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”Decoupling” Resilience from Sustainability in the next Civil Engineering Body of Knowledge (CEBOK4)

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Abstract

The Civil Engineering Body of Knowledge (CEBOK), established by the American Society of Civil Engineers (ASCE), articulates the foundational knowledge and professional competencies essential for civil engineers to assume responsible charge. To remain responsive to evolving societal demands, technological advancements, and environmental challenges, the CEBOK is periodically revised- most recently in 2019 (Third Edition), with a fourth edition currently under development. This paper examines how the CEBOK - Task Committee is considering "decoupling" resilience from sustainability in CEBOK4 (Fourth Edition), clarifying their differences and elevating resilience as a stand-alone critical competency for the next generation of engineers. It details the rationale, process, and challenges of updating learning outcomes, and introduces a national survey designed to assess current educational practices and establish a baseline for resilience instruction. The paper concludes with a strategic roadmap for integrating resilience across civil engineering, aligned with accreditation standards and institutional priorities. Practical vignettes include embedding resilience concepts into an introductory first-year civil and environmental, construction management and structural design courses.

Introduction

In this work, “Resilience” is defined as “the ability to plan, prepare for, mitigate, and adapt to changing conditions from hazards to enable rapid recovery of physical, social, economic, and ecological infrastructure” [1]. Sustainability, on the other hand, is defined as the balance between the environment, equity, and economy - meeting the needs of the present, without compromising the ability of future generations to meet their own needs [2]. Resilience has become increasingly central to civil engineering practice as aging infrastructure systems face growing exposure to extreme events, climate variability, and cascading failures. The ABET Civil Engineering Program Criteria currently require that programs address “principles of sustainability, risk, and resilience,” and the American Society of Civil Engineers (ASCE) Civil Engineering Body of Knowledge, Third Edition (CEBOK3), addresses sustainability and resilience together [3]. Other studies similarly treat resilience as a subset or extension of sustainability [4], [5], [6], [7], [8].

While resilience and sustainability constructs overlap, they differ in emphasis: resilience prioritizes redundancy, adaptability, robustness, and rapid recovery under disturbance, whereas sustainability emphasizes life-cycle resource stewardship and long-term environmental, economic, and social balance. A concise comparison of resilience and sustainability is provided in Table 1.

Conflating these constructs in curricular outcomes may obscure distinct competencies, such as recovery planning, hazard-informed design, and performance-based assessment. In parallel, professional codes, standards, and frameworks-including those advanced by ASCE and related organizations- have increasingly referenced resilience explicitly, signaling a shift in practice expectations [5], [9], [10], [11], [12].

Table 1. Comparison of key dimensions distinguishing sustainability and resilience across time horizon, focus, design emphasis, and assessment metrics.

Dimension	**Sustainability**	**Resilience**
Time Horizon	Long-term stewardship	Pre-, during, and post-disturbance
Primary Focus	Resource balance	System performance under disruption
Design Emphasis	Efficiency, minimizing life-cycle impacts	Redundancy, robustness, and rapid recovery
Assessment Metrics	Life cycle cost and impact assessment, carbon emissions, equity	Recovery time, restoration level, and reliability

This paper examines whether the forthcoming Fourth edition of the Civil Engineering Body of Knowledge (CEBOK4) should elevate resilience as a standalone outcome, describes the task committee's review process, reports findings from a national survey of U.S. civil engineering programs, and proposes a curricular roadmap for embedding resilience across undergraduate education.

Shaping the Next CEBOK: The Process, The Rationale, and the Review

The initial Civil Engineering Body of Knowledge (CEBOK) was published in February 2004, after nearly two years of intense work by the Committee on the Academic Prerequisites for Professional Practice. As an evolving document, updates of the original CEBOK began in October 2005, primarily as a response to the publication of several vision documents that were published by ASCE that provided a roadmap for the future civil engineer and thus identified areas of competencies required for practice [13]. The current edition of the CEBOK, Third Edition, was developed by the previous Civil Engineering Body of Knowledge Task Committee (CEBOK TC) between 2016-2019, which further refined and expanded upon content [3].

