

Approved Changes to the Criteria for Accrediting Engineering Programs¹ Effective for Evaluations during the 2008-2009 Accreditation Cycle

PROGRAM CRITERIA FOR CIVIL AND SIMILARLY NAMED ENGINEERING PROGRAMS (Passed by the Board of Directors of ABET [on second and final reading] on November 3, 2007)

1. Curriculum

The program must demonstrate that graduates can: apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives; apply knowledge of four technical areas appropriate to civil engineering; conduct civil engineering experiments and analyze and interpret the resulting data; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.

2. Faculty

The program must demonstrate that faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience. The program must demonstrate that it is not critically dependent on one individual.

GENERAL CRITERIA FOR MASTERS LEVEL PROGRAMS (Passed by the Board of Directors of ABET [on second and final reading] on November 3, 2007)

Masters level programs must develop, publish, and periodically review, educational objectives and program outcomes. The criteria for masters level programs are fulfillment of the baccalaureate level general criteria, fulfillment of program criteria appropriate to the masters level specialization area, and one academic year of study beyond the baccalaureate level. The program must demonstrate that graduates have an ability to apply masters level knowledge in a specialized area of engineering related to the program area.

¹ These two sets of criteria assume that the formal educational requirement for the professional practice of civil engineering (licensure) will be "B + M/30" (Reference: ASCE. 2004. *Civil Engineering Body of Knowledge for the 21st Century*, pp.15-16.) in the future. These criteria further assume that the appropriate level of competency for Outcomes 1-11 and 13-15 of the Body of Knowledge (Reference: ASCE, pp. 50-54) will be fulfilled at the baccalaureate level, and appropriate competency for Outcome 12 will be fulfilled at the masters level.

Frequently Asked Questions

CONTENTS

- Q1: [How do we know what *levels of achievement* are expected to satisfy these criteria?](#)
- Q2: [Why are mathematics through differential equations, calculus-based physics, and chemistry singled out for special attention in the CE Program Criteria?](#)
- Q3: [Why is there a requirement for one additional area of science?](#)
- Q4: [Could you clarify the requirement for one additional area of science?](#)
- Q5: [Why do the Program Criteria require coverage of *four* civil engineering areas?](#)
- Q6: [The old CE Program Criteria require *proficiency* in four civil engineering areas; the new Program Criteria require that graduates can *apply* knowledge of four areas. Why the change?](#)
- Q7: [Doesn't *application* represent a lower level of competence than *proficiency*? Hasn't this change "lowered the bar" with respect to graduates' civil engineering competence?](#)
- Q8: [The old CE Program Criteria use the phrase "recognized major civil engineering areas" while the new criteria refer to "technical areas appropriate to civil engineering." Is there a difference?](#)
- Q9: [The old CE Program Criteria require an ability to conduct experiments in *more than one* CE area. The new criteria require only that graduates "can conduct civil engineering experiments...." Does this mean there is no longer a requirement for this ability to be demonstrated in more than one CE area?](#)
- Q10: [What is meant by "design a system, component, or process in more than one civil engineering context?"](#)
- Q11: [Why are management, business, public policy, and leadership principles included in the criteria?](#)
- Q12: [The requirement for management, business, public policy, and leadership in the CE Program Criteria seems onerous. How will programs be able to cover these professional practice topics and still offer adequate technical content?](#)
- Q13: [Management, business, public policy, and leadership are very broad subject areas. What aspects of these subject areas should be addressed in my CE curriculum?](#)
- Q14: [Why are management, business, public policy, and leadership principles required *at the undergraduate level*? Wouldn't it make more sense to address these topics in a professional practice-oriented master's degree program?](#)
- Q15: [The Masters Level Criteria use the phrase, "fulfillment of program criteria appropriate to the masters level specialization area." Could you clarify the meaning and intent of this phrase?*](#)
- Q16: [Why are the Masters Level General Criteria not more explicit in requiring graduates of accredited MSCE programs to meet the ABET Civil Engineering Program Criteria?*](#)
- Q17: [In the Masters Level General Criteria, what is meant by "a specialized area of engineering related to the program area?"*](#)
- Q18: [How will programs be required to *demonstrate* that their graduates can apply masters level knowledge in a specialized area of engineering?*](#)

* Q15, Q16, Q17, and Q18 are based upon the "Criteria for Masters Level Programs" at the end of the first page of this document.

