ABET EAC Civil Engineering Program Criteria

Review and Commentary for Program Evaluators and Civil Engineering Programs

AMERICAN SOCIETY OF CIVIL ENGINEERS

For CE Program Criteria implemented in 2024-25 Review Cycle

Legend

As a convenience for Faculty and Program Evaluators who are experienced with ABET accreditation and the CE Program Criteria (CEPC), the following annotations are provided on all remaining slides in this presentation:

= No change from previous CEPC

= Minor change from previous CEPC

= Significant change from previous CEPC

Relevant sections of the **Commentary** are cited as:

1.a.i = Commentary Section 1.a.i

ABET EAC Criteria

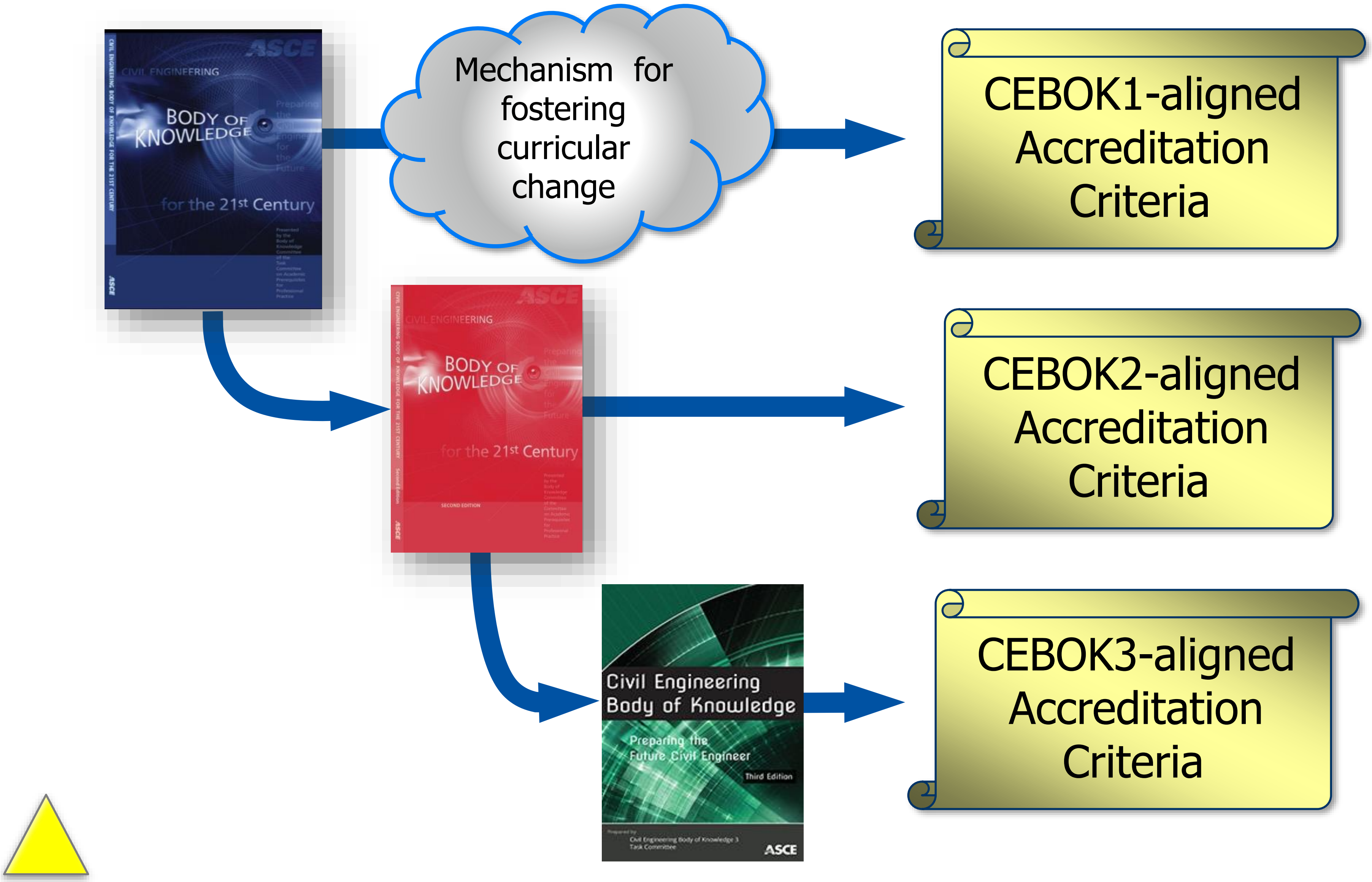
- The ABET EAC Criteria consist of eight General Criteria plus program-specific criteria.

- The program-specific criteria are divided into two parts:
  1. Curriculum
  2. Faculty

Why Change?

- Maintain alignment between the ASCE Civil Engineering Body of Knowledge (CEBOK) and the CE Program Criteria (CEPC)
  - Updated on an 8-year cycle
  - CEBOK 3rd Edition (CEBOK3) published in 2019
  - Civil Engineering Program Criteria now being updated for alignment with CEBOK3
- ABET EAC directed that Program Criteria wording must not imply student outcomes

Background: The BOK and CEPC



BOK & CEPC Development

Event	BOK 3rd Ed.	BOK 4th Ed.
CEBOK update initiated	Oct 2016	Oct 2024
New CEBOK edition published	Mar 2019	Mar 2027
Draft CE Program Criteria published	Mar 2022	Mar 2030
CE Program Criteria (CEPC) approved	Oct 2023	Oct 2031
First reviews under new CEPC	Sept 2024	Sept 2032

8 year cycle

CE Program Criteria (Effective 2024-25)
Curriculum

1) Curriculum

The curriculum must include:

a) Application of:

i) mathematics through differential equations, probability and statistics, calculus-based physics, chemistry, and either computer science, data science or an additional area of basic science

ii) engineering mechanics, materials science, and numerical methods relevant to civil engineering

iii) principles of sustainability, risk, resilience, diversity, equity, and inclusion to civil engineering problems

iv) the engineering design process in at least two civil engineering contexts

v) an engineering code of ethics to ethical dilemmas

b) Solution of complex engineering problems in at least four specialty areas appropriate to civil engineering

c) Conduct of experiments in at least two civil engineering contexts and reporting of results

d) Explanation of:

i) concepts and principles in project management and engineering economics

ii) professional attitudes and responsibilities of a civil engineer, including licensure and safety.

CHANGES IN WORDING OR REQUIREMENTS FROM PREVIOUS PROGRAM CRITERIA ARE HIGHLIGHTED IN PINK

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 following provision has been deleted: “The program must demonstrate that it is not critically dependent on one individual.”

Commentary on the civil engineering program criteria and all things ABET can be downloaded from ASCE's [website](https://www.asce.org/career-growth/educators/accreditation-and-abet)

Commentary on the ABET Program Criteria for Civil and Similarly Named Programs

Effective for 2024-2025 Accreditation Cycle

Initial Issue (Rev. 0), January 2024

By the ASCE Civil Engineering Program Criteria Task Committee

Subsequent revisions

By the ASCE Committee on Accreditation Operations

https://www.asce.org/career-growth/educators/accreditation-and-abet

CE Program Criteria

1. Curriculum

Notes on CE Curricular Requirements

- Curricular requirements ***are not student outcomes*** and, as such, do not require assessment and evaluation
- If a program chooses to incorporate one or more elements of curricular requirements into its stated Student Outcomes, then assessment and evaluation in accordance with Criterion 4 is required
- The Task Committee’s intent was to give Programs a high degree of flexibility in meeting these requirements