The CEBOK is the guiding document for the profession, and defines "the knowledge, skills, and attitudes necessary to become a licensed professional engineer" through what now numbers as 21 outcomes and is used as the basis for the ABET Criteria for civil engineering programs. ASCE Committees use the CEBOK for preparing the future civil engineers for responsible charge with emphasis on lifelong learning and mentoring [14].

The CEBOK document is currently being updated and the leadership team for the current CEBOK Task Committee (CEBOK TC) was appointed by the ASCE Committee on Education in Spring 2024. A task committee was formed in the summer of 2024 and includes 12 voting committee members and 31 corresponding members [13].

The first actions of the committee included a comprehensive and critical review of published literature regarding the future of engineering, other disciplines, civil engineering practice, issues facing the profession, along with a review of other BOK documents. The goal of this effort was to determine if the sources affirmed the third edition of the CEBOK, if sources indicated that something was missing and should be added, or if anything should be removed, and thus develop a strategic vision for what is required to prepare the future civil engineer. This assessment indicated that an update of the CEBOK is warranted, not only to emphasize new technologies, but to also place a stronger emphasis on public policy, leadership and management, resilience and sustainability, which had already emphasized the importance of developing resilient infrastructure projects that serve society in the face of extreme events and climate change. Civil engineers will need to understand how civil engineering systems function collectively and will need to apply concepts of resilient design to solve complex engineering projects considering resource constraints, changing environments, extreme weather, and other societal pressures [2] .

Over the past year and a half, the CEBOK TC has devoted time to a detailed review of the current CEBOK3 and has established subcommittees to evaluate each of the 21 outcomes, including the roles played by new and emerging technologies including AI and sensing, cross cutting topics, and the direction of sustainability and resilience. The committee developed pre-draft versions of the outcomes and gathered input from practitioners, academia, management, public entities, and engineering professional societies, including ASCE committees and ASCE's Infrastructure Resilience Division (IRD) to finalize CEBOK, Edition 4 (CEBOK4).

As a result of this process to date, it became apparent that resilience has continued to emerge as an important area of civil engineering practice, with a developing analysis framework distinct and separate from sustainability. This committee considers including a new "resilience" outcome that defines resilience and makes the case of its importance in civil engineering project delivery and clarifies its distinction from sustainability. Based on the resilience subcommittee's evaluations, the level of achievement and typical pathways for fulfillment of the outcome will also be presented.

The future of our infrastructure necessitates accounting for resilience. Accordingly, the ASCE includes resilience among the criteria used to assign grades, alongside capacity, condition, public safety, and innovation [15].

While CEBOK3 successfully elevated sustainability and broadened professional competencies, several limitations remain. First, resilience was embedded within sustainability without clearly articulated performance expectations or defined achievement levels, resulting in uneven curricular interpretation. Second, resilience-related competencies were not explicitly differentiated across hazard analysis, system recovery, redundancy design, and performance-based evaluation. Third, assessment pathways were not clearly defined, limiting consistent program-level implementation. CEBOK4 is uniquely positioned to address these gaps by (1) clarifying resilience as a discrete competency, (2) defining measurable levels of achievement aligned with Bloom's taxonomy, (3) articulating curricular pathways for fulfillment, and (4) strengthening alignment between educational outcomes and contemporary professional standards and infrastructure performance frameworks.

In what follows, the development and administration of the survey to civil engineering program heads is discussed. Moreover, a road map that embeds resilience across the civil engineering curriculum is presented with a few vignettes.

