2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #37250

Preparing the Future Civil Engineer: ASCE's Proposed Revision of the ABET Civil Engineering Program Criteria – Implementation Tools

Dr. David A. Dzombak, P.E., Carnegie Mellon University

David Dzombak is Hamerschlag University Professor Emeritus in Civil and Environmental Engineering at Carnegie Mellon. His professional focus is on water quality engineering, environmental restoration, and energy-environment issues.

Wayne R. Bergstrom

Dr. Bergstrom is a Principal Engineer and Fellow at Bechtel Infrastructure and Power Corporation.

Dr. Jay A. Puckett, P.E., University of Nebraska, Lincoln
Dr. Stephen J. Ressler, P.E., United States Military Academy, West Point

Stephen Ressler, P.E. Ph.D., Dist.M.ASCE, F.ASEE is Professor Emeritus from the U.S. Military Academy (USMA) at West Point. He earned a B.S. degree from USMA in 1979, a Master of Science in Civil Engineering from Lehigh University in 1989, and a Ph.D. in Civil Engineering from Lehigh University in 1991.

Ms. Leslie Nolen, C.A.E., American Society of Civil Engineers

Leslie Nolen, CAE, serves as director, educational activities for the American Society of Civil Engineers. She brings over 25 years of association management experience to her work with ASCE's Committee on Education on issues of importance to the undergraduate education of civil engineers.

Preparing the Future Civil Engineer: ASCE's Proposed Revision of the ABET Civil Engineering Program Criteria – ABET Approvals and ASCE Implementation Support

ABSTRACT

The American Society of Civil Engineers (ASCE) employs a systematic approach to aligning the civil engineering profession's needs with its education and practice standards. The primary tools involved in this approach are the Civil Engineering Body of Knowledge (CEBOK) and the program criteria for ABET-accredited civil engineering programs, which are developed with substantial community review and input. Both the CEBOK and the Civil Engineering Program Criteria (CEPC) are reviewed by ASCE committees and revised, if deemed necessary, on an eight-year cycle.

In May 2019, ASCE published the Civil Engineering Body of Knowledge, 3rd Edition (CEBOK3). ASCE then convened a Civil Engineering Program Criteria Task Committee (CEPCTC) in January 2020 to review the current ABET Civil Engineering Program Criteria and propose revisions, if needed, based on (1) the publication of the CEBOK3, (2) a major revision to the EAC/ABET General Criteria which became effective for reviews during the 2019-2020 accreditation cycle, and (3) compliance with guidance from EAC/ABET on curricular topics and faculty qualifications.

This paper is the third in a series to describe the efforts by ASCE and the CEPCTC in reviewing and revising the Civil Engineering Program Criteria. The first paper, presented at the 2021 ASEE National Conference, documented the formation of CEPCTC and its development of an initial draft of proposed CEPC revisions. The second paper, presented at the 2022 ASEE National Conference, focused on a) the solicitation and collection of feedback from a broad community of stakeholders regarding the initial 2021 draft of proposed CEPC changes, and b) further revisions to the proposed CEPC in response to that feedback. This third paper describes the changes to the CEPC resulting from the first phase of the ongoing ABET review and approval process and focuses on the development of commentary and training materials to support the proposed CEPC implementation and use. These materials support programs and program evaluators (PEVs). Although not officially part of the CEPC, these supplementary materials help explain the intent of the CEPC and offer best practices, references to literature, PEV training, and other helpful resources.

This paper will aid in understanding and implementing the revised Civil Engineering Program Criteria by the education and professional communities. It is also hoped that ABET's Member Societies might be encouraged by this series of papers to share their approaches to program criteria development, thereby fostering a "best practices" dialogue for the betterment of the engineering profession.

INTRODUCTION

Purpose and Scope

Revisions to the ABET Engineering Accreditation Commission (EAC) Civil Engineering Program Criteria (CEPC) [1] have been proposed by ASCE to align with the most recent edition of the ASCE Civil Engineering Body of Knowledge [2]. This paper summarizes the current status of the proposed revisions and the steps being taken to assist in their implementation. It is the third in a series of papers intended to document the CEPC revision process. The first paper in the series, "Preparing the Future Civil Engineer: Review and Update of the ABET Civil Engineering Program Criteria" [3], was presented at the 2021 ASEE Annual Conference and describes the overall process -that produced the first draft of the updated CEPC. The second paper, "Preparing the Future Civil Engineer: ASCE's Proposed Revision to the ABET Civil Engineering Program Criteria" [4], was presented at the 2022 ASEE Annual Conference. It describes the solicitation and incorporation of stakeholder feedback which resulted in the final set of proposed CEPC revisions, which were submitted to ABET for consideration and approval.

