COMMENTARY

On the ABET/EAC Criteria for Accrediting

Environmental Engineering Programs

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AMERICAN ACADEMY OF ENVIRONMENTAL ENGINEERS & SCIENTISTS®

1125 West Street, Suite 251
Annapolis, MD 21401
Phone: (410)266-3311
http://www.aaees.org

Preamble to Commentary

This Commentary is intended to provide program evaluators (PEVs) with guidance on interpreting the Environmental Engineering program criteria. Environmental engineering programs can meet these criteria in a variety of ways. The guidance provided in this document is not exhaustive but incorporates clarifications that might be helpful to PEVs. PEVs should use professional judgment to assess whether the requirements of the program criteria are met, within the context of these guidelines. This Commentary is not intended to be in conflict with ABET Criteria or Policy and PEVs should not quote or cite this Commentary as a basis for assigning a shortcoming.

Although this Commentary is primarily intended to address the interpretation of the Environmental Engineering program criteria, there are some aspects of the General Criteria and the Accreditation Policy and Procedures Manual (APPM) that relate to the program criteria. These are discussed below.

Criterion 2. Program Educational Objectives

This criterion states that "the program must have published program educational objectives, as defined in these criteria, that are consistent with the mission of the institution and the needs of the program's various constituencies. There must be a documented, systematically utilized, and effective process, involving all constituencies identified by the program, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission and the needs of the program's constituencies." This criterion was changed by ABET in 2025 and became effective beginning with the 2026-27 accreditation cycle. A notable change in this criterion is the explicit statement that the PEO review must include all constituencies. Another change (effective with the 2024-25 accreditation cycle) was with regard to the definition of program constituency. Constituencies are defined by the program and should include those groups that have an interest in the program and are **able to provide meaningful input** regarding the program educational objectives. Some programs use members of their advisory boards to represent various constituencies, so there must be some assurance that the needs provided by board members are representative of their respective constituency groups. Employers or industry representatives on advisory boards need not have backgrounds in environmental engineering; however, such representatives should be knowledgeable in areas relevant to PEOs, such as employment opportunities and industry expectations for the skills, knowledge and abilities of environmental engineering graduates.

Criterion 3. Student Outcomes

ABET/EAC program criteria are curriculum and faculty requirements; they are not student outcomes. As such, programs are under no obligation to establish additional program-criteria-related student outcomes beyond those explicitly required by Criterion 3. If a program chooses to establish additional program-criteria-related student outcomes, then the program will need to assess the additional student outcomes.

PEVs are encouraged to review summer and intersession offerings of required and elective courses to verify that both the material covered and the attainment of student outcomes in these courses are consistent with those of the same courses offered in regular semesters.

Criterion 5. Curriculum

Criterion 5(a)

This criterion states that “The curriculum must include a minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program.” The EAC Criteria document defines basic sciences as “disciplines focused on knowledge on understanding of the fundamental aspects of natural phenomena. Basic sciences consist of chemistry and physics and other natural sciences including life, earth, and space sciences.” Coursework in Geographic Information Systems (GIS) and computer science usually does not meet the definition of a basic science. The EAC considers computer science to be engineering science; therefore, computer science credits should be counted in the engineering topics category.

Criterion 5(b)

This criterion states that “The curriculum must include a minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering and computer sciences and engineering design, and utilizing modern engineering tools.” Many environmental engineering curricula include coursework in GIS, and there is sometimes a question as to whether this coursework should be counted in the engineering topics category. GIS course credits can be counted towards engineering topics to the extent that the GIS course include engineering applications. Examples of such applications include infrastructure mapping, stormwater and watershed management, pollution mapping, hydrological modeling, and flood risk mapping. GIS course credits will normally not count towards engineering topics if the coursework focuses primarily on non-engineering applications such as database management, cartography without engineering analysis, or other non-technical visualization.