Methods: Survey Development and Administration

The CEBOK Resilience Sub-Committee drafted an online survey to establish a baseline of resilience instruction for the civil engineering and similarly named departments in the United States. Sixteen questions were developed by the subcommittee, iteratively revised through content validation by curriculum and pedagogy experts within the larger Task Committee, and piloted with program directors and faculty to refine wording to reduce respondent burden. The instrument is organized into five blocks: curriculum and course content; instructional strategies and faculty development; institutional support and priorities; assessment and outcomes; and barriers and opportunities. The survey, provided in appendix, was administered via Qualtrics by posting to the ASCE Department Heads community; participation was voluntary, anonymous, and IRB-exempt.

The goals of the present study are to establish a national baseline of resilience instruction and to examine institutional factors that support ABET-aligned resilience outcomes. To this end, the following Research Questions (RQ) guided our data analysis:

> **RQ1:** To what extent are resilience concepts currently integrated across U.S. civil engineering curricula, which course types include them, and what is the extent of student exposure?
>
> **RQ2:** To what degree do US Civil Engineering Departments explicitly state and assess resilience learning outcomes in ways that satisfy ABET Civil Engineering Program Criteria, and which institutional supports or barriers predict compliance?

Results

The survey remained open for more than two months, with reminder messages distributed at least twice and near the end of the administration period to encourage participation. The survey was sent directly from ASCE to department heads of civil engineering programs in the United States via the department heads community post. A total of 36 responses were received out of 200 different schools targeted, which is considered an acceptable response level based on personal communication between the authors and ASCE headquarters. The responses were analyzed and those addressing the aforementioned research questions, RQ1 and RQ2, are summarized in the sections below.

US Schools' Current Level of Resilience Integration in the Curriculum (RQ1):
Survey Question #1 "*Are resilience concepts integrated into your civil or environmental engineering curriculum at any level?*" showed that 27 programs (75%) incorporate resilience concepts, suggesting majority exposure to resilience among the respondents. However, 3 programs (8%) do not incorporate at all resilience concepts, and the remaining 6 programs (17%) did not answer this question.

Answers to Survey Question #2 provided a range of courses or course types where resilience is currently implemented among the respondent schools. As Fig. 1 illustrates, the majority of the programs include resilience concepts in several courses and mostly in their core civil or environmental engineering courses (17) followed equally by the senior design (14), and upper technical elective courses (14). Some programs include resilience in sustainability focused electives (12).

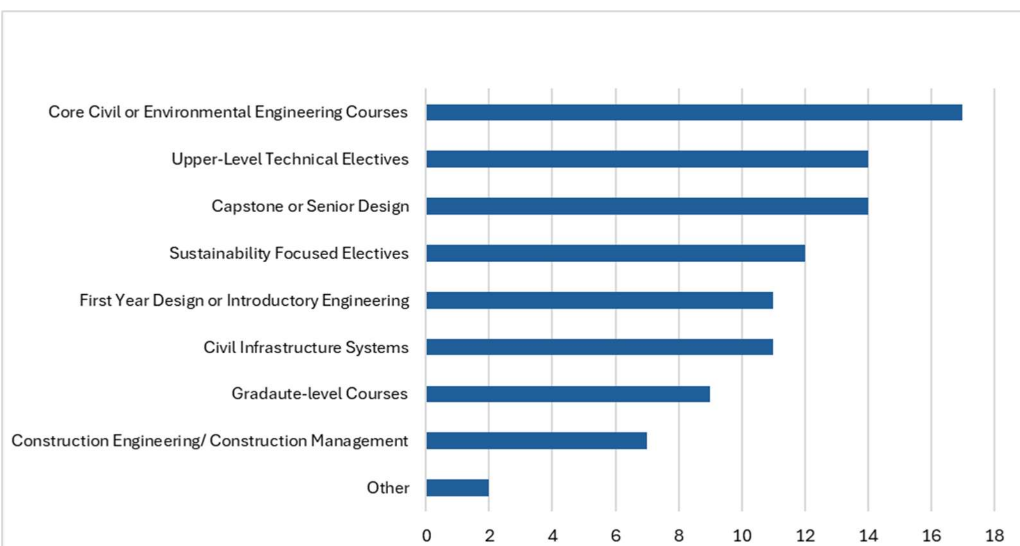

Figure 1. Course types reporting resilience integration (N=36 programs).

