Introduction

ABOUT THIS BOOK

This book contains a complete 16-hour practice exam for the Structural Engineering (SE) exam in buildings, including both vertical and lateral exam components. A morning breadth module, covering buildings and bridges topics, is included for each component. This book also contains an afternoon depth module covering buildings topics only. Topics covered reflect the exam specifications identified by the National Council of Examiners for Engineering and Surveying (NCEES) for each component. (See Table 1.)

For the morning breadth modules, problems are written in the same multiple-choice format and level of difficulty as on the SE exam. Problems take an average of six minutes to solve. Breadth problems are scored based solely on the option selected (rather than on the documented solution method, as depth problems are scored). The problems are written to avoid ambiguity and don’t require you to make any simplifying assumptions. Problems may be either qualitative or quantitative. Quantitative problems present an introductory statement, followed by a list of required design codes and additional design data. Illustrations showing structural details, dimensions, and loading information are also included. This book provides blank answer sheets for you to record your answers (as you would on the actual exam). A step-by-step solution is included for each breadth problem, so that you can review your work and correct any errors.

For the afternoon depth modules, problems are similar to the morning breadth quantitative problems in that they present an introductory statement, followed by a list of required design codes and additional design data. However, the depth problems aren’t multiple-choice; instead, they require you to write essay responses and show your calculations. Like the depth problems on the exam, the depth problems in this book are less straightforward than the multiple-choice problems, sometimes require you to make assumptions, and always require you to show all of your work to receive full credit. (The components of the depth solutions that you would be required to show to receive full credit are presented in blue in this book, and supporting text is black.) You have an average of one hour to solve each of the exam’s depth problems. Because you must record all your calculations in the exam-provided solution booklet to receive full credit, you may want to use graph paper to record your answers for the problems in the depth modules of this book. Depth problems in this book contain three to five subparts, as on the exam. For problems containing subparts, the various parts are referenced as “part 1(a),” “part 1(b),” and so forth, where “1” is the problem number and “(a)” or “(b)” denotes the subpart. Problem subparts are distinguished from solution subparts by the word “problem” (e.g., problem part 1(a)). Occasionally, there may be other acceptable solutions beyond what is presented in this book, and these will be noted in the solution text.

Depth problems and solutions include illustrations that depict structural details, dimensions, and loading information. When multiple illustrations are provided, they are identified by Roman numerals. In problems, these illustrations are referred to as “illustration I,” “illustration II,” and so forth. These illustrations are referenced in solutions, they are referred to as “problem illustration I,” “problem illustration II,” and so forth. Sometimes, a section is cut or a detail is magnified and shown in a subsequent illustration. When this is the case, the illustration uses an arrow to indicate the location of the subsequent illustration, along with text stating “illustration I,” “illustration II,” and so forth.

A step-by-step solution is provided for each problem. Some solutions include more than one solving method so you can see alternative solution approaches. The text, calculations, and illustrations in the depth solutions are color-coded to indicate which elements must be recorded in your examination booklet to receive full credit on the depth exams. All items appearing in blue are required elements of a complete solution. Items in black are explanatory and included in this book to illustrate the complete solution approach and to increase your exposure to exam-adopted codes. All final answers are presented in boxes for clarity.

When codes are referenced in either the breadth or the depth modules, they are generally referenced by abbreviation. Abbreviations are identified in the “Codes and References” section of this book, preceding their full title.

The nomenclature section lists the variables, symbols, and subscripts used in this book. Whenever possible, variables match those used in a specific code. The use of code-based variables may result in different problems using different variables to represent the same engineering term (e.g., height may be represented as either $h$ or $H$). When this book’s application of a variable differs from the code, a note identifies the difference.
### Table 1 NCEES Structural Engineering (SE) Exam Component Module Specifications