Mathematics and Basic Science

1.a.i

a) Application of:

i) mathematics through differential equations, probability and statistics, calculus-based physics, chemistry,

and

either computer science, data science or an additional area of basic science

Mathematics, Physics, Chemistry

1.a.i

- Specific courses are not required, but most of this criterion is typically met by coursework in:
  - Calculus with coverage of differentiation, integration, and applications of calculus in engineering problems
  - Differential Equations
  - Probability and Statistics
  - College-level Physics with Calculus as a prerequisite or corequisite
  - College-level Chemistry
- Applications:
  - Can be in any relevant course(s)
  - Do not have to be in an engineering context

Normally met through Criterion 5, 30 semester hours of Math and Basic Science

Additional Area of Science

1.a.i

- Requires that students be exposed to a third area of science to develop greater science *breadth* (beyond physics and chemistry)
- Additional areas of basic science may include natural or life sciences, such as biology, ecology, geology, meteorology, or others
- No requirement for all students to have exposure to the same additional area of science
- Exposure to computer science or data science topics ***(next slide)*** can be used in lieu of exposure to basic science

ASCE

Computer or Data Science

1.a.i

- Curricular content and applications could be from a wide variety of theoretical and applied fundamentals related to computation, computers, automation, and information management systems
- Topics might include machine learning, artificial intelligence, data structures and management, network science, data analytics, etc.
- There is no requirement for all students to have exposure to the same computer or data science
- Curricular content devoted primarily to learning a computer language would not satisfy this criterion
- Exposure to an additional area of basic science ***(previous slide)*** can be used in lieu of computer science or data science

Important Caveats

1.a.i

CAUTION:

- Curricular content devoted primarily to learning a computer language would not demonstrate sufficient depth in either computer science or data science fundamentals to satisfy this provision
- Computer science courses do not meet the EAC/ABET Criterion 5 requirements for 30 semester credit hours of college-level mathematics and basic sciences

a) Application of:

ii) engineering mechanics, materials science, and numerical methods relevant to civil engineering

Engineering Mechanics

1.a.ii

- **Mechanics** - Behavior of systems under the action of forces
- Program can define scope, but most programs include coursework in Statics, Mechanics of Solids, and Fluid Mechanics
- Coursework may be offered by other programs or departments
- Some applications must be relevant to civil engineering

ASCE

Materials Science

1.a.ii

- **Materials Science** - Scientific study of properties of solid materials and how a material's composition and structure determine those properties
- Separate course not required
- CE course not required, but applications must be relevant to CE
- No requirement for all students to be exposed to same content
- Examples of CE-related topics:
  - Corrosion and prevention measures
  - Behavior of asphalt binder under varying environmental conditions
  - Fatigue in metals and composite materials

Other examples provided in Commentary

Numerical Methods

1.a.ii

- **Numerical Method** - A mathematical method that solves a continuous problem using numerical approximation
- Included topic(s) should address problem definition, application of a mathematical model, formulation of the numerical model, and evaluation of results
- Separate course not required
- CE course not required, but applications must be relevant to CE
- No requirement for all students to be exposed to same content
- Examples of CE-related topics:
  - Curve-fitting of lab data
  - Stiffness or Flexibility Methods for Structures
  - Pipe network analysis
  - Other examples provided in Commentary

Other examples provided in Commentary

Sustainability, Risk, Resilience, Diversity, Equity, and Inclusion

1.a.iii

a) Application of:

iii) principles of sustainability, risk, resilience, diversity, equity, and inclusion to civil engineering problems

Sustainability, Risk, Resilience 1.a.iii

- Definitions for civil engineers:
  - **Sustainability** – A set of economic, environmental, and social conditions in which society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality, or the availability of resources
  - **Risk Assessment** – Characterization of the potential adverse effects that hazards can inflict on people, property or the environment
  - **Resilience** – Ability of a system to withstand an extreme event and recover efficiently
- No specific principles of sustainability, risk, or resilience are required
- Principles must be applied to engineering problems, *not necessarily to engineering design*
- No requirement to include in all student experiences or in multiple contexts

Sustainability, Risk, Resilience 1.a.iii

Examples of compliance in a CE context:

- Sustainability
  - Selection of construction materials including alternatives
  - Project impact on land, water and air resources
  - Use of scorecards like LEED, Green Globes, ENVISION to rate projects
- Risk
  - Impact of various natural hazards
  - Inability to fully characterize a setting
  - Variability in demand for traffic or hydraulic design
- Resilience
  - Use of redundant elements (structures, hydraulics)
  - Impact of road outages and recovery times
  - Case studies of failures

Other examples provided in Commentary

Diversity, Equity, and Inclusion 1.a.iii

- Definitions (from ASCE Policy Statement 417):
  - **Diversity -** Range of human differences, encompassing the characteristics that make one individual or group different from another.
  - **Equity** - Fair treatment, access, opportunity, and advancement for all people, achieved by intentional focus on their disparate needs, conditions, and abilities.
  - **Inclusion** - Intentional, proactive, and continuing efforts and practices in which all members respect, support, and value others.
- Application of DEI to civil infrastructure solutions:
  - Incorporate perspectives that represent the diversity of served communities
  - Ensure engagement of stakeholders from various backgrounds and identities
  - Seek to meet the needs of all stakeholders equitably

Diversity, Equity, and Inclusion 1.a.iii

- Separate course not required
- Can be taught by faculty from other disciplines
- Not redundant with General Criterion 5
  - Criterion 5 provision only requires “[curricular] content that ensures awareness” of DEI
  - ASCE’s position is that DEI should be integrated into civil engineering problem-solving

Diversity, Equity and Inclusion 1.a.iii

Examples of Compliance:

- Exposure to ASCE 73-23, Ch. 2 & 3, which address leadership and quality of life assessment for infrastructure projects
- Using rating systems such as Greenroads, Green Globes, ENVISION, or LEED to introduce metrics for societal well-being
- Using case studies to show how past CE projects have adversely affected underserved communities
- Using case studies to show how past CE projects have successfully met the needs of one or more underserved communities

Other examples provided in Commentary

Engineering Design Process

1.a.iv

a) Application of:

iv) the engineering design process in at least two civil engineering contexts

Changed from: “design a system, component, or process”

ABET Definition of Engineering Design:

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 trade- offs, for the purpose of obtaining a high-quality solution under the given circumstances.

Engineering Design Process

1.a.iv

- Engineering design typically includes both analysis and synthesis; analysis without synthesis is not design
- Students should have some iterative design in the curriculum, but not all design experiences need be iterative
- Engineering design does not necessarily involve the devising of a complete system; a component or subsystem constitutes an acceptable design experience

Engineering Design Process

1.a.iv

- Students should have exposure to design problems that are incompletely defined and open-ended

- Exposure should be in at least two civil engineering contexts

- Engineering standards and realistic constraints are critical in civil engineering design; the program must show that standards and codes are taught and applied

ASCE

Engineering Code of Ethics

1.a.v

a) Application of:

v) an engineering code of ethics to ethical dilemmas

Changed from: “analyze issues in professional ethics”

Engineering Code of Ethics

1.a.v

- Expose students to reading, understanding, and applying a code of ethics to specific professional situations

- The most common codes of ethics for civil engineers are ASCE and NSPE

Engineering Code of Ethics

1.a.v

Examples of Compliance:

- Require a course or module in engineering ethics, which includes the application of the ASCE Code of Ethics or other code to a specific design or professional situation
- Cover ethical dilemmas within a course, referencing a specific design or professional situation
- Apply ENVISION in the classroom as an evaluation tool to engage students in a discussion of ethics
- Provide seminar presentations from practicing professionals on real-world ethical dilemmas and possible solutions based on applying a code of ethics

Other examples provided in Commentary

Complex Engineering Problems 1.b

b) Solution of complex engineering problems in at least four specialty areas appropriate to civil engineering

Changed from: “analyze and solve problems in at least four technical areas appropriate to civil engineering”

ASCE

Complex Engineering Problems 1.b

ABET Definition of Complex Engineering Problems:

Complex engineering problems include one or more of the following characteristics: involving wide-ranging or conflicting technical issues, having no obvious solution, addressing problems not encompassed by current standards and codes, involving diverse groups of stakeholders, including many component parts or sub-problems, involving multiple disciplines, or having significant consequences in a range of contexts.