Survey Question #4 asked respondents to identify the instructional methods used to teach resilience within their programs. The survey provided a set of commonly used pedagogical approaches, including traditional lectures, guest speakers, case study analysis, experiential learning, project-based learning, and modeling or simulation activities. As shown in Fig. 2, the results indicate that traditional lectures, case studies, and project-based learning are the most frequently employed instructional methods, often supplemented by experiential learning approaches, guest speakers, and professional panels. One respondent selected the "other" category and reported the use of laboratory exercises and data analysis activities to support resilience instruction. Given the interdisciplinary and applied nature of resilience, the use of real-world examples and hands-on learning approaches is particularly well suited to reinforcing both theoretical understanding and practical application. Overall, the responses indicate that resilience is taught using a range of instructional strategies and is introduced at multiple points across undergraduate and graduate curricula, albeit with varying levels of depth.

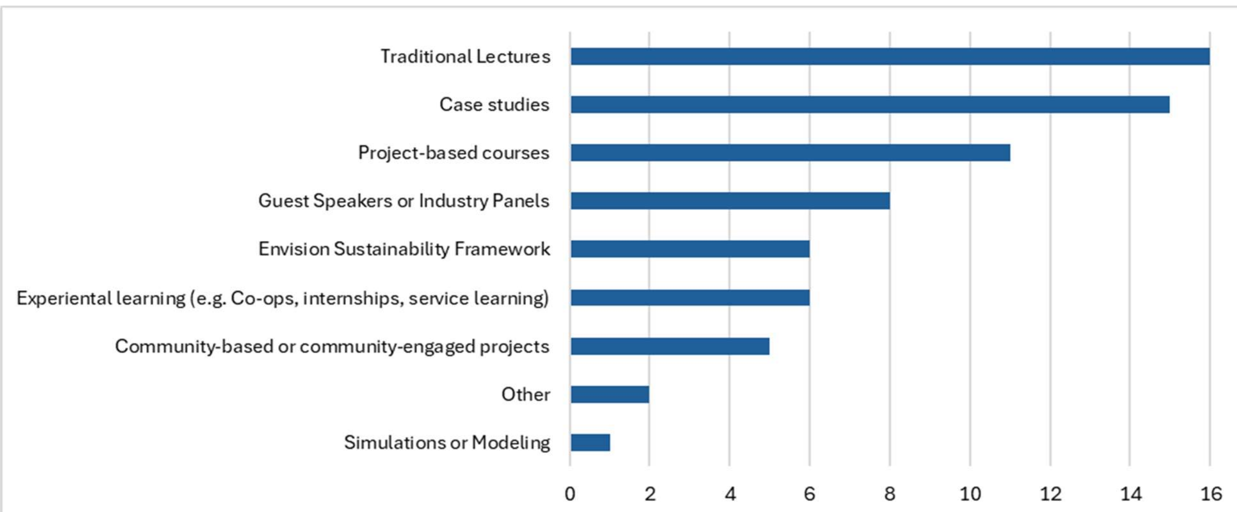

Figure 2. Instructional methods used to teach resilience across surveyed civil and environmental engineering programs (N = 36 programs).

Alignment and Compliance of Departmental Learning Outcomes with ABET Civil Engineering Program Criteria: Institutional Support or Barriers (RQ2):

Survey responses to Question #5: *"Has your program provided or supported professional development for faculty related to resilience instruction?"* reveal a substantial gap in faculty preparation. Only 25% of responding programs reported offering professional development related to resilience, indicating that most faculty may lack structured preparation to teach resilience beyond informal or ad hoc approaches, while 60% indicated that no such support was provided and 15% were unsure. Responses to Question #11 ("Are resilience-related learning outcomes explicitly stated in course syllabi and/or program-level outcomes?") suggest broad interest in resilience but uneven curricular depth. Although 74% of respondents indicated that resilience concepts are included at some level, only 21% reported explicit outcomes at both course and program levels, revealing an assessment gap.