| Friday: vertical forces (gravity/other) and incidental lateral forces component |
|-----------------------------------|-----------------------------------------------|
| **Module Specifications**         |                                               |
| morning breadth module           | analysis of structures (32.5%)                |
| 4 hours                           | generation of loads (10%)                    |
| 40 multiple-choice problems       | load distribution and analysis methods (20%)  |
|                                   | design and details of structures (67.5%)      |
|                                   | general structural considerations (7.5%)      |
|                                   | structural systems integration (5%)           |
|                                   | structural steel (12.5%)                     |
|                                   | cold-formed steel (2.5%)                     |
|                                   | concrete (12.5%)                             |
|                                   | wood (10%)                                   |
|                                   | masonry (7.5%)                               |
|                                   | foundations and retaining structures (10%)    |
| afternoon depth module
| 4 hours                           | steel structure (1-hour problem)              |
| essay problems                    | concrete structure (1-hour problem)           |
|                                   | wood structure (1-hour problem)               |
|                                   | masonry structure (1-hour problem)            |
| bridges                           | concrete superstructure (1-hour problem)      |
|                                   | other elements of bridges (e.g., culverts, abutments, and retaining walls) (1-hour problem) |
|                                   | steel superstructure (2-hour problem)         |
| Saturday: lateral forces (wind/earthquake) component |
| morning breadth module           | analysis of structures (37.5%)                |
| 4 hours                           | generation of loads (17.5%)                   |
| 40 multiple-choice problems       | load distribution and analysis methods (20%)  |
|                                   | design and details of structures (62.5%)      |
|                                   | general structural considerations (7.5%)      |
|                                   | structural systems integration (5%)           |
|                                   | structural steel (12.5%)                     |
|                                   | cold-formed steel (2.5%)                     |
|                                   | concrete (12.5%)                             |
|                                   | wood (7.5%)                                  |
|                                   | masonry (7.5%)                               |
|                                   | foundations and retaining structures (7.5%)   |
| afternoon depth module
| 4 hours                           | steel structure (1-hour problem)              |
| essay problems                    | concrete structure (1-hour problem)           |
|                                   | wood and/or masonry structure (1-hour problem) |
|                                   | general analysis (e.g., existing structures, secondary structures, nonbuilding structures, and/or computer verification) (1-hour problem) |
| bridges                           | piers or abutments (1-hour problem)           |
|                                   | foundations (1-hour problem)                  |
|                                   | general analysis of seismic structures (e.g., seismic and/or wind) (3-hour problem) |

*Afternoon sessions focus on a single area of practice. You must choose either the buildings or bridges depth module, and you must work the same depth module across both exam components.

*At least one problem will contain a multistory building, and at least one problem will contain a foundation.

*At least two problems will include seismic content with a seismic design category of D and above. At least one problem will include wind content with a base wind speed of at least 110 mph. Problems may include a multistory building and/or foundation.
Most steel problems in this book (and on the SE exam) can be solved using either allowable stress/strength design (ASD) or load and resistance factor design (LRFD), so solutions for both methods are presented. For wood design, the problems and solutions in this book utilize only the ASD method. Although the exam allows solutions using either ASD or LRFD for many wood problems, ASD solutions are used exclusively in this book to save you time on the exam. (ASD and LRFD for wood design are nearly identical, except for the additional conversion factors required for LRFD.) The masonry design problems in this book are solved using the ASD provisions of TMS 402 Chap. 2 to match current NCEES requirements. All concrete design problems use the strength design method of ACI 318.

HOW TO USE THIS BOOK

The best way to prepare for the exam is by solving problems. The exam day environment is intense, so the more experience you have solving problems in a timed setting, the better. Problems from the Structural Engineering Reference Manual and its companion book Structural Engineering Solved Problems, as well as problems from other textbooks, are a good starting point. But it is important to practice solving many six-minute multiple-choice and one-hour essay problems like those you will see on exam day.

Upon getting this book, it may be tempting to flip through the problems and solutions immediately to see where you stand before you begin studying, but this approach is not recommended. The only way to simulate the exam situation is to solve problems you’ve never seen before. That is why you should refrain from reviewing the problems in this book until you have completed, or nearly completed, your study of the subject matter.

Start your review by studying the codes and references (see the section later in this Introduction titled “How to Prepare for the Exam”). Then, set aside four-hour blocks of time for each of the four exam modules, and complete the problems in the allotted time. For the problems that you answer correctly, you can feel confident heading into the exam. For the problems that you solve incorrectly, you can spend some time before the exam to further review related topics.