Q₁: How do we know what *levels of achievement* are expected to satisfy these criteria?

A₁: In these criteria, expected *levels of achievement* are based on Bloom’s Taxonomy—the well-established model for defining educational objectives using verbs that are keyed to six levels of cognitive development. Bloom’s six levels of cognitive development are, from lowest to highest, Knowledge (Level 1), Comprehension (Level 2), Application (Level 3), Analysis (Level 4), Synthesis (Level 5), and Evaluation (Level 6). Each successive level represents a progressively more sophisticated form of thinking and problem-solving. Bloom’s model stipulates that certain measurable, action-oriented verbs can be directly associated with a particular level of cognitive development. Thus, in the criteria, the verbs themselves define the associated level of achievement. *Explain* is associated with Comprehension (Level 2); *apply* and *conduct* imply Application (Level 3); *analyze* and *interpret* refer to Analysis (Level 4), and *design* to Synthesis (Level 5).

The terms *recognition*, *understanding*, and *ability*, used in the first edition of the BOK and in previous versions of the draft criteria, are no longer used. These terms, though well-defined in the BOK, proved difficult to measure and thus did not facilitate effective curriculum development.

In translating from the old levels of achievement to the new Bloom-based levels, it is reasonable to consider Knowledge (Level 1) and Comprehension (Level 2) as roughly equivalent to *recognition*; Application (Level 3) and Analysis (Level 4) as equivalent to *understanding*; and Synthesis (Level 5) and Evaluation (Level 6) as equivalent to *ability*.

Q₂: Why are mathematics through differential equations, calculus-based physics, and chemistry singled out for special attention in the CE Program Criteria?

A₂: Mathematics through differential equations, calculus-based physics, and chemistry are considered to be part of the “technical core” for civil engineers. All graduates must be able to apply knowledge of these subjects.

Q₃: Why is there a requirement for one additional area of science?

A₃: The Civil Engineering Body of Knowledge places increased emphasis on math and science fundamentals, and it recommends a much broader science background, so that future engineers are better equipped to adapt to emerging fields like biotechnology and nanotechnology. Consequently, this provision of the CE Program Criteria is intended to assure that graduates learn and can solve problems in at least one additional area of science. Likely candidates for the “additional area of science” include biology, ecology, geology/geomorphology, and geospatial representation; however, the program has wide latitude to define this curricular area, consistent with its own program objectives.

Q₄: Could you clarify the requirement for one additional area of science?

A₄: The requirement for “one additional area of science” reflects ASCE’s intent that civil engineering graduates develop greater breadth in the basic sciences beyond the technical core subjects of physics and chemistry. As stated in Q₃, some possible additional areas of study include biology, ecology, geology, geomorphology, and geo-spatial representation—areas of significant interest and increasing importance for civil engineers. This list is by no means all-inclusive, and it is not necessary that all students within a program study the same additional area of science. However, in cases other than those listed above, it is the program’s responsibility to

demonstrate that the selected area(s) of science provides breadth beyond physics and chemistry, consistent with the program objectives. In general, an advanced course in physics or chemistry (i.e., one for which a basic-level physics or chemistry course serves as a prerequisite) would not fulfill this requirement, because such a course would provide additional depth rather than breadth. This would also be true of a course in a specialized branch of chemistry, like organic chemistry or biochemistry. For the same reason, a course that is primarily engineering science in content would not fulfill this requirement. Finally, because the focus of this provision is on increased breadth in basic science, an additional course in mathematics generally would not fulfill this requirement.

Q₅: Why do the Program Criteria require coverage of *four* civil engineering areas?

A₅: Civil engineering is a broad discipline; thus civil engineering curricula should be similarly broad. Curricular breadth facilitates the development of well-rounded students who are able to make well-informed career decisions. In addition, licensing boards support breadth in the curriculum. The old CE Program Criteria require proficiency in four CE areas. Given the BOK's emphasis on technical breadth, it would be inappropriate for the proposed new criteria to *reduce* the breadth requirement.