Barriers to integration were further explored through Questions #12 and #13. Responses to Question #12 identified curriculum overload and ABET-driven constraints as the primary challenges to incorporating resilience within existing curricula. In contrast, responses to Question #13 indicate a strong willingness among department heads to adopt resilience instruction if implementation-ready resources were available. Respondents emphasized the value of sample courses and instructional materials that explicitly connect resilience concepts to core engineering fundamentals, noting, for example, the usefulness of "a sample course that we can review and decide where and how to incorporate" and "instructional materials that can tie into basic concepts."

These findings highlight the need for a clear curricular roadmap, expanded institutional support, targeted faculty development, and accessible instructional examples that demonstrate how resilience can be meaningfully and efficiently integrated into civil and environmental engineering education.

Collectively, the survey findings reveal three central patterns: (1) resilience is present in many curricula but implemented unevenly, (2) explicit learning outcomes and assessment practices remain inconsistent, and (3) institutional and faculty-level constraints limit deeper integration. These findings directly inform the research questions and frame the subsequent discussion regarding whether resilience should remain embedded within sustainability or be elevated as a distinct outcome within CEBOK4.

Road Map: Embedding Resilience across the Civil Engineering Curriculum

Significant efforts to integrate resilience into the civil engineering curriculum have been reported in the literature. Chittoori et al. [16] describe approaches for permeating sustainability and resilience across the curriculum rather than confining these topics to a single course or elective. Their work provides examples of learning objectives spanning the undergraduate program, including introductory engineering, civil engineering case studies, environmental engineering, construction materials, geotechnical engineering, transportation engineering, water treatment, reinforced concrete design, and pavement design. McWhirter et al. [17] -further demonstrate that incorporating resilience throughout the curriculum can broaden students' perspectives and enhance their ability to integrate resilience and sustainability considerations into design decisions.

Other studies emphasize the importance of grounding resilience instruction in professional practice and standards. Greenwood et al. [18] explicitly connect resilience to civil engineering codes and standards and outline a comprehensive set of hazard-focused topics and intended learning outcomes aligned with common practice. Wang et al. [19] describe the development of "risk and resilience"–focused courses, including *Introduction to Risk and Resiliency*, *Reliability and Optimization Methods in Engineering*, and *Sensing and Data Analytics for Infrastructure Systems*, and provide sample projects to support applied learning.

Additional instructional models extend resilience education beyond traditional classroom settings. Pagán-Trinidad et al. [20] report on a U.S. Department of Homeland Security-sponsored project aimed at building capacity in resilience education for students, faculty, and staff, with a focus on the impacts of natural hazards on coastal infrastructure, existing structural conditions, and rehabilitation strategies. Rahat et al. [21] introduce "safe-to-fail" strategies as disaster-resilient design approaches within architecture, engineering, and construction curricula, using a combination of structured lectures and interactive discussion sessions to address flood hazard mitigation and adaptation.

Guidance from ABET further supports integrating resilience within existing courses. The ABET Civil Engineering Program Criteria Commentary provides illustrative examples and clarifies that resilience instruction need not be present in multiple *courses* or all student experiences ASCE Commentary on ABET, 2024 [22]. Rather, programs must ensure that students are exposed to resilience concepts and their application within civil engineering practice. This guidance facilitates the incorporation of resilience into core technical courses without requiring the creation of standalone courses. Illustrative examples from the commentary include:

- Incorporating redundant elements in structural or network design courses to improve system robustness and reliability.
- Analyzing transportation network disruptions, roadway outages, and recovery times in transportation engineering courses.
- Applying reliability-based design approaches (e.g., Class I reliability) in water and wastewater infrastructure courses.
- Considering multiple concurrent stressors when assessing infrastructure in hazard-prone regions; and
- Using infrastructure failure and recovery case studies to inform future design and planning decisions.