Alternatively, you can use this book to practice solving problems related to a specific topic after you complete your study of that subject area. For example, after you have completed your study of concrete, you may want to locate the concrete problems in this book and solve them separately from the other problems. The design codes listed in the problem statement will help you to recognize the related topics (e.g., any question that lists ACI 318 as a design code is a good question to challenge your understanding of concrete design).

Bring this book with you on exam day. It is quite possible that you’ll encounter a couple questions that are very similar to those in this book, in which case you can save time by referring to this book’s solutions.

As a general rule, use your time studying the design codes and references to master the material, and use your time solving practice problems to master your exam-taking techniques. For more exam preparation tips, see the subsection later in this Introduction titled “Exam-Taking Strategies and Tips.”

LICENSURE FOR STRUCTURAL ENGINEERS

Although the SE exam is available in most states as a standardized structural engineering licensing exam, the benefits of passing the exam vary from state to state. Many states offer a separate SE license contingent on passing the SE exam and meeting other state-specific requirements. Some of these states have title or practice acts, which require a valid SE license in order to perform certain types of structural engineering work. Other states that offer an SE license have no practice restrictions, in which case an SE license entitles the licensee to use the title of SE, but offers no additional benefits. Consult your state board for more information about state engineering licensing requirements. (Visit PPI’s website at ppi2pass.com/stateboards for links to all state board websites.)

Structural engineers who pass the SE exam in states that do not offer separate SE licensure can receive a PE license only—the same license that can be obtained by taking an 8-hour exam. As a result, many structural engineers in these states wonder why they should bother taking a two-day exam when a one-day exam will earn them the same license. However, even in these states, structural engineers who pass the SE exam have several advantages over structural engineers who pass the PE exam.

The SE exam is the only NCEES exam that exclusively covers material relevant to a structural engineer; passing the exam is the only way for practicing structural engineers to truly demonstrate competency in their profession. Although the 8-hour civil breadth and structural depth PE exam covers structural engineering topics, the morning module of the exam also covers many subjects beyond the expertise of most structural engineers, including topics from environmental, transportation, and water resources engineering.

Another advantage of taking the SE exam is that passing the exam makes you eligible for SE licensure in the future. Even if your state has not yet adopted SE licensure, by passing the SE exam now, you will be eligible to become a licensed SE as soon as your state’s licensing board recognizes separate licensure for structural engineers.

Furthermore, the National Council of Structural Engineers Associations (NCSEA), which advocates for national adoption of the SE license, has established the
Structural Engineering Certification Board (SECB). SECB’s goal is to identify and certify professionals who are qualified to practice structural engineering. Passing the SE exam can make you eligible for SECB certification, regardless of whether or not your state offers SE licensure, and can make you more marketable to the public as a structural engineer.

Many states with SE licensure allow you to apply for reciprocity (also commonly called comity or endorsement) upon passing the SE exam, so you can become an SE in those states. To aid in this process, NCEES has established the Model Law Structural Engineer (MLSE) designation. This designation can be added to your NCEES record upon passing the SE exam to expedite the comity licensure process.

No matter what the engineering licensure terms are for your state, the best approach is to stay ahead of the curve, dedicate a couple months to studying, and pass the SE exam. The experience is both challenging and rewarding, as you refresh your knowledge of basic structural engineering principles and gain further understanding of the codes that govern the profession.

**REGISTERING FOR THE EXAM**

You must pass the Fundamentals of Engineering (FE) exam before taking the SE exam, and you must apply to take the exam through the professional licensing board of the state in which you would like to become licensed. The exam is administered twice a year in April and October, and the deadline to apply is typically four to eight months before the exam date. Each state sets its own requirements for the education and experience that must be met before you can take the exam, so check with your local licensing board before applying.

After your state accepts your application, you must then register with NCEES and the examination service company that will be proctoring the exam in your state. Two to three weeks before the exam, NCEES will notify you that your exam-day documents are available to download from its website.

**EXAM FORMAT AND CONTENT**

The 16-hour SE exam consists of two 8-hour components: the vertical forces component, offered on Friday, and the lateral forces component, offered on Saturday. For the vertical forces component, most problems relate to the analysis and design of structures due to gravity loads such as dead, live, and snow loads; other problems relate to soil and fluid loads. The lateral forces component relates to wind and earthquake loads and the detailing and analysis of lateral systems. (See Table 1 for SE exam topics and their corresponding percentage of the exam.)