Criterion 5(d)

This criterion states that "The curriculum must include a culminating major engineering design experience that 1) incorporates appropriate engineering standards and multiple constraints, and 2) is based on the knowledge and skills acquired in earlier course work." If an environmental engineering program has a common major design experience with other programs, or environmental engineering students are participants in a multidisciplinary design project, the PEV should ensure that environmental engineering students are assigned design tasks that are based on the knowledge and skills acquired in their environmental engineering coursework. Therefore, the focus of the culminating major design experience for environmental engineering students should not be in external areas such as structural or transportation engineering, as might occur in joint environmental-civil engineering capstone courses. If the major design experience of environmental engineering students is not in a specialty area of environmental engineering, then this could be a shortcoming because Criterion 5 states that "The program curriculum must provide adequate content for each area, consistent with the student outcomes and program educational objectives, to ensure that students are prepared to enter the practice of engineering." If the major design experience is not in a specialty area of environmental engineering, then students are not being adequately prepared for the practice of environmental engineering.

The design of a field sampling system for collecting environmental data is usually not considered as environmental engineering design.

A possible scenario is that some project reports presented for review by the PEV do not incorporate appropriate engineering standards and multiple constraints. A mitigating factor might be the consideration that these elements were required and the directions were not followed by the students. In such cases, there must be strong supporting evidence, such as a design project requirements document, interim-report submittal feedback, grading rubrics, and instructor comments on the final report, that these components were required.

PEVs should be careful not to enforce additional requirements for the major design experience that are not stated in Criterion 5. For example, Criterion 5 does not require that drawings and cost estimates be part of the major design experience. Also, neither Criterion 5 nor the program criteria state that the faculty member(s) supervising the culminating major design experience must have expertise in environmental engineering.

Criterion 6. Faculty

Of relevance here is the Criterion 6 requirement that "The program must demonstrate that the faculty members are of sufficient number, and they have the competencies to cover all of the curricular areas of the program." It is generally expected that faculty members responsible for supervising environmental engineering students in culminating design experiences have competencies in the areas covered by the design projects.

Criterion 7. Facilities

This criterion requires that modern tools, equipment, computing resources, and laboratories appropriate to the program be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. In the context of environmental engineering, this includes commonly used laboratory tools and equipment. While older equipment can still offer educational value, care should be taken to ensure equipment remains relevant to current environmental engineering practice and reflects contemporary technology.

Environmental Engineering Program Criteria

The program criteria are divided into two sections: curriculum and faculty. The curriculum requirements specify topics that must be substantially covered in the required coursework of the environmental engineering program. Verification that a program meets the curriculum requirements can be done by reviewing the curriculum, course syllabi, and sample coursework, along with interviews with faculty members and students. The faculty requirements of the program criteria relate only to the qualifications of faculty members teaching design courses. Verification that a program meets the faculty requirements can be done by identifying the required design courses in the curriculum and reviewing the qualifications of the faculty members who teach these courses. More detailed guidance on evaluating compliance with the program criteria is provided in this document.

ABET/EAC Environmental Engineering Program Criteria

1. Curriculum

The curriculum must include:

a) Mathematics through differential equations, probability and statistics, calculus-based physics, chemistry (including stoichiometry, equilibrium, and kinetics), earth science, biological science, and fluid mechanics.
b) Material and energy balances, fate and transport of substances in and between air, water, and soil phases; and advanced principles and practices relevant to the program objectives.
c) Hands-on laboratory experiments, and analysis and interpretation of the resulting data in more than one major environmental engineering focus area, e.g., air, water, land, environmental health.
d) Design of environmental engineering systems that includes considerations of risk, uncertainty, sustainability, life-cycle principles, and environmental impacts.

e) Concepts of professional practice and project management, and the roles and responsibilities of public institutions and private organizations pertaining to environmental policy and regulations.

2. Faculty

The program must demonstrate that a majority of those faculty members teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, board certification in environmental engineering, or by education and equivalent design experience.

Program Criteria Commentary

1. Curriculum

a) Mathematics through differential equations, probability and statistics, calculus-based physics, chemistry (including stoichiometry, equilibrium, and kinetics), earth science, biological science, and fluid mechanics.

Mathematics through differential equations

Mathematics coursework should include calculus, which is the basis of differential equations. Calculus coursework typically covers the principles and applications of differentiation and integration, vectors and vector-valued functions, and multivariable and vector calculus. Coverage of differential equations typically includes ordinary and partial differential equations, and their corresponding solution techniques.