As indicated above, resilience encompasses a diverse set of competencies that can be cultivated through multiple instructional approaches and contexts. To illustrate practical implementation across curricular levels, three brief vignettes are presented. These include a first-year project emphasizing rapid recovery and decision-making under constraints, a senior-level construction management exercise using the Envision framework to evaluate risk and stakeholder impacts, and structural design modules that integrate redundancy, robustness, and repairability through performance-based design. Collectively, these vignettes demonstrate pedagogical mechanisms, including project-based learning, role play, and performance assessment that align instructional strategies with distinct resilience competencies.

VIGNETTE I: *Teaching Resilience in a first year introductory civil and environmental engineering course through project-based learning.*

Webber and Ozis [23] highlight the importance of introducing resilience concepts early in engineering curricula to help students understand how infrastructure performs under uncertainty and disruption. Within this context, a first-year Civil and Environmental Engineering course incorporated a month-long, project-based learning experience designed to foreground resilience thinking through an applied design challenge.

Building on project-based learning pedagogy, the culminating assignment positions student teams as engineers responding to a humanitarian need on a flood-impacted island. Teams are tasked with designing and deploying a floating bridge capable of transporting a small toy truck and humanitarian aid across a water tank under strict time, cost, and material constraints. This structure mirrors real-world emergency response conditions and provides a platform for students to practice resilience-focused decision-making.

To guide their work, students must address a series of resilience-oriented questions embedded within the technical requirements of the project. These include:

- *Problem characterization:* What are the constraints that impact bridge performance?
- *System vulnerability:* How might material limitations, buoyancy uncertainties, or construction challenges affect the reliability of the bridge?
- *Impact on users and context:* How does the bridge design support safe transport of aid and minimize risk during deployment?
- *Risk acceptance and tradeoffs:* How should teams balance safety, cost, assembly time, and stability when making design decisions?

During the design and testing phases, students also consider:

- What strategies can be used to mitigate major risks (e.g., instability, sinking, dynamic loading)?
- How can redundancy or fail-safe features be incorporated within the constraints?
- How should resilience be evaluated using available performance data (e.g., accelerometer readings, cost metrics, assembly time)?
- How do design choices influence the overall lifecycle and robustness of the system?

The project culminates in a live testing event in which teams assemble their bridge within a three-minute window and drive the remotely controlled truck across the span. Students then present their reports including buoyancy testing results, reflecting on hazards, design tradeoffs, risk acceptance, and resilience strategies demonstrated through their design. This project allows teams to articulate their own design and an understanding of resilience across the full team design-build-test cycle and to connect technical performance with broader engineering judgment.

VIGNETTE II: *Teaching Resilience in a construction management course through Envision Framework.*

Adhikari et. al. [24] demonstrate the need for better preparing students to understand extreme weather events and their consequences. The majority of the surveyed students from three states believed that both resilience and evacuation concepts need to be taught in college.

Avrithi and Fong [25] suggest that the Envision framework can be incorporated in the construction engineering courses for improving student problem solving. More specifically, categories CR2.3 "Evaluate Risk and Resilience," CR2.4 "Establish Resilience Goals and Strategies," and CR2.5 "Maximize Resilience," (Envision) address resilience and simplified rubrics can be used by students for their design and construction projects [26].

Especially in a Construction Management course, students are separated into teams with the assigned roles of "client," "engineer," "contractor," and any involved "stakeholder." The project aims to showcase the relationships between these parties and the importance of incorporating resilience in design.

The "client" proposes a horizontal infrastructure project (bridge, road, a light rail station, etc.) with specific criteria to be realized at locations with different hazards, e.g., flooding, wildfires, earthquakes, etc. The "client" needs to identify the hazard and its anticipated impact and answer the questions:

- What is the vulnerability of the project to hazards?
- How will the project impact other community systems and stakeholders?