Each 8-hour component contains a 4-hour morning breadth module and a 4-hour afternoon depth module, as outlined in Table 1.

For the afternoon depth module, you can choose to answer either building or bridge problems, but you must make the same choice for the vertical and lateral components. It is important to note that, regardless of whether you choose building or bridge problems for the afternoon modules, the morning modules contain both building and bridge problems (roughly 75% buildings and 25% bridges). Therefore, even if you plan to take the building module, you must still be familiar with the bridge design topics from *AASHTO LRFD Bridge Design Specifications*.

To pass the SE exam and be eligible for the SE license, you must obtain an acceptable score on both the vertical and lateral components. However, it is possible to take the components separately (e.g., take the vertical component in April and take the lateral component in October). Most candidates choose to take the full 16-hour exam in a single weekend. It is also possible to take both components together but pass only one. In this case, within a five-year period you would need to retake and pass only the exam component that you did not pass initially.

**Breadth Modules (Multiple-Choice Problems)**

Both 4-hour breadth modules contain 40 multiple-choice problems, and each problem has four answer options. Each multiple-choice problem is completely independent. In other words, you will never need to use your answer from one problem to solve a subsequent problem. You will be given an examination booklet with one problem on each page and blank space to perform calculations. All calculations must be performed within the examination booklet. If you write on anything except the examination booklet and answer sheet, your exam will be disqualified, and you will be dismissed from the exam site. An answer sheet is also provided for you to record your answers, and only this answer sheet is graded. No credit is given for calculations written in the examination booklet.

There are two main types of problems in the breadth modules: qualitative (approximately 10–20% of the problems) and quantitative (approximately 80–90% of the problems). Qualitative problems generally do not require calculations. Instead, they may ask about engineering principles and practices; about the particular requirements of a specific design code section; or about how to pick the correct deflected shape, shear, or moment diagram. They may also ask you to identify the most appropriate structural detail.

Quantitative problems require calculations. They may ask you to calculate a force, stress, dimension, or other numerical value by using a general engineering equation or an equation from one of the design codes. The problem statements for quantitative breadth problems typically include applicable design codes, design criteria,
simplifying assumptions, and four answer options. Most quantitative problems also include an illustration showing the referenced structural component with dimensions and member sizes. Occasionally, the problem statement will contain more information than is necessary to solve the problem.

**Depth Modules (Constructed Response/Essay Problems)**

Both 4-hour depth modules in buildings contain four 1-hour essay problems. (The bridge depth modules, which are not included in this book, include two 1-hour essay problems and one 2-hour essay problem.)

The problem statements for depth problems include applicable design codes, design criteria, problems to be solved, and illustrations. The illustrations show structural details, dimensions, and loading information. As with the breadth problems, the depth problems may provide more information than is actually required to solve the problem correctly.

For each problem, there will be approximately three to five subparts labeled with the problem number and a letter corresponding to the subpart. For example, problem 1 will include subparts (a), (b), (c), and so forth. These subparts may ask you to calculate a load, determine a force, design a member, check the adequacy of a member, or sketch a structural detail. All the subparts are at least loosely related, and occasionally you will need to use a value from a previous subpart.

Unlike the multiple-choice modules, your answers must all be handwritten—there is no answer sheet for you to fill out. Instead, a solution booklet of graph paper will be provided for each problem. Use this booklet to show all your calculations and your final answers.

**HOW TO PREPARE FOR THE EXAM**

Beginning the task of studying for the SE exam can be daunting. Historically, the pass rate for the exam has only been about 35%–50% for first-time takers, which is considerably lower than the pass rate for 8-hour PE exams. These statistics are not meant to scare you, but rather to motivate you to study. If you are well-prepared, you will feel confident on exam day and will be more likely to pass the exam.

**Design Codes and Recommended References**

The SE exam is an open-book exam. Therefore, you are allowed to bring references to the exam as long as they are bound and remain bound. Personal notes in a three-ring binder and other semipermanent covers can usually be used. However, some states use a “shake test” to eliminate loose papers from binders, so make sure nothing escapes from your binders when they are inverted and shaken.

A few states maintain a formal list of banned books or don’t permit collections of solved problems, sample exams, and solution manuals. Therefore, check with your state’s board of engineering registration for any restrictions. (The PPI website has a listing of state boards at ppi2pass.com/stateboards.)