Probability and statistics

Probability and statistics are separate but related areas of study. Probability theory is used to quantify the likelihood that a single event or combination of events will occur, whereas statistics are used to quantify the characteristics of data or the relationships between data sets. Coverage of probability and statistics can be accomplished by having a mandatory course in probability and statistics, or by integrating substantial coverage of probability and statistics into one or more mandatory engineering courses.

Calculus-based physics

The curriculum could include at least one physics course that requires calculus as a prerequisite, or the curriculum could require a physics course in which differentiation and integration are taught within the course and are used to derive basic physical relationships.

Chemistry (including stoichiometry, equilibrium, and kinetics)

Chemistry coverage would normally include at least one course in general chemistry, and topics must include the basic principles of stoichiometry, equilibrium, and kinetics.

Earth science

This criterion can be met by a curriculum that requires at least one earth science course. If a separate earth science course is not required, then this criterion can be met by having in-depth earth science coverage within one or more required courses that cover other topics. This criterion can be met by having dispersed coverage of earth-science topics that include more than one earth-science discipline. Earth-science coverage in the curriculum must be primarily presented in the context of basic science rather than as engineering applications. If earth-science coverage is dispersed within multiple courses, the collective coverage must be substantial. Substantial coverage might be the equivalent of three credits of coursework in earth science; however, lesser coverage might also be acceptable depending on other factors such as curriculum context and depth of coverage. Evaluation will ultimately depend on the judgment of the PEV based on these guidelines. Earth sciences include but are not limited to the disciplines of geology, soil science, hydrologic science, meteorology, oceanography, and limnology. The emphasis of an earth science is on basic science rather than engineering, and therefore, courses such as geotechnical engineering, soil mechanics, and engineering hydrology might not normally have sufficient earth-science coverage to meet this criterion.

Biological science

This criterion can be met by a curriculum that includes at least one required course in biology, such as general biology or microbiology, or a course in a closely related area such as ecology or toxicology. If a separate biological science course is not required, then this criterion can be met by having in-depth biological science coverage within one or more required courses that also cover other topics. Biological science is the study of living things, and the emphasis of this criterion is on basic science rather than engineering. Courses such as water and wastewater engineering, wastewater treatment, and unit processes would not normally have sufficient biological science coverage to meet this criterion.

Fluid mechanics

This criterion can be met by requiring at least one course in fluid mechanics. If a separate fluid mechanics course is not required, then this criterion can be met by having in-depth fluid mechanics coverage within one or more required courses that cover other topics. Fluid mechanics is an engineering science, and the emphasis of this criterion is on scientific principles

b) Material and energy balances, fate and transport of substances in and between air, water, and soil phases; and advanced principles and practices relevant to the program objectives.

rather than engineering. Courses in open-channel flow and hydrology would not normally have sufficient fluid mechanics coverage to meet this criterion. Essential topics that are normally covered in the area of fluid mechanics include the principles of fluid statics and the dynamics of fluids under laminar and turbulent flow conditions.

Material and energy balances

Material balances are based on the law of conservation of mass, and energy balances are based on the law of conservation of energy, which is sometimes called the first law of thermodynamics. Coverage of material and energy balances can be either in a single course or distributed within several courses. Formulation of material and energy balances can be done using either control-volume or differential-analysis approaches.

Fate and transport of substances in and between air, water, and soil phases

"Fate" processes include physical, chemical, and biological transformations of substances, and "transport" processes include diffusion, dispersion, advection, interphase mass transport, and settling processes associated with the physical movement of substances present as atoms, molecules, or particulate phases. Fate and transport processes occur in all states of matter, and the criterion specifically requires that the curriculum contain coursework in the fate and transport of substances in and between air, water, and soil phases. The curriculum should include, as a minimum, coverage of interphase chemical equilibrium and the formulation and application of the advection-diffusion equation for non-conservative substances, with specific applications in environmental engineering. Examples of fate and transport topics that are relevant to environmental engineering include: mass transport across phase boundaries, models of biologically mediated decay, fate of pathogens in the environment, nutrient-biomass relationships, and the fate of nonaqueous phase liquids in soil and groundwater.