The "engineer" and "contractor" involve the "client" and "stakeholders" to answer the questions:

- What is the probability of the event happening?
- What is the client's acceptance level of risk?

The "engineer" and "contractor" answer the questions:

- What are the strategies to address major project risks?
- How to calculate resilience?
- What risk management strategies to apply?
- How will these impact the life of the project.?

The final deliverable is an oral presentation by the team to showcase their understanding of hazards, acceptance of risks, and resilience goals throughout the lifecycle of the project.

VIGNETTE III: *Teaching resilience in a structural design course through performance- based-design (PBD) concepts.*

The fundamental attributes of infrastructure resilience include redundancy, robustness, and rapid recovery. Case studies of historical structural failures are incorporated to identify failure mechanisms and extract lessons for resilient design.

Redundancy

Redundancy is introduced through instruction on the advantages of statically indeterminate structural systems and the provision of alternate load paths. Students learn how redundancy enhances structural resilience by enabling a structure to maintain stability even after the loss of a critical component.

For example, in the context of disproportionate or progressive collapse prevention in multi-story buildings, students examine scenarios in which a first-story column is removed due to an extreme event, such as a vehicular collision. Through this exercise, students identify and design alternate load paths that allow the structure to redistribute forces and remain stable following localized damage.

Robustness

Robustness refers to the ability of a structure to withstand or tolerate damage without experiencing collapse. A key instructional focus is the role of ductility in achieving robust structural performance. Code-compliant structures are designed to exhibit ductile rather than brittle failure modes, providing deformation capacity prior to collapse.

Specific examples discussed in class include:

- Strong-column/weak-beam design, which promotes desirable inelastic behavior and helps ensure that damage is distributed in a controlled manner without global collapse.

- Adequate confinement reinforcement (e.g., ties or stirrups) in structural members subjected to significant shear forces—such as beams, girders, and columns—to enhance ductility and energy dissipation capacity.

Rapid Recovery

Rapid recovery- the ability of a structure to regain functionality within a reasonable timeframe following a hazard event- is another essential characteristic of resilient infrastructure. Students are taught that post-event repairability and functional continuity are critical to community resilience.

While prescriptive design codes achieve life-safety objectives, they do not necessarily ensure rapid recovery or post-event functionality. To address this limitation, students are introduced to Performance-Based Design (PBD) as an alternative design approach now permitted by the International Building Code (IBC) [27].

As described by Aghayere et. al.[28]

> *Performance-Based Design is a design approach that focuses on goals beyond life safety. It is based on [explicitly] defined performance objectives that must be related to some design criteria or some parameter threshold [such as] lateral deflections, inter-story drift [ratios], and lateral acceleration limits. These performance objectives and [associated] damage levels are jointly established by project stakeholders and depend on the specific hazard and its intensity, as well as the occupancy and risk category of the structure.*

Through exposure to PBD concepts, students gain an understanding of how structural design decisions can influence not only life safety but also post-event functionality and recovery, thereby strengthening the resilience of the built environment.

Discussion

A majority of programs (75%) report integrating resilience concepts somewhere in the curriculum; however, this exposure is uneven and typically confined to a limited number of course types. Core civil engineering courses, senior design, and upper-level electives are the most common venues, suggesting that resilience instruction is often localized and dependent on individual faculty expertise rather than embedded within a coordinated curricular strategy. Moreover, the predominance of traditional instructional approaches, such as lectures, case studies, and guest speakers, indicates that resilience is frequently introduced at a conceptual level, with fewer opportunities for applied, experiential, or design-oriented learning. Faculty preparation emerges as a significant barrier to broader integration. Only 25% of programs report providing professional development related to resilience instruction, limiting departments' capacity to expand or deepen curricular offerings. This lack of institutional support is further compounded by commonly cited challenges, including curriculum overload and ABET-driven constraints, which motivate programs to seek flexible, integrable approaches rather than standalone courses. Consistent with these findings, respondents expressed a strong interest in implementation-ready instructