

Access to the Fundamentals of Engineering Examination by Engineering Technology BS Graduates

John A. Weese, Ph.D., P.E., Texas A&M University

Abstract

Graduates of baccalaureate engineering technology (ET) programs accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET) are well qualified to sit for the Fundamentals of Engineering examination (FE examination) as graduating seniors. In some states this practice is allowed. However, the path registration as a Professional Engineer (PE) usually involves somewhat different conditions from those for graduates of engineering programs accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET). This paper discusses the importance of providing ET graduates access to the FE examination as graduating seniors, steps that may prove successful for negotiating access, and suggestions for maintaining access once it is obtained. Programs in the commonwealth of Virginia and the state of Texas are described, along with the experiences of ET graduates and the FE examination.

Introduction

The earning of a baccalaureate degree in engineering technology is not the normal starting point for obtaining status as a registered professional engineer. However, graduation from a BS program engineering technology that is TAC/ABET accredited provides assurance of quality at a level where the graduating senior should be granted access to the FE examination because the TAC/ABET accredited programs are quite capable of standing on their own merits. The broader interpretations of engineering afforded by the Engineering Accreditation Commission's Criteria 2000¹ may be helpful.

There are many sound reasons why seniors in TAC/ABET accredited ET programs should be allowed to sit for the FE examination. Their education suits them well for performing competitively on the examination itself. Engineering technology curricula are properly positioned to equip graduates to take the general FE examination as well as most of the discipline specific FE exams that have been offered since 1996. The background in mathematics, basic sciences, engineering sciences, engineering design and the support areas provided in TAC/ABET accredited BSET programs, while different from those in engineering curricula, none the less provide ET seniors a solid base to compete effectively on the FE examination.

The increased globalization of engineering practice is bringing together people with many different engineering backgrounds to work as teams on multi-faceted engineering systems. Some of these engineering backgrounds are more diverse than is found in the differences between engineering and ET curricula in the US. Only some of the engineering team members from other nations are likely to seek permission to take the FE examination, their presence in

engineering practice will probably lead to wider interpretations by boards of registration. Having passed the FE examination provides ET graduates access to some positions for which potential employers might not consider them otherwise.

Negotiating Access

The process for gaining access to the FE examination by ET graduating seniors can be initiated by an ET dean, department head, or members of the faculty. Those engaging in the effort should be thoroughly grounded in all aspects of ABET accreditation and familiar with NCEES. There are about a half dozen steps for successfully negotiating access to the FE examination for seniors and graduates of TAC/ABET accredited BSET programs. They include:

- Studying the Board of Registration for Professional Engineers (PE Board) in your state
- Selecting an ET champion to make the case
- Recruiting external supporters for the negotiation
- Preparing the negotiation case
- Cultivating allies on the PE board
- Constructing the specific request

Step One - Studying the PE Board. Start with the PE Board's web site. Examine the membership, the constitution and bylaws; scan applicable state laws; and note the frequency and sites of board meetings. Determine if ET's are specifically excluded from the FE exam. You may find that they are only excluded by not being specifically included as an ABET accredited engineering program. Carefully evaluate avenues for obtaining PE status for applicants with non-traditional engineering credentials. It is possible that persons with degrees in physics, mathematics, or environmental science may have routes to registration that should be equally applicable for ET graduates. Also examine the procedures the board uses to evaluate the equivalence of the credentials for engineers from other countries since some of those credentials are very similar to those for TAC/ABET accredited BSET graduates.

Step Two - Selecting an ET Champion. Two basic factors are important for the ET champion. These involve the champion's personal qualifications and also the institutional support for the champion. The champion ought to be a member of the ET faculty and the champion must be a PE in the state with a current license to practice. If possible, it is enormously helpful if a few members (even one) of the PE board members know the champion. The champion should be respected by recognized industries important to the state's economy and by PEs practicing in the state. The champion must be a good spokes person for appearances before the PE board, including qualities of being persuasive and the capacity for being persistent in the face of potential critical questioning.

As a corollary to the champion's personal characteristics, recognize the importance of the backing of this effort by the champion's institution. If the institution has an engineering faculty, which is often the case, the champion must have their backing before a proposal is made to the PE board. It certainly helps if the institution will give the champion a modest amount of time and an allowance for travel to visit key PE board members and to present testimony before the board.

Step Three - Recruit External Supporters. Good, influential friends are very valuable allies for negotiating access. Search for people who have current licenses to practice in the state, are fluently familiar with BSET programs (especially the one at your institution), and have experience hiring BSET graduates as employees or working with them as colleagues. As in the case of the champion, it definitely helps if supporters are known by any of the members of the PE board. The more important their industry is to the economy of the state, the more likely the board is to consider their advice.