Advanced principles and practices relevant to the program objectives

The program must demonstrate that coursework in environmental engineering topics is advanced beyond introductory-level coverage in one or more of the recognized specialty areas of environmental engineering. Advanced principles are normally those principles taught in a second course in a subject area. The advanced coursework must support achievement of the program's educational objectives. For example, if a program's education objectives include graduates excelling in engineering practice, then the curriculum could include sufficiently advanced courses emphasizing the practice of environmental engineering for graduates to qualify for entry-level engineering positions. As another example, if the program's education objectives include having graduates successfully complete advanced studies in environmental engineering, then the program could demonstrate that students take advanced coursework expected of entry-level students at either the MS or PhD level. The distribution of emphasis on engineering analysis versus design is at the discretion of the program in meeting its educational objectives.

c) Hands-on laboratory experiments, and analysis and interpretation of the resulting data in more than one major environmental engineering focus area, e.g., air, water, land, environmental health.

This criterion is an extension of General Criterion 3(6) which requires "an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions". Within environmental engineering, the emphasis is on conducting laboratory experiments utilized in characterization, monitoring, process analysis, or pilot plant studies and then analyzing and interpreting the resulting data in the context of environmental engineering. Compliance with this program criterion can be demonstrated by showing that all program graduates have exposure to hands-on laboratory experiences within the curriculum that relate to processes in at least two different environmental engineering focus areas. Relevant environmental engineering focus areas are: air pollution control, solid and hazardous waste management, industrial hygiene, and water supply/wastewater. The "hands-on" requirement of this criterion normally precludes virtual labs; however, under unusual circumstances, such as a pandemic or local disaster, virtual labs might be necessary and acceptable. Care should be taken to separately identify laboratory experiments relating to the different environmental engineering focus areas. For example, gravimetric analysis of solids content, determination of concentrations of indicator organisms, and determination of both the solubility and the concentration of dissolved oxygen ~~in water~~ all relate to water. The aforementioned laboratory experiences are basically all water-quality analyses. Laboratory experiences in environmental health could also be appropriate as a separate focus area if the curriculum provides laboratory experiences in such areas as environmental toxicology, pathogen and/or indicator-organism quantification, industrial hygiene, and noise pollution.

Laboratory training relating to safety and hygiene is not a requirement of the program criteria, such training is related to the APPM laboratory safety requirement.

Surveying exercises are not to be considered as laboratory experiments in environmental engineering curricula.

d) Design of environmental engineering systems that includes considerations of risk, uncertainty, sustainability, life-cycle principles, and environmental impacts.

The General Criteria provides a detailed definition of engineering design. The ABET definition of engineering design is given below for ready reference:

Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-

making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. Engineering design involves identifying opportunities, developing requirements, performing analysis and synthesis, generating multiple solutions, evaluating solutions against requirements, considering risks, and making tradeoffs, for the purpose of obtaining a high-quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability.

The breadth of design experiences across the curriculum should reflect the breadth of the environmental engineering discipline (air, water, land), however, there are no requirements for the design to be applied to any specific medium. The design constraints must include a minimum of the following five considerations: risk, uncertainty, sustainability, life-cycle principles, and environmental impacts, although other constraints may be included. Although applications and contexts can be quite variable, consideration of risk is usually expressed either in terms of health risk, ecological risk, or in terms of probability of failure of a system; uncertainty is usually expressed in terms of a range of possible outcomes of an event or variable; sustainability relates to practices that support ecological, human, and economic health while meeting the needs of the present and not compromising the ability of future generations to meet their needs; life-cycle principles usually relate to quantifying the environmental impacts of the manufacture, use, maintenance, and final disposal of a material or product; and environmental impacts usually relate to quantifying or describing alterations of the natural environment resulting from a given activity.

The five considerations stated in this criterion do not have to be covered in a single course, such as the capstone design course, they could be covered across many environmental engineering courses. Coverage of these topics does not have to be extensive.

e) Concepts of professional practice and project management, and the roles and responsibilities of public institutions and private organizations pertaining to environmental policy and regulations.