Q₆: The old CE Program Criteria require *proficiency* in four civil engineering areas; the new Program Criteria require that graduates can *apply* knowledge of four areas. Why the change?

A₆: The term *proficiency* caused much confusion among program evaluators and faculty. Because the verb *apply* maps unequivocally to Application (Level 3) in Bloom's Taxonomy (see Q₁ above), its use greatly enhances the clarity and measurability of the criteria.

Q₇: Doesn't *application* represent a lower level of competence than *proficiency*? Hasn't this change "lowered the bar" with respect to graduates' civil engineering competence?

A₇: As noted in the answer to Question 6, the term *proficiency* has caused considerable confusion. Attempts to achieve this disputed level of competence have perhaps dominated other, equally important curricular needs in many programs. Many have argued, with some justification, that *proficiency* in any given area of civil engineering practice can only be attained after suitable post-graduate professional practice; and for most of us, this *proficiency* is ultimately achieved in only one, or possibly two, areas of practice. By requiring that graduates *can apply knowledge of four civil engineering technical areas*, the proposed criteria acknowledge that undergraduate programs cannot provide the *proficiency* that comes with professional experience, but they can certainly provide the broad technical background that will enable civil engineering graduates to develop such *proficiency*. In a sense, this can be interpreted as setting a lower, albeit more realistic, standard for undergraduate programs. However, it must also be remembered that accompanying the implementation of these proposed criteria will be a parallel expectation that the future graduate engineer will receive additional post-graduate education at the masters level (or equivalent) in a specialized area of civil engineering, contributing to the eventual attainment of professional "*proficiency*."

Q₈: The old CE Program Criteria use the phrase “recognized major civil engineering areas” while the new criteria refer to “technical areas appropriate to civil engineering.” Is there a difference?

A₈: Yes. The new terminology is specifically intended to provide programs with greater flexibility in defining their curricular content. The phrase “technical areas appropriate to civil engineering” is intended to accommodate non-traditional emerging engineering areas like biotechnology and nanotechnology—provided the program can justify them as “appropriate to civil engineering.”

Q₉: The old CE Program Criteria require an ability to conduct experiments in *more than one* CE area. The new criteria require only that graduates “can conduct civil engineering experiments....” Does this mean there is no longer a requirement for this ability to be demonstrated in more than one CE area?

A₉: Yes. The new Program Criteria are less prescriptive; it is up to programs to determine how they demonstrate that their graduates can conduct civil engineering experiments. This change was made for consistency with the BOK and to provide programs with greater curricular flexibility. It must be noted, however, that the requirement to “analyze and interpret the resulting data” represents a relatively high level of achievement. The verbs *analyze* and *interpret* both correspond to Analysis (Level 4). (See Q₁ above for further discussion of levels of achievement.) Attaining Level 4 will still require a robust laboratory program.

Q₁₀: What is meant by “design a system, component, or process in more than one civil engineering context?”

A₁₀: This provision replaces the requirement for “the ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum” in the old CE Program Criteria. The phrase “design experiences integrated throughout...” was eliminated in order to make the criteria more outcomes-based and less prescriptive. The new reference to “more than one civil engineering context” is intended to ensure that students experience the design process in at least two different CE technical areas (e.g., a structural design experience and an environmental design experience).

Q₁₁: Why are management, business, public policy, and leadership included in the criteria?

A₁₁: These topics are included because the civil engineering profession needs to develop well-rounded, humanistic individuals who are able to view the technical, business, public policy, and professional practice aspects of engineering holistically. We must develop engineers, not technicians.

Q₁₂: The requirement for management, business, public policy, and leadership in the CE Program Criteria seems onerous. How will undergraduate programs be able to cover these professional practice topics and still offer adequate technical content?

A₁₂: It is critical to recognize that graduates are only expected to be able to *explain* the fundamentals in these areas. The verb “*explain*” implies that graduates only achieve Comprehension—Level 2 of the six levels of Bloom’s Taxonomy. There is absolutely no requirement for a course or courses devoted to management, business, public policy, and leadership; these topics can easily be addressed *at the Comprehension level* within existing courses, projects, or other learning experiences.

Q₁₃: Management, business, public policy, and leadership are very broad subject areas. What specific aspects of these subjects should be addressed in a CE curriculum?

A₁₃: The ASCE Commentary (BOK Outcomes 13, 14, and 15) discusses the specific aspects of management, business, public policy, and leadership that are most relevant to the professional practice of civil engineering.

Q₁₄: Why are these professional practice topics required *at the undergraduate level*? Wouldn't it make more sense to address these topics in a professional practice-oriented master's degree program?

A₁₄: Management, business, public policy, and leadership principles are included in the Baccalaureate Level CE Program Criteria because:

(a) Professional practice fundamentals are considered to be an essential element of an undergraduate engineering education – even for those who do not pursue entry into the professional practice of engineering.

(b) Many CE Department Heads asked that these topics *not* be included in the Masters Level Criteria, so that existing research-oriented master's degree programs could be preserved.

(c) Including professional practice topics in the Baccalaureate Level Criteria supports standardization and promotes students' mobility between institutions.

(d) Including CE professional practice topics in the Masters Level General Criteria is not possible, because these criteria must be applicable to (and approved by) all engineering disciplines.

Under the new criteria, any program that wishes to address professional practice issues *only* in its master's program would be free to do so. In this case, however, only the master's program would be accreditable.

Q₁₅: The Masters Level General Criteria use the phrase, “fulfillment of program criteria appropriate to the masters level specialization area.” Could you clarify the meaning and intent of this phrase?

A₁₅: The intent of this criterion is that Lead Societies will guide the EAC in determining which program criteria are required for accredited master's programs in their respective disciplines. ASCE is the Lead Society for civil engineering and the subdisciplines of civil engineering. ***ASCE intends that graduates of accredited master's programs in (1) civil engineering and (2) advanced specialization areas related to civil engineering (e.g., structural, geotechnical, transportation, water resources engineering, etc.) meet the ABET Civil Engineering Program Criteria.*** For a given graduate, it does not matter whether these criteria are satisfied through the undergraduate curriculum, through the graduate curriculum, or otherwise. ASCE does not intend to require fulfillment of the program criteria prior to entry into an accredited master's program, nor does it intend that accredited master's programs necessarily incorporate additional curricular elements that will satisfy the program criteria. However, ASCE does intend that all graduates from accredited master's programs in civil engineering (or masters level specialization areas related to civil engineering) fulfill the BOK, regardless of whether they hold ABET-accredited BSCE degrees or not. For compliance with this criterion, it is only necessary for the Program to demonstrate that its graduates have fulfilled the outcomes required by the Civil Engineering Program Criteria as a requirement for graduation from the accredited master's program.

Q16: Why are the Masters Level General Criteria not more explicit in requiring graduates of accredited MSCE programs to meet the ABET Civil Engineering Program Criteria?

A₁₆: The Masters Level General Criteria cannot be more explicit because they are *general criteria*—they apply to engineering programs in all disciplines. The wording of this criterion has been crafted in order to provide each professional society the flexibility to define which Program Criteria are appropriate to its accredited master’s programs.

Q17: In the Masters Level General Criteria, what is meant by “a specialized area of engineering related to the program area?”

A₁₇: ASCE’s intent is to allow individual programs to exercise great flexibility in defining masters level specialization areas related to civil engineering. The specialization might be a traditional CE sub-discipline, such as structural engineering, construction engineering and management, and water resources management. However, nontraditional, boundary, and emerging fields such as ecological engineering and nanotechnology are also encouraged. And in a professional practice-oriented master’s program, CE professional practice might, itself, be defined as the specialty area.

Q18: How will programs be required to *demonstrate* that their graduates can apply masters level knowledge in a specialized area of engineering?

A₁₈: ASCE’s intent is to allow individual programs great flexibility in determining how they will demonstrate that graduates can apply masters level knowledge in a specialized area of engineering. Some possible ways include successful project reports, theses, or comprehensive exams approved by the faculty. Note that these methods of demonstrating compliance *do not require the creation of new assessment systems* for masters level programs.