The scope of this paper includes:

- a brief overview of the initial revision process and the draft CEPC revisions;
- a summary of the stakeholder feedback process that resulted in the final proposed CEPC;
- actions taken by ABET to further modify and approve the CEPC on first reading;
- actions taken by ASCE to develop a commentary to help civil engineering faculty and program evaluators attain a common understanding of the CEPC;
- a summary of the remaining ABET approval process for the revised CEPC; and
- an outline of the remaining efforts that ASCE will take to assist in the implementation of the revised CEPC.

The authors of this paper are currently serving as members of ASCE Civil Engineering Program Criteria Task Committee (CEPCTC), which was formed in January 2020 and tasked with the review and possible revision of the CEPC.

Background

The CEPCTC was formed by ASCE to review the existing CEPC in light of the CEBOK3 [2], and to propose revisions if warranted. This is part of a recurring eight-year cycle which is intended to assure that the Civil Engineering Body of Knowledge, and the education criteria intended to foster the start of the acquisition of that body of knowledge, remain aligned.

After considering the combined requirements in the modified ABET EAC General Criteria (implemented in the 2019-2020 accreditation cycle) and the existing CEPC, the CEPCTC identified some misalignment with the General Criteria and with the CEBOK3. In addition, the EAC asked for revisions in the existing CEPC, as well as in other program criteria, to avoid language that implied student outcomes in the curricular criteria. As a result, the committee

developed revisions to the CEPC and completed a draft update of the CEPC in April 2021. This draft was publicized [3] and was distributed to a broad stakeholder community for review and comment. Stakeholder input resulted in further revisions, and the final proposed CEPC [4] were approved by ASCE in April 2022. The proposed CEPC were submitted to ABET for review and approval in May 2022, and are provided in Appendix A of this paper.

The overall process that has led to the development of revised CEPC, and the associated training Commentary, is outlined in Table 1. Those activities shown in bold typeface have been completed since preparation of our previous publication [4] and are documented herein.

Table 1 – Revised Civil Engineering Program Criteria Timeline

Activity	Timeline
Develop ASCE CEBOK3	2016 – 2019
Solicit nominations and form CEPC Task Committee	July 2019 – January 2020
Review CEBOK3 Outcomes and current EAC criteria	February – August 2020
Develop Draft CEPC revision	September 2020 – March 2021
Finalize Draft CEPC	April 2021
Solicit stakeholder feedback on Draft CEPC	May – August 2021
Collect stakeholder feedback on Draft CEPC	May – August 2021
Present Draft CEPC at ASCE Dept Heads Conference	June 2021
Present paper on Draft CEPC at ASEE Conference	July 2021
Collate and assess stakeholder feedback	August – October 2021
Revise Draft CEPC based on stakeholder feedback	November – December 2021
Finalize Proposed CEPC and submit to ASCE	December 2021
Review of Proposed CEPC by ASCE for approval	December – April 2021
Submit Proposed CEPC to ABET	May 2022
Present CEPC update at ASCE Dept Heads Conference	June 2022
Present paper on Draft CEPC at ASEE Conference	June 2022
ABET EAC First Reading of CEPC	**July 2022**
ABET EAD First Reading of CEPC	**October 2022**
Develop Draft Commentary on CEPC	**November 2022**
Solicit stakeholder feedback on Commentary	**February-April 2023**
ABET Public Comment Period on CEPC	November 2022 – June 2023
EAC/ABET Second Reading of CEPC	July 2023
EAD/ABET Second Reading of CEPC	October 2023
Finalize and publish Commentary	December 2023
First accreditation cycle for which CEPC will be effective	2024-2025

Note - Bold typeface in Table 1 denotes the process activities reported in this paper.

STATUS OF THE CIVIL ENGINEERING PROGRAM CRITERIA – ABET ACTIONS

EAC Revisions to the Proposed CEPC

In July of 2022, the Criteria Committee of ABET's Engineering Accreditation Commission (EAC) chose to make two modifications to the proposed CEPC. In the first of these, criterion 1.a.i was modified from:

> "mathematics through differential equations, probability and statistics, calculus-based physics, chemistry, and least one additional area of basic or formal science"

to read as follows:

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

The EAC Criteria Committee objected to the term "formal science" in the proposed CEPC, and its potential for being misunderstood and inconsistently applied. Nevertheless, the substitution of computer science or data science (terms which are perhaps more widely understood) is consistent with ASCE's intent to allow applicable fields of formal science to meet the requirement for an additional area of science instruction.

The EAC Criteria Committee also inserted the term "engineering" into the term "complex problems" in criterion 1.b. of the proposed CEPC. This more clearly invokes the EAC definition of "complex engineering problems" in the Definitions section of the ABET EAC "Criteria for Accrediting Engineering Programs" [1], and is also consistent with ASCE's intent.

With these revisions, the EAC Criteria Committee approved the following proposed CEPC and submitted it to the EAC for consideration.