Elements within this criterion can be covered either in a single course or in multiple courses across the curriculum. Environmental engineers are professionally engaged across a wide spectrum of business, governmental, and non-profit organizations. Coverage of concepts of professional practice usually includes such topics as engineering economics, professional ethics, and engineer-client-stakeholder relationships. Project management usually includes coverage of the roles and responsibilities of various parties within a project; topics related to project management are sometimes covered and practiced within team-based exercises such as design projects. Relevant curricula topics include: the roles and responsibilities of the various public institutions responsible for setting environmental policies, passing laws, developing regulations, and enforcing those regulations through permits; the roles and responsibilities of private organizations to comply with applicable environmental regulations, and to shape public policy; and the mandate of professional engineers to protect the public trust regardless of the employment sector.

2. Faculty

A majority of those faculty members teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, board certification in environmental engineering, or by education and equivalent design experience.

The program normally identifies courses that are primarily design, and the credentials of the faculty members teaching these design courses are evaluated. The PEV should also review the content of all required engineering courses to ensure that all design courses have been identified. Qualifications of faculty teaching elective design courses are not considered under this criterion.

The requirement of professional licensure is generally met by registration as a Professional Engineer within the United States. Equivalent professional registration obtained in other countries can also meet the requirement of professional licensure, and the PEV will need to make a judgment as to equivalence of registration standards. In some countries, registration as a professional engineer simply requires having a degree in engineering, with no experience requirement; this would not be equivalent to professional licensure as understood in the United States. The discipline in which a faculty member is registered and the practice area of the faculty member should be closely aligned with the course(s) being taught. Board certification in environmental engineering is normally met via BCEE certification by the American Academy of Environmental Engineers and Scientists (AAEES). Other AAEES certifications such as BCEEM and BCES do not require design experience, and therefore, the design qualifications of faculty members with these certifications should be reviewed in more detail. The ASCE certification Board Certified Water Resources Engineer (BC.WRE) (formerly Diplomate Water Resources Engineer, D.WRE) is an acceptable qualification for faculty members teaching design courses. In the absence of acceptable credentials, such as P.E., BCEE, or BC.WRE, qualifications by virtue of education and equivalent design experience, can require that the instructor have both the appropriate academic training and satisfy the minimum design experience required to become a licensed professional engineer.

ABET Accreditation Policy and Procedure Manual (APPM)

Section I.E.5.b. (1) of the APPM requires that PEVs examine the facilities used by a program "to assure the instructional and learning environments are adequate and are safe for the intended purposes. Neither ABET nor its representatives offer opinions as to whether, or certify that, the institution's facilities comply with any or all applicable rules or regulations pertaining to: fire, safety, building, and health codes, or consensus standards and recognized best practices for safety."

Facilities include laboratories, classrooms, and any other facilities used for instruction. PEVs should exercise their professional judgement when assessing whether a facility is "safe for the intended purpose." Examples of unsafe conditions include 1) extension cords running along the floor and creating a tripping hazard, 2) students handling hazardous substances without adequate PPE, 3) essential safety equipment such as fume hoods, emergency showers, eyewash stations, and fire extinguishers have not been provided or recently inspected or are not in working order, 4) safety signage is absent or not visible, 5) materials are not stored appropriately (e.g., flammable materials are not to be in refrigerators, reactive chemicals are not to be stored together), and 6) gas cylinders are not secured properly. It is prudent for a PEV to ask faculty members and technicians who teach the laboratory courses what safety protocols are in place for classes and what training is required. It is also prudent for a PEV to request documentation on whether the Environmental Health and Safety (EHS) unit of the institution has inspected and certified the laboratory facilities used by students. Interviewing EHS personnel and/or using best professional judgement to assess whether the facility is safe for its intended purpose are appropriate. A PEV should not cite a particular rule, regulation, code, standard, or best practice as a basis for assigning a shortcoming.

If there is a clear safety violation observed during the visit, it should immediately be brought to the attention of the Program Head or Chair. If feasible, any safety violations should be corrected before the evaluation is presented during the exit meeting.