Vertical Forces (Gravity/Other) and Incidental Lateral Component of the Structural Engineering BREADTH Exam Specifications

Effective Beginning with the April 2018 Examinations

- The 4-hour Vertical Forces (Gravity/Other) and Incidental Lateral breadth examination is offered on Friday morning and focuses on gravity loads. It contains 40 multiple-choice questions.

- The exam uses the US Customary System (USCS) of units.

- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.

- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.

- Score results are combined with depth exam results for final score of this component.

I. Analysis of Structures 13
   A. Generation of Loads 5
      1. Dead
      2. Live (e.g., occupancy, roof, pedestrian)
      3. Moving (e.g., vehicular, crane)
      4. Impact (e.g., vehicular, crane, elevator)
      5. Vessel collision
      6. Earth pressure
      7. Differential settlement
      8. Hydrostatic/hydrodynamic
      9. Flood
      10. Snow
      11. Rain (i.e., ponding)
      12. Ice
      13. Thermal
      14. Shrinkage
      15. Load combinations
      16. Wind and other loads on bridges
   B. Load Distribution and Analysis Methods 8
      1. Static (e.g., determinate and indeterminate, location of forces and moments, free-body diagrams)
      2. Shear and moment diagrams
      3. Code coefficients and tables
      4. Truss analysis methods (i.e., method of sections and/or method of joints)
      5. Approximate beam or truss analysis methods
      6. Approximate frame analysis methods
7. Influence lines  
8. Computer-generated structural analysis techniques (e.g., modeling, interpreting and verifying results)

## II. Design and Details of Structures

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7. Prestressed concrete
8. Post-tensioned concrete
9. Composite design
10. Attachment of elements and anchorage to concrete (e.g., inserts, attachment plates, dowels)
11. Crack control

F. Wood
1. Beams (i.e., sawn, glued laminated, structural composite/engineered)
2. Columns
3. Bearing walls
4. Trusses
5. Connections (e.g., bolted, nailed, screwed)

G. Masonry
1. Flexural members
2. Compression members
3. Flexural-compression members
4. Bearing walls
5. Attachment of elements to masonry

H. Foundations and Retaining Structures
1. Use of design pressure coefficients (e.g., active, passive, at rest, bearing, coefficient of friction, cohesion, modulus of sub-grade reaction)
2. Buoyancy effects
3. Retaining walls and abutments
4. Spread footings
5. Combined footings/mat foundations
6. Piles (e.g., concrete, steel, timber)
7. Drilled shafts/drilled piers/caissons
8. Restrained walls (e.g., basement, vault)
Vertical Forces (Gravity/Other) and Incidental Lateral Component of the Structural Engineering DEPTH Exam Specifications

Effective Beginning with the April 2018 Examination

The 4-hour Vertical Forces (Gravity/Other) and Incidental Lateral depth examination is offered on Friday afternoon. The depth modules of the Structural Engineering exam focus on a single area of practice in structural engineering. Examinees must choose either the BUILDINGS or the BRIDGES module. Examinees must work the same module on both components. That is, if bridges is the module chosen in the Vertical Forces component, then bridges must be the module chosen in the Lateral Forces component. All questions are constructed response (essay).

The exam uses the US Customary System (USCS) of units.

BUILDINGS
The Vertical Forces (Gravity/Other) and Incidental Lateral Structural Engineering depth exam in BUILDINGS covers loads, lateral earth pressures, analysis methods, general structural considerations (element design), structural systems integration (connections), and foundations and retaining structures. This 4-hour module contains one problem from each of the following areas:

- Steel structure
- Concrete structure
- Wood structure
- Masonry structure

All problems are equally weighted. At least one problem includes a multistory building, and at least one problem includes a foundation.

BRIDGES
The Vertical Forces (Gravity/Other) and Incidental Lateral Structural Engineering depth exam in BRIDGES covers gravity loads, superstructures, substructures, and lateral loads other than wind and seismic. This 4-hour module contains three problems, one from each of the following areas:

- Concrete superstructure (25% of your score)
- Other elements of bridges (e.g., culverts, abutments, retaining walls) (25% of your score)
- Steel superstructure (50% of your score)
Lateral Forces (Wind/Earthquake) Component of the Structural Engineering BREADTH Exam Specifications
Effective Beginning with the April 2018 Examination

- The 4-hour Lateral Forces (Wind/Earthquake) breadth examination is offered on Saturday morning and focuses on wind/earthquake loads. It contains 40 multiple-choice questions.
- The exam uses the US Customary System (USCS) of units.
- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.
- Score results are combined with depth exam results for final score of this component.

I. Analysis of Structures

A. Generation of Loads
   1. Horizontal seismic
   2. Vertical seismic
   3. Dynamic seismic lateral earth pressure
   4. Wind loads on buildings—MWFRS (directional procedure)
   5. Wind loads on buildings—MWFRS (envelope procedure)
   6. Wind loads on other structures and building appurtenances—MWFRS
   7. Wind loads—components and cladding (C&C)
   8. Wind loads on bridges
   9. Load combinations

B. Load Distribution and Analysis Methods
   1. Statics (e.g., determinate and indeterminate, location of forces and moments, free-body diagrams)
   2. Approximate frame analysis methods
   3. Computer-generated structural analysis techniques (e.g., modeling, interpreting, and verifying results)
   4. Seismic static force procedures
   5. Seismic dynamic force procedures
   6. Seismic irregularities (e.g., horizontal and vertical)
   7. Horizontal torsional moments
   8. Relative rigidity force distribution
   9. Flexible diaphragms
   10. Rigid diaphragms
   11. Wind load distribution
II. Design and Details of Structures

A. General Structural Considerations
   1. Construction administration (procedures for correcting nonconforming work, testing methods, inspection methods, structural observation)
   2. Serviceability requirements (i.e., deflection, building drift)
   3. Anchorage of a structural system to resist uplift and sliding forces
   4. Components, attachments, and cladding
   5. Seismic coefficients (e.g., response modification factor, redundancy factor, overstrength factor, deflection amplification factor)
   6. Abutment/pier seat width

B. Structural Systems Integration
   1. General structural systems selection based on design criteria (e.g., height limits, foundation considerations)
   2. Specifications, quality controls, and coordination with other disciplines
   3. Constructability
   4. Strengthening existing systems (e.g., details, system compatibility, reinforcing methods)

C. Structural Steel
   1. Braced frames
   2. Moment resisting frames
   3. Dual systems
   4. Cantilever columns
   5. Bridge piers
   6. Bridge bracing elements

D. Cold-Formed Steel
   1. Steel diaphragms
   2. Bearing wall systems (e.g., shear wall systems, flat strap bracing)

E. Concrete
   1. Shear walls
   2. Moment resisting frames
   3. Diaphragms
   4. Bridge piers/abutments
   5. Bridge reinforcement details (e.g., ductile detailing, anchorage)

F. Wood
   1. Diaphragms (e.g., drag struts, chords)
   2. Sub-diaphragms
   3. Shear walls

G. Masonry
   1. Out-of-plane (i.e., slender walls)
   2. Shear walls
   3. Anchorage of walls (e.g., out-of-plane, uplift)
   4. Attachment of elements to masonry

H. Foundations and Retaining Structures
   1. Retaining walls and abutments
   2. Spread footings
   3. Piles (e.g., concrete, steel, timber)
   4. Drilled shafts/drilled piers/caissons
Lateral Forces (Wind/Earthquake) Component of the Structural Engineering DEPTH Exam Specifications

Effective Beginning with the April 2018 Examination

The 4-hour Lateral Forces (Wind/Earthquake) depth examination is offered on Saturday afternoon. The depth modules of the Structural Engineering exam focus on a single area of practice in structural engineering. Examinees must choose either the BUILDINGS or the BRIDGES module. Examinees must work the same module on both components. That is, if bridges is the module chosen in the Vertical Forces component, then bridges must be the module chosen in the Lateral Forces component. All questions are constructed response (essay).

The exam uses the US Customary System (USCS) of units.

BUILDINGS
The Lateral Forces (Wind/Earthquake) Structural Engineering depth exam in BUILDINGS covers lateral forces, lateral force distribution, analysis methods, general structural considerations (element design), structural systems integration (connections), and foundations and retaining structures. This 4-hour module contains one problem from each of the following areas:

- Steel structure
- Concrete structure
- Wood and/or masonry structure
- General analysis (e.g., existing structures, secondary structures, nonbuilding structures, and/or computer verification)

All problems are equally weighted.

At least two problems include seismic content at Seismic Design Category D and above.
At least one problem includes wind content of at least 140 mph.
Problems may include a multistory building.
Problems may include a foundation.

BRIDGES
The Lateral Forces (Wind/Earthquake) Structural Engineering depth exam in BRIDGES covers gravity loads, superstructures, substructures, and lateral forces (including seismic). This 4-hour module contains three problems, one from each of the following areas:

- Piers or abutments (25% of your score)
- Foundations (25% of your score)
- General analysis of seismic forces (50% of your score)