Licensure Examinations

Volunteers develop the structural engineering licensure examinations

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Based on conversations with a variety of NCSEA members, it is apparent that many licensed engineers around the nation do not understand the preparation process for the structural Principles and Practice of Engineering (PE) licensure examinations. These examinations are developed by the National Council of Examiners for Engineering and Surveying (NCEES) through countless hours donated by licensed volunteers. This article will explain the development of the PE Structural I examination. A future article will cover the preparation of the PE Structural II examination.

Professional Issues

Examination Specifications

The specifications for the Structural I examination are based on a Professional Activities and Knowledge Survey (PAKS), distributed by NCEES among licensed engineers working in the structural area throughout the United States. This survey is used to determine the activities a structural engineer should be able to perform, and the knowledge a structural engineer should possess at the time of licensure. The PAKS is normally conducted at five-year intervals.

NCEES dispersed the last PAKS to approximately 6,000 licensed engineers, and approximately 2,000 survey forms were returned. Though NCEES strives to have the highest rate of return possible, psychometricians consider a 30% return rate a valid outcome. NCEES psychometricians review and analyze the survey results, and 12 licensed engineers, recruited by NCEES to represent different geographical and professional areas of practice, prepare the specifications based on the survey's statistical data. The current specifications developed from the most recent survey results are as follows:

Analysis of Structures

- Loads 7%
- Lateral Forces 8%
- Lateral Force Distribution 11%
- Methods 5%

Design and Details of Structures

- General Structural Considerations 7%
- Steel 18%
- Concrete 16%
- Wood 9%
- Masonry 9%
- Foundations and Retaining Structures 10%

Under each of the categories listed above are many subcategories, which may be viewed on the NCEES Web site at www.ncees.org.

Preparation of Examination Questions

The NCEES Structural Engineering Examination Committee, made up of volunteer licensed engineers, prepares questions for use on the Structural I examination. A volunteer who writes questions is referred to as an item writer. Two other volunteers (again, all licensed engineers) review the item writer's question to determine if it is appropriate for use on the examination. The reviewers may also make recommendations to improve the question. The Structural Examination Committee Chair then reviews the question and determines whether to accept it for the item bank.

The committee chair assembles an upcoming examination by selecting questions from the item bank based on the current exam specifications. Two other committee members pre-test the selected questions, or the "exam," as if they were examinees. The pre-testers record the time it takes to solve each question, check to see if their solutions are consistent with the solutions prepared by the item writers, and fill out a form pertaining to each question and solution. Two additional committee members review the pretest results and incorporate the pretest comments, as appropriate, to finalize the questions for exam assembly. As a final check, a team of three reviews the assembled examination. Every examination administered—often referred to as a "live" examination—contains a different set of questions.

Examination Format

The PE Structural I examination has 80 multiple-choice questions. Although the multiple-choice format has been criticized, there are many good reasons for using multiple-choice questions instead of eight one-hour essay problems, which was the examination's previous format. A variety of reasons for the transition to multiple-choice are explained below.

Testing a sufficient number of knowledge areas:

A one-hour essay question can test three or four knowledge areas only. If NCEES uses the eight-problem one-hour format, only about 32 knowledge areas can be tested per examination. In contrast, an 80-question multiple-choice exam can test 80 knowledge areas per examination.

Disadvantages to scoring essay problems:

Licensed engineers must volunteer to score the essay problems, and it is a time consuming process. In the eight-problem one-hour format, each volunteer scores

several hundred problems. Scorers must maintain scoring consistency throughout the process. Scorers have admitted that this is very difficult to do over an extended period of time.

Volunteers follow a uniform scoring plan for each essay problem. Some of the scorers follow a strict interpretation of the scoring plan while others are more liberal. Examinees whose solutions are scored by liberal scorers have a better chance of passing the examination than those whose solutions are scored by stricter scorers.

At times, scorers recognize an acceptable alternate solution to a problem they are scoring and grant proper credit, alerting fellow scorers to the alternate solution. Though every effort is made to give all acceptable solutions the appropriate credit, those problems scored prior to the recognition of the acceptable alternate solution may not receive proper credit because of human error.

Advantages to scoring multiple-choice questions

Scoring is quick because it requires simple electronic scanning of the answer sheets. Licensed engineers are not required to pass answer sheets through the scanner.

When results reveal that a high number of examinees selected the same wrong answer, the question is scrutinized. If it is determined that there is a plausible reason for so many examinees selecting the same wrong answer, the question may be scored with two right answers. The answer sheets will be re-scanned so that every appropriate answer will receive proper credit for the question.

Psychometricians are able to determine, through statistics, whether a multiple-choice examination is more or less difficult than prior multiple-choice examinations. The passing score can be adjusted for the differences in level of difficulty so that the minimum competency required of passing examinees is consistent among all examinations. This is impossible to accomplish with essay examinations, which is why the pass rates for essay examinations (in the format that NCEES administered in the past) varied greatly from one administration to another.

Who Prepares the Examinations?

The NCEES Structural Engineering Examination Committee is made up of approximately 50 licensed engineers from around the nation. Around 25 of these committee members assemble four times a year to work on examination preparation. Two meetings are generally held at the NCEES headquarters in Clemson, South Carolina, and the other two are generally held in Atlanta, Georgia, and Reno, Nevada. These committee members volunteer their time, and the NCEES reimburses them for travel, hotel accommodations, and meals.

The NCEES is always looking for qualified volunteers for this committee. If you are interested in contributing to this effort, visit the NCEES Web site at **www.ncees.org** and submit a Volunteer Interest Form.