The Codes and References section of this book lists exam-adopted design codes and recommended references. As a general rule, if you did not use a book during your preparation, don’t bother bringing it on exam day. Most of the problems on the SE exam can be solved using your engineering judgment and the NCEES design codes, although other references may help you to answer a few problems or may be useful during your review.

**Creating a Study Schedule and Obtaining Study Materials**

The SE exam covers many topics and design codes, so the best strategy is to start studying early. Your total ideal study time depends on your experience, but successful examinees report spending 200–300 hours preparing for the exam. You should begin studying around six months before the exam and dedicate 10–20 hours each week to rigorous study. There is no one correct way to study—it is up to you to determine whether your learning style is best suited to independent study, study groups, webinars, or review courses (or a combination of these methods).

As soon as possible, gather all of your study materials and make sure that they are up to date.

1. Check the NCEES website for the current exam specifications and exam-adopted design codes.

2. Obtain copies of all the exam-adopted design codes. (The Codes and References section of this book includes the codes adopted at the time of publication and other books you may need.) Be sure that you have a copy of the correct edition of the listed code. Some design codes don’t change significantly between editions, but it is possible to solve a problem incorrectly simply by using the wrong edition. Buying all of these books can be expensive, so it is worthwhile to see if your employer or colleagues have copies that you can borrow.

3. Review any errata and amendments to design codes and mark them in your books.

In addition to obtaining the reference books, you must use an NCEES-approved calculator. Visit PPI’s website at ppi2pass.com/calculators for a complete list of approved calculators. The best choice is a model with multiple lines of text display, which allows you to see the equations you have typed and to check that you haven’t made an input error. To maximize your speed on exam day, use this calculator throughout your studying and also during your daily work.

The next step is to set aside blocks of time every week when you will devote yourself to following a detailed
study schedule. An ideal study schedule would include two- to five-hour sessions at least two to three times a week. (If you find it difficult to focus in the evenings after a full day of work, try studying mostly in the mornings and on weekends.) It is especially important to create a detailed study schedule if you are among the majority of examinees who are employed full time and have limited availability for studying. Make a list of the topics you want to study each week, and stick to it. Try to spend 25–50 hours on each of the following topics (the topics that are most prevalent on the exam are listed first).

- loads (ASCE/SEI7 and IBC)
- general structural analysis, including seismic design (IBC, textbook on structural analysis, and other references)
- concrete (ACI 318 and PCI Design Handbook)
- steel (AISC Steel Construction Manual and AISC Seismic Design Manual)
- bridges (AASHTO LRFD Bridge Design Specifications)
- foundations (textbook on foundations)
- wood (NDS National Design Specification for Wood Construction ASD/LRFD)
- masonry (TMS 402/602 Building Code Requirements and Specification for Masonry Structures)

To help you determine which sections of the design codes are most relevant, refer to the SE exam specifications listed in Table 1. It is a good idea to start by reviewing the topics you are least familiar with, as you will have the most difficulty retaining this material. Then, return to the subjects you are least familiar with after a full day of work, try studying mostly in the mornings and on weekends.) It is especially important to create a detailed study schedule if you are among the majority of examinees who are employed full time and have limited availability for studying. Make a list of the topics you want to study each week, and stick to it. Try to spend 25–50 hours on each of the following topics (the topics that are most prevalent on the exam are listed first).

- loads (ASCE/SEI7 and IBC)
- general structural analysis, including seismic design (IBC, textbook on structural analysis, and other references)
- concrete (ACI 318 and PCI Design Handbook)
- steel (AISC Steel Construction Manual and AISC Seismic Design Manual)
- bridges (AASHTO LRFD Bridge Design Specifications)
- foundations (textbook on foundations)
- wood (NDS National Design Specification for Wood Construction ASD/LRFD)
- masonry (TMS 402/602 Building Code Requirements and Specification for Masonry Structures)

To help you determine which sections of the design codes are most relevant, refer to the SE exam specifications listed in Table 1. It is a good idea to start by reviewing the topics you are least familiar with, as you will have the most difficulty retaining this material. Then, return to the subjects you are least familiar with after a month or so before the exam.

Supplement your design code review by reading related sections of the Structural Engineering Reference Manual and other textbooks to understand how the code sections are applied in design. The Codes and References section of this book lists additional resources that you may find helpful to your studies.

When determining how to spend these hundreds of hours studying, it is important to keep in mind that this is an open-book exam. There is no need to commit any code text or equations to memory. More than anything else, the exam is about being able to find and apply the relevant design code sections quickly and correctly. It is a good idea to study the design codes carefully to ensure that you understand the provisions and that you are able to navigate through them. When studying tables and figures, read all of the footnotes—the fine print is fair game for an exam problem.

The following are good practices to follow when preparing your references for studying and exam day.

- Check your state’s exam requirements and restrictions, as some states restrict which books and materials can be used for the exam. (The PPI website has a listing of state boards at ppi2pass.com/stateboards.)

- Place tabs with neatly written labels on the pages of your design codes and references to help you quickly find important sections and equations during the exam. Tabs must be permanent. Loose pieces of paper or sticky notes that are easy to remove aren’t permitted.

- Write notes in the margins of the design codes that help you to better understand the provisions or that direct you to other relevant code sections. (However, be very careful to not write anything in your references during the exam—this is strict grounds for your exam to be disqualified and for you to be dismissed from the exam site.)

- Create personal summary sheets of the most important equations and design code procedures. For example, a seismic summary sheet might include the step-by-step procedure for determining the base shear of a building. Summary sheets serve a dual purpose, as they help you to better understand the code provisions as you write them down and, if allowed by your state, function as an easy-to-use reference on exam day. Be sure to bind the sheets (using a three-ring binder, spiral binding, etc.) before bringing them to the exam. Stapled pages and notebooks aren’t permitted for use on the exam by any states.

- Compile a set of typical details as you study, as the depth problems will often require you to sketch structural details. If your state allows bound personal notes or photocopy drawings of connection and reinforcing details, put them in a binder organized by material type so you can easily reference the details during the exam.

**Exam-Taking Strategies and Tips**

To pass the SE exam, there is no substitute for studying, studying, and studying some more. However, there are some basic strategies that you can employ on exam day to help you maximize your score.

**Keep track of time.** For the breadth modules, you have an average of only six minutes to solve each problem, so periodically check the clock to make sure you are on track to complete about ten problems per hour. If you’ve spent more than five minutes on a problem and aren’t getting close to an answer, move on and come back to that problem at the end. Similarly, for the depth modules, don’t spend much more than one hour on a single problem—your accuracy will slip if you end up
rushing through the remainder of the problems. If you are struggling with one depth module subpart, make an assumption that allows you to move on to the next subpart.

Mark an answer for each breadth problem. For the breadth modules, there is no penalty for incorrect answers, so it is imperative that you mark an answer for every problem. Ideally, you’ll want to maintain a pace that gives you 15 minutes at the end to return to the problems you found tricky and check that the bubbles on your answer sheet correspond with your intended answers. For any calculation-heavy problems, reenter the equations into your calculator to check that you did not make an input error. During the last five minutes, make sure all of the bubbles are dark and fully filled in, and make a guess for any problems you weren’t able to attempt.

Read problem statements carefully. While the problems on the exam are mostly straightforward because they are designed to determine your competency rather than “trick” you into giving a wrong answer, some problems may include a key piece of information that is easy to overlook. Some examples of details that are easy to overlook include

- the problem specifying lightweight concrete
- the steel reinforcement having a strength of $F_y = 40$ kips/in$^2$
- the problem specifying the loads in kips but asking for an answer in tons

It is easy to miss these types of details if you are rushing while reading the problem statement. Time spent carefully reading each problem is time well spent.

For the depth problems, be sure to read the entire problem statement before beginning your solution. An illustration on the next page may include valuable information.

Understand what you should be solving for. Pay close attention to exactly what the problem is asking you to calculate. For example, if the problem asks for the “nominal strength” or “nominal capacity,” do not include any $\phi$, $\Omega$, or other adjustment factors in your calculation. However, if the problem asks for the “design strength,” “allowable strength,” or “adjusted design value,” do include $\phi$, $\Omega$, or other adjustment factors as appropriate. If the problem asks you to calculate a load, force, or stress, you need to determine whether you should be using factored or unfactored loads; generally, if the problem asks for a “design” force, you should include appropriate load factors, and if the problem asks for a “service level” force, you should use unfactored loads.