Complex Engineering Problems 1.b

- Generally recognized, but non-exhaustive, list of civil engineering specialty areas:
  - Structural
  - Environmental
  - Transportation
  - Geotechnical
  - Construction
  - Water Resources
  - Hydraulics/Hydrology
  - Surveying/Measurement
- New specialty areas will emerge as civil engineering evolves
- The program must demonstrate that a non-standard specialty area is appropriate
- See Commentary for possible justifications

Complex Engineering Problems

1.b

- Most programs include these problems in specialty-area courses
- If capstone experience is used to satisfy this requirement, all four areas must be addressed in the course or project
- Only one of the seven elements listed in the ABET definition is required for a problem to be complex

Examples of compliance provided in Commentary

Conduct of Experiments

1.c

c) Conduct of experiments in at least two civil engineering contexts and reporting of results

The phrase “analyze and interpret the resulting data” has been deleted.

Conduct of Experiments

1.c

- Student laboratory experiences include exposure to experimental procedures and data reporting in areas associated with civil engineering projects, for example, but not limited to:
  - Soil properties
  - Properties of structural materials (e.g. steel, concrete, wood)
  - Water and wastewater properties
  - Performance of transportation systems
- Reporting of results may include analysis, interpretation, and conclusions; however, these are General Criteria requirements and thus are not required to be in the CE lab component

c) Explanation of:

i) concepts and principles in project management and engineering economics

The phrase "business, public policy and leadership" has been deleted.

Project Management

1.d.i

- The use of “explanation” in this provision implies that curricular coverage need not be extensive
- The criterion focuses on project management, not just general management
- Examples of project management coverage:
  - Project work plans, scope, deliverables, budget and schedule preparation and monitoring
  - Interaction with non-civil engineering disciplines
  - Contract negotiation
  - Quality assurance and quality control
  - Dispute resolution processes

Other examples provided in Commentary

Engineering Economics

1.d.i

- Examples of engineering economics coverage:
  - Time value of money
  - Categorization of costs
  - Depreciation and taxes
  - Type and breakdown of costs
  - Financial statements
  - Estimation of cash flows
  - Return on investment
- Exposure to engineering economics may be through a stand-alone course or integrated into other courses

Professional Attitudes and Responsibilities

1.d.ii

d) Explanation of:

ii) professional attitudes and responsibilities of a civil engineer, including licensure and safety.

Changed from: "explain the importance of professional licensure."

Professional Attitudes and Responsibilities

1.d.ii

- The use of “explanation” in this provision implies that curricular coverage need not be extensive; a separate course is not necessary
- Two key professional responsibilities—licensure and safety—must be addressed in the curriculum
- Coverage of safety could include safety in design, and/or construction site safety, and/or occupational safety
- Other professional responsibilities could include credentialing, innovation, legal issues, knowledge of history and heritage, cultural perspectives, public policy, and global perspectives
- Professional attitudes include creativity, curiosity, flexibility, dependability, and others

Examples of compliance provided in Commentary

Program Criteria:

2. Faculty

45

Faculty

2

Faculty teaching courses that are primarily design in content must be qualified to teach the subject matter by virtue of professional licensure, or by education and design experience.

The provision "The program must demonstrate that it is not critically dependent on one individual" has been deleted.

Faculty

2

- Design courses in the curriculum must be identified
- If the faculty members teaching design courses are professionally licensed, then the criterion is met
- If an unlicensed faculty member is teaching a design course, then the program must demonstrate that the faculty member is qualified by virtue of education and design experience

Faculty

2

Examples of materials demonstrating that a faculty member is qualified by education and experience:

- Licensure in a closely related field
- Certification in a relevant discipline or specialty
- Educational history
- Continuing education record
- Employment record (design experience)

Questions?

Please submit your questions in the chat window.

Thank you!

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