Proposed Program Criteria for Civil and Similarly Named Engineering Programs
Lead Society: American Society of Civil Engineers

These program criteria apply to engineering programs that include "civil" or similar modifiers in their titles.

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

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.

The proposed CEPC, as revised by the EAC Criteria Committee, are also provided in Appendix B, where the changes implemented by the EAC are indicated.

First Reading by the EAC and EAD

Following these revisions, the EAC of ABET approved the proposed CEPC on first reading in July of 2022. The Engineering Area Delegation (EAD) of the ABET Board of Delegates similarly approved the proposed CEPC on first reading at its meeting in October of 2022.

Public Comment Period and the Second Reading by the EAC and EAD

ABET subsequently published the proposed CEPC and opened a public comment period. The EAC will consider comments received through mid-June 2023 before its second reading in July of 2023. If approved, the EAD will hold its second reading in October 2023, and if approved, the new CEPC will probably be implemented for accreditation visits starting in the 2024-2025 accreditation cycle.

ASCE's IMPLEMENTATION SUPPORT – THE CEPC COMMENTARY

With any set of standards, rules, or criteria, questions of interpretation always arise regarding terminology and phrasing, and the EAC Accreditation Criteria are no exception. While conducted within a defined framework and monitored process, ABET program evaluation is an inherently subjective process. ABET provides opportunities for educators and evaluators to share a common understanding of its rules, processes, and general criteria through training sessions, workshops, the annual ABET Symposium, and website resources. As the lead society responsible for proposing revisions to the CEPC and for providing and training the PEVs for evaluation of civil engineering programs, ASCE has a strong interest in fostering a similar,

common understanding of the CEPC among civil engineering educators and program evaluators. ASCE has long encouraged such a common understanding through its "Commentary on the ABET Program Criteria for Civil and Similarly Named Programs" [5], herein termed the Commentary. To aid in implementing the revised CEPC, the Task Committee has substantially revised the Commentary.

What is the Commentary, and What is it Not?

In simplest terms, the Commentary is an explanation of the Task Committee's intent (and, by extension, ASCE's intent) relative to the primary elements of the revised CEPC. It explains the background and context for the CEPC and the Task Committee's expectations for significant flexibility in curriculum design and program evaluation. In this document, the Task Committee cites published resources and suggests example approaches that can meet the intent of the CEPC. The revised Commentary is intended as a guide for educators and PEVs alike to share a common understanding of the revised CEPC, and is a vehicle for substantive discussion when ambiguities in the CEPC inevitably arise from alternative perspectives and interpretations.

Perhaps more importantly, we must clarify what the Commentary is not. It is not intended to be a prescriptive manual and has been written with this in mind. It is not a rigid set of evaluation requirements or a list of required courses. It is not "shadow criteria," in that it does not add to, or detract from, the CEPC or any other applicable EAC criteria. It does not modify any ABET rule or procedure.

Preparation of the Commentary

Drafting of the revised Commentary began with the formation of a subcommittee of the CEPC Task Committee at the end of 2021. Individual sections were assigned to subcommittee members for drafting, and the subcommittee in conference conducted collating of these sections. The full Task Committee provided review and comment late in 2022, as the draft was being completed. The draft document was then shared with the ASCE Committee on Accreditation Operations (COAO) for their review and comment.

The revised Commentary contains some explanatory information to help civil engineering faculty and PEVs understand the background of the revised CEPC. Many stakeholders may already be aware of this background information. However, this synopsis will be provided as a resource to help all stakeholders, whether fully informed or not about the revised CEPC, acquire a shared common understanding of the CEPC development.

The revised Commentary includes sections on each of the 12 elements of the curricular requirements and the element on faculty requirements contained in the revised CEPC. Each of these 13 sections discusses the Task Committee's perspectives regarding the subject requirement and outlines actions that programs could take to meet each requirement. References to published resources are also provided to further inform the stakeholders' perspectives on specific CEPC requirements. A limited number of definitions are also provided in the revised Commentary to aid in understanding the CEPC, but terms that are defined elsewhere within the ABET criteria [1]

retain the ABET definition; no re-definition of such terms is provided in the revised Commentary nor was any such re-definition intended by the Task Committee.

Stakeholder Review and Comment

The draft of the revised Commentary was distributed in February 2023 for stakeholder review and input. The stakeholders for this document primarily include the chairs and faculty of accredited civil engineering programs and civil engineering PEVs. An online forum for comments and discussion on the ASCE Collaborate website provided the opportunity to gather feedback from the aforementioned stakeholders as well as others in the civil engineering accreditation community. A similar approach was followed successfully to solicit feedback during the Task Committee's preparation of the proposed CEPC [4]. This forum collected feedback from February through April of 2023.

Completion and Publication

After receipt of stakeholder comments, the Task Committee will reconsider the draft revised Commentary once more in light of the feedback; further document revisions are likely during May and June of 2023. Assuming the EAC approves the latest revised CEPC on second reading in July, unchanged or with only minor changes, the new Commentary will then receive final copy-editing by ASCE, with final approval by the Task Committee scheduled for August. The completed new Commentary will then be forwarded to the COAO and the ASCE Committee on Accreditation for final reviews and approvals in September and October 2023. We anticipate publication and dissemination of the revised Commentary in November 2023, but not before the revised CEPC receives final ABET approval. The Task Committee will align the revised Commentary with any last changes in the CEPC that may accompany approval.

Stewardship of the "Living" Commentary

The ASCE Commentary has long been considered a "living" document for training and guidance, subject to more-or-less continuous updating by the COAO as needed. As noted earlier, experience with any given set of CEPCs can lead to questions within the civil engineering education community, including civil engineering PEVs, regarding the interpretation and application of specific program criteria provisions. The Commentary has been a vehicle for discussing these issues as they arise, promoting a common understanding among all stakeholders, and training civil engineering PEVs to approach them flexibly.

Periodic updating and distribution of the Commentary is the responsibility of the COAO. Upon completion of the revised Commentary, it will be transferred to the care and stewardship of the COAO.

CONCLUDING THE CEPC REVISION PROCESS

The prerogative for final approval, and final modification, of the revised CEPC rests with the EAC and EAD of ABET. Further modifications may yet occur. Nevertheless, the process of substantially revising the CEPC is nearing its conclusion.

ASCE's Civil Engineering Program Criteria Task Committee began its work at the beginning of 2020 and will likely sunset near the end of 2023. During this 4-year period, the Task Committee will have held more than 45 teleconferences with its members and corresponding members, and garnered feedback from numerous stakeholders on the revised CEPC and Commentary. The overall effort has been described in this paper and its two companion papers [3],[4]. It has also been documented in meeting minutes, stakeholder input/communications records, and internal assessments of various curricular topics. These records, and any closing recommendations that the Task Committee might make, will be retained by ASCE to assist those tasked with future efforts to review and possibly update the CEPC as the needs of our profession continue to evolve. The Task Committee's efforts were similarly informed by records generated when the CEPC were last substantially revised.

As the conclusion of the Task Committee's work approaches, the authors wish to thank the many members and corresponding members of the Task Committee as well as ASCE staff, for their steadfast efforts over the past few years. We also thank the many stakeholders who have contributed invaluable feedback on our work.

REFERENCES

[1] "2023-2024 Criteria for Accrediting Engineering Programs," ABET, Baltimore, MD. https://www.abet.org/wp-content/uploads/2023/01/23-24-EAC-Criteria_FINAL.pdf [Accessed January 16, 2023].

[2] Civil Engineering Body of Knowledge 3 Task Committee, *Civil Engineering Body of Knowledge: Preparing the Future Civil Engineer,* 3rd Edition. Reston, VA: ASCE, 2019.

[3] W. Bergstrom, S. Ressler, and L. Nolen, "Preparing the Future Civil Engineer: Review and Update of the ABET Civil Engineering Program Criteria", *Proceedings of the 2021 ASEE Annual Conference*, ASEE, 2021.

[4] L. Nolen, J. Puckett, D. Dzombak, and W. Bergstrom, "Preparing the Future Civil Engineer: ASCE's Proposed Revision to the ABET Civil Engineering Program Criteria", *Proceedings of the 2022 ASEE Annual Conference*, ASEE, 2022.

[5] "Commentary on the ABET Program Criteria for Civil and Similarly Named Programs – Effective for the 2019-2020 Accreditation Cycle," January 2019, ABET, Baltimore, MD. https://www.asce.org/-/media/asce-images-and-files/career-and-growth/educators/civil-engineering-program-commentary-eac.pdf [Accessed January 28, 2022].

APPENDIX A: Proposed Civil Engineering Program Criteria

As submitted to the EAC Criteria Committee by ASCE in May 2022, prior to further revision by the EAC Criteria Committee

These program criteria apply to engineering programs that include "civil" or similar modifiers in their titles.

1) Curriculum

   The curriculum must include:

   a) Application of:
      i) mathematics through differential equations, probability and statistics, calculus-based physics, chemistry, and at least one additional area of basic or formal 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 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

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.

APPENDIX B: Proposed Civil Engineering Program Criteria

As revised by the EAC Criteria Committee in July 2022 (with EAC revisions annotated in bold) and approved by ABET's EAC and EAD on first reading

These program criteria apply to engineering programs that include "civil" or similar modifiers in their titles.

1) Curriculum

   The curriculum must include:

   a) Application of:
      i) mathematics through differential equations, probability and statistics, calculus-based physics, chemistry, and ~~at least one additional area of basic or formal science~~ **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

3) 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.