Know what “most nearly” means. The term “most nearly” can be a little tricky: NCEES uses this phrase for quantitative problems to account for the fact that many problems will have a range of correct answers. This range of answers may result from the rounding of intermediate values or small differences in assumptions (e.g., assuming a self-weight for normal weight concrete of 145 lb/ft$^3$ instead of 150 lb/ft$^3$). If your answer falls halfway between two of the choices, this may be a sign that you have made a mistake. However, it is normal for an answer not to match one of the listed choices exactly, even if you have precisely solved the problem without intermediate rounding or assumptions of any kind. Do not spend valuable exam time trying to calculate an exact match. Mark the answer that is most nearly correct, and then move on to the next problem. Also ensure that you are rounding up or down appropriately. For example, if the problem asks for the maximum load a beam can carry, you must round your calculated value down (as rounding up would exceed the maximum capacity).

Ace easy problems. There will be a couple of problems in the breadth module that may seem a little too easy: don’t overcomplicate them. By getting these problems correct and moving on, you will have more time to spend on the difficult problems.

Know some shortcuts. There are many ways to simplify the code equations to help you save time on exam day. For example, rather than solve a quadratic equation, you can use the expression $A_s = M_s/4d$ to approximate the required area of flexural steel for tension-controlled concrete members. In addition, it is common for code sections to list several equations where only the largest or smallest calculated value is applicable. Therefore, it is a good idea to write in the margins of the code when each equation controls. If you know this ahead of time, you can minimize the number of calculations you need to perform on exam day.

Adjust the order you solve problems in as appropriate. The breadth module question order roughly follows the topic order listed in the exam specifications (see Table 1). However, questions that cover similar topics are not always grouped together. As a result, some examinees find it advantageous to solve the breadth problems out of order by grouping together problems with the same design code listed in the “Design Criteria.” For example, you may want to solve the bridge problems consecutively to avoid having to take out and put away the bulky AASHTO code several times during the exam. If you choose to solve the problems out of order, use extra care to ensure that the bubbles you fill in on your answer sheet correspond to the correct problems.

Use indexes. When you come across a problem that you have no idea how to begin, the best approach is to look in the index or table of contents of the referenced design code. Often, this can help you to find the relevant code section more quickly, especially in the massive AASHTO code.

Look at the answer options before starting to solve the problem. The options given for the breadth problems
can often provide valuable insight into how to approach a problem. For example, if the answers are very close together, you'll have to be precise in your calculations, whereas if there is a wider range of answers, you can simplify calculations, take shortcuts, or round intermediate values. Also, it may occasionally make sense to work backward. For example, if you are trying to determine the lightest adequate shape for a steel column, it may be faster just to look up the tabulated capacities of the four answer options rather than try to solve for the most efficient shape directly.

**Validate your answers.** The quantitative breadth problems are often designed so that the incorrect answers can be arrived at by making common mistakes. If you recognize what some common mistakes might be, you can analyze whether your answer is more likely to be correct by quickly checking to see if common mistakes lead to the other answer options. Additionally, for steel and wood problems, you may have the option to solve the problem using either ASD or LRFD. If time allows, it is a good idea to check your answer by solving the problem both ways to make sure you still arrive at the same answer option.

**Have a good understanding of what graders are looking for.** For the breadth problems, the grader is a machine, and what the machine is looking for is very simple: a dark circle filled in on your answer sheet that corresponds to the correct answer. For the depth problems, the grader is a person, and what he or she is looking for is not as obvious. NCEES does not publish any information about how the depth problems are graded, but it can reasonably be assumed that the graders are looking for you to display sound engineering judgment and competency in the subject matter. Getting the correct numerical answers is important, but it is more important that you use the correct code provisions and don’t skip any applicable code checks.

With this in mind, you should always:

- reference the exact code section you are using by adding the section number in either the text of your answer or the right margin
- state clearly if you skip a check because you think it is not required by inspection
- clearly note any assumptions that were made and why they are appropriate
- write as neatly as you can while still keeping the time limit in mind (although you are not graded on your penmanship, a neat solution conveys a better overall impression to the grader)
- start each equation on a new line and maintain a uniform margin on the left
- use a straight edge and label everything you think might be relevant for sketches
- describe in words how you would answer the problem. If you run out of time, list the code sections you would use if you had enough time to complete the problem.