Step Four - Preparing the Case for the PE Board. Probably the strongest card is the TAC/ABET criteria. An excellent case can be made by drawing comparisons between the TAC and the EAC criteria of ABET. Stress the strong backgrounds in mathematics, basic sciences and engineering sciences. Board members are likely to appreciate the emphasis ET programs place on applications and preparing graduates to "hit the ground running" upon entering their first professional assignment. Exhibit your institution's TAC/ABET accredited curricula; indicate the quality and extent of laboratory experiences in your ET curricula to stress the focus on applications and preparation for service to industry. Present the results of employer satisfaction surveys performed for TAC/ABET visits, emphasizing the engineering capabilities of the program's ET graduates. List the qualifications of your institution's ET faculty, being sure to stress industry experience and PE status in addition of the usual academic credentials. Provide data on enrollments, student qualifications, production of graduates, placement rates, listings of industries hiring your ET graduates, and the titles of the positions into which they have been hired. Make sure your presentation data are well organized for presentation and that hard copies are available for each board member.

Step Five - Cultivating Allies on the PE Board. The members of the PE board may be unfamiliar with ET programs and some of them who "know" something, may have a negative impression. Consequently, having even one ally among the members of the board is most helpful. A straightforward approach often works best. After selecting the most promising ally, call for an appointment and provide the reason for your visit. Make your presentation and ask the ally's criticisms and suggestions for improvement. After discussion, ask the ally for support when you make your presentation to the PE board. Also ask this ally to recommend other members of the board to whom you should make this presentation and, hopefully, recruit as additional allies.

A very valuable ally at the PE board is the board's executive director. At the first opportunity, the ET champion should contact the executive director and start building a relationship. It definitely helps if the champion can point out efforts to promote PE registration to students such as having helped administer the FE exam, taught parts of a refresher course for seniors preparing to take the FE, and promoting PE registration among students, both in engineering and in ET. Invite the executive director to visit your department. Provide the executive director with information about your institution's ET programs and make sure the person is familiar with the information you'll be presenting to the PE board, well ahead of time.

Step Six - The Specific Request. It generally works best to make the presentation to the PE board in person at one of its scheduled meetings. The most important part is the specific request for action you wish the PE board to take. Give careful consideration to the conditions being

requested for BSET seniors and graduates compared to those from EAC/ABET accredited engineering programs. It is prudent to be prepared for conditions somewhat different from those awarded to those pursuing engineering degrees. The key element is to get the PE board to honor your request to allow seniors and graduates of TAC/ABET accredited BSET programs to sit for the FE examination. The difference may take the form of a longer period for documenting engineering experience before being eligible to take the principles and practices examination or, perhaps, documenting some engineering experience before being awarded status as an Engineer In Training (EIT). Be prepared for critical questions and to negotiate. Expect to have the successes of your candidates monitored closely, at least in the initial years.

Maintaining BSET Access to the FE Examination

Expect success in gaining access to the FE examination for BSET graduating seniors to be just the initial step. Carefully construct a program for informing the BSET seniors about the process for becoming a registered engineer in your institution's state and carefully explain the challenges they may face when they take the FE examination. It is very prudent to conduct a refresher course tailored to BSET seniors to increase their awareness of the nature of the FE examination. Engineering seniors usually report that the mathematics portion of the FE examination is where they find it easiest to do well and this fact is verified by statistics kept by the National Council of Examiners of Engineers and Surveyors (NCEES). Most engineering seniors score well on the mathematics section of the FE examination and this factor helps engineering seniors achieve a relatively high passing. Since mathematics is less vigorously emphasized in ET programs, it will be important for the ET refresher course to provide exercises and study problems for ET majors and help generate a more nearly level playing field for the ET seniors. The FE examination is an eight-hour exercise, administered as a four-hour morning session followed by a four-hour afternoon session after a one-hour lunch break. It is not uncommon for engineering seniors, as well as engineering technology seniors, to be unaccustomed to taking examinations of this duration. Conditioning their stamina and making sure their calculator skills are equal to the task are big helps.

Strongly encourage your students to provide you prompt feedback about their performance on the FE examination. Have them describe sections for which they felt well prepared as well as others where they had difficulty. The processing of the FE examination by NCEES takes considerable time. Have good systems in place so that students will readily provide you the results of their examinations. You will usually receive their feedback earlier than you will receive information from the PE Board in your state. Use this feedback to further inform the next group of BSET seniors about preparing for the FE examination and also use it to adjust your refresher course so that it is as helpful as possible.

The executive director of the state's PE Board will provide you information about your graduates' successes. You can also obtain more detailed information about their performances on various parts of the FE examination because it can be used as a useful assessment tool. The FE examination is one of the few available nationally normed tools for assessment. The data from the executive director can also include statistical information about graduates of other programs so that you can assess how your BSET seniors fared compared to other takers of the same examination. These data usually do not specifically identify other institutions so you will

need to develop relationships with other ET programs to determine how your seniors fared compared to their peers from other programs.

Examples from Virginia and Texas

In Virginia, an arrangement was negotiated with the state board so that seniors in TAC/ABET accredited BSET programs could take the FE examination². Upon passing the FE examination, the Board sent the BSET graduate a letter confirming the earning of a passing score. The letter further explained that upon documenting two years of engineering experience, status as an EIT would be conferred. In Virginia, once an EIT documents four years of engineering experience after receiving the EIT, the person is eligible to sit for the Principles and Practices examination. This was a very fine arrangement since some employers would accept the letter from the Board as justification for appointing the BSET graduate to an engineering position.

In Texas, seniors in TAC/ABET accredited BSET programs are allowed to sit for the FE examination³. Upon passing, they are identified as EITs in Texas. However, EITs with BSET degrees are required to document eight years of engineering experience before being allowed to sit for the Principles and Practices Examination. While the longer wait before being eligible to take the Principles and Practices Examination may seem excessive, the path is there for those dedicated to earning the license to practice as a Professional Engineer.

Having access to the FE examination helps establish the quality of a BSET program. It helps recruit better students. It also is a factor for recruiting good faculty. It definitely helps recruit faculty who are PEs.

The fraction of seniors actually electing to take the FE is usually modest, being the order of 15% or less. The FE examination is perceived as a significant challenge and there are some employers to whom it is unimportant whether their engineers are PEs. Traditionally, ET faculty members have taken steps to ensure that ET seniors planning to take the FE examination recognize the rigor of the undertaking and are appropriately prepared. As increasing numbers of ET seniors succeed in passing the FE examination, it encourages other students to work even harder to attain new levels of achievement. Passing rates among the seniors electing to take the FE examination are usually good, normally exceeding 75%. However, initial successes can definitely lead to over confidence so guard against complacency in all sectors.

Engineering faculty are sensitive to the pass rates of their institution's students on the FE examination, a situation keenly felt at Texas A&M University. Consequently, it was very important, even for the relatively small number of BSET seniors taking the FE examination, that their pass rate not have an appreciable negative effect on Texas A&M University's overall rate. Fortunately, that has not been a problem so, this is not an issue, presently.

Closing Thoughts

The case for providing seniors in TAC/ABET accredited BSET programs may not be as formidable as perceived. PE boards recognize the intensity of industries' needs for engineering talent so they are potential allies for ET.

There will be some opposed to providing ET seniors access to the FE examination and they may make their points rather vehemently. However, the force of evidence is on the ET side and engineers usually respond quite well to logic. Making the case for ET access to the FE examination is a positive act, not an attack on any established position. Keep the quest on the high road. PE board members are likely to discover that they appreciate the character and quality of BSET programs, once they are provided a good briefing.

Emphasis on the FE examination is receiving much attention because of its potential use as an assessment instrument for EAC/ABET Engineering Criteria 2000. Given the similar efforts underway in the TAC of ABET, this focus on the FE examination is probably beneficial to the ET cause. There is a subsequent factor to remember. While national pass rates for EAC/ABET takers of the FE examination are quite good, pass rates of those who take the Principles and Practices examination four (or more) years later are considerably less. According to NCEES data, the passing rates of takers from among the larger engineering disciplines, CE, ME, EE, ChE, and IE, are 40% or lower for a number of administrations of the examination. This raises some questions, such as the relevance of the Principles and Practices examination to the actual work and practice of engineers. However, it also points out the need to stress life-long learning and the importance of continuing education.

Bibliography

1. Accreditation Board for Engineering and Technology, "Engineering Criteria 2000," *2000 ABET Accreditation Yearbook*, September 30, 2000, pp. 80-88.
2. Commonwealth of Virginia, Virginia Board for Architects, Professional Engineers, Land Surveyors, Certified Interior Designers, and Landscape Architects, Reg. Effective December 1, 1999, Statutes Title 54.1, Chapter 4, Excerpts from Title 13.1, Part IV, "*Qualifications for Licensing of Professional Engineers*," pp. 11-16.
3. Texas Board of Professional Engineers, Texas Engineering Practice Act and Board Rules, Rev: 10-02-2000, Chapter 131. Practice and Procedure, Subchapter E. Education, paragraph 131.91, "*Educational Requirements for Applicants*," Subparagraph 131.91(2) (A), pp. 30 of <http://www.tbpe.state.tx.us/law2000.htm>.

JOHN A. WEESE

John Weese is a Professor of Mechanical Engineering and Coordinator of Engineering Accreditation at Texas A&M University. He is also a Regents Professor in the Texas A&M University System. From 1986 to 1997, he served as head of the Engineering Technology and Industrial Distribution department at Texas A&M. From 1974 to 1983, he was Dean of the School of Engineering at Old Dominion University. He held appointments at the University of Denver from 1963 to 1974, including four years as Dean of the College of Engineering. He was a member of the faculty of the USAF Academy while on active duty from 1960 to 1962. He has industry experience with Allis Chalmers, Boeing and Martin Marietta and he was a division director in the engineering directorate of NSF from 1983 to 1986. He has been an ASME ABET Ad Hoc Visitor for Engineering Programs, served five years on the EAC of ABET, and terms on the ABET Board of Directors. He is an ABET Fellow, an ASME Fellow Member, an ASEE Fellow Member and was ASEE's 1999-2000 President. He is a registered engineer in Colorado, Texas, and Virginia. He earned his BSME from Kansas State University and the 2000 recipient of the KSU College of Engineering Distinguished Service Award. Dr. Weese earned his MS and Ph.D. degrees in Engineering Mechanics from Cornell University.