREVIATION	DESIGN STANDARD TITLE
TSS 2014	*Recommended Standards for Wastewater Facilities*, 2014, Great Lakes—Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.
WATER 2018	*Recommended Standards for Water Works*, 2018, Great Lakes—Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.