**Before Exam Day**

Spend the last week or two before the exam making sure you can quickly navigate the codes using your tabs. Solve as many practice problems as possible to make sure you are up to speed.

If possible, visit the exam site before exam day. Figure out the best way to get there and where to park. If you live far from the exam site, consider reserving a room at a nearby hotel for the night before the exam.

The SE exam is open-book, so try to resist the urge to cram on the night before the exam. Instead, relax and get as much sleep as possible.

**Exam Day**

On the morning of the exam, eat a high-protein breakfast, and give yourself plenty of time to get to the site.

Getting all your books to the exam site can be a challenge. Consider using a large suitcase with wheels, and have a plan for organizing your books on exam day. Most likely, the provided desk will not be large enough for all your references. One way to keep your books organized and within reach is to place them in milk crates on the floor.

After completing the vertical forces component of the exam on Friday, try not to think too much about how you performed. Relax, get some sleep, and prepare to do it all again on Saturday.

**What You Will Need on Exam Day**

You should bring the following items with you to the exam.

- A letter of admittance
- A current, signed, government-issued photo ID (not a student ID card)
- An NCEES-approved calculator
- A spare calculator (you can likely borrow one from a coworker for the weekend)
- A straight edge for drawing sketches and reading alignment charts (a 6 in ruler works best)
- A wristwatch or small desk clock: There will be an official clock in the room, but it may not be visible from your seat.
- Earplugs
- Several layers of clothing: Be prepared for the exam room to be hot or cold.
• A water bottle: Confirm with your state that drinks are allowed.
• Approved reference materials

Certain items, such as cell phones and your own pens or pencils, for example, should be left in your test room locker or car. Check with your state board (ppi2pass.com/stateboards) to confirm what is and is not allowed in the exam room.

AFTER THE EXAM

If you think any problems are flawed, ask the proctor for a reporting form immediately after the exam. Follow the proctor’s instructions for preparing and submitting the form. The problems on the exam are thoroughly reviewed and errors are rare, but they can occur.

After leaving the exam room, try not to think too much about the problems or how you did. Know that it is normal to get tripped up on some problems and that it is not worth stressing about. Enjoy your newfound free time, and apply what you’ve learned to your projects at work.

Exam Scoring

NCEES typically releases scores to state licensing boards two to three months after the exam (sometime in December or January if you took the exam in October and sometime in June or July if you took the exam in April). Because some state boards choose not to release the results right away, you might find out your results on a different day than someone else who took the same exam.

The exam is scored on a pass or fail basis, and only those who fail receive detailed results. The exam is neither curved such that a certain percentage of people pass each time nor is there a consistent cutoff score that you need to meet to pass. Instead, NCEES works with subject experts and statisticians to determine the score that corresponds with a minimum competency level: this becomes the passing score. The passing score is not published, and it varies based on the difficulty of each exam. However, based on scores reported by examinees who did not pass, it is believed that the passing score has historically been around 70%.

Although NCEES grades the breadth problems as simply “correct” or “incorrect,” its system for grading depth problems is not transparent. Each depth problem receives a grade of “unacceptable,” “needs improvement,” or “acceptable,” but it is unknown what the criteria are for each category or how the depth scores are combined with the breadth scores. Suffice it to say that you will need to do well on both the breadth and depth modules to receive a passing score.

After You Receive Your Results

If you fail, do not be discouraged. Historically, the pass rate for the SE exam has been low. The studying you have already done has not gone to waste: your code books are still tagged, and everything you have learned can easily be refreshed with brief study sessions. Remember that if you pass only the vertical or lateral component of the exam, you need to retake and pass only the other component within five years to be eligible for licensure. If you do not pass either component, consider studying for and taking only one 8-hour component at a time. Use the diagnostic report that you received from NCEES to figure out which subjects you need to study more. Dedicate more time for review, solve practice problems, and then take the exam again.

Once you pass, it is time to celebrate. Fill out any paperwork required to get your license, thank everyone who supported you while you prepared, and ask your employer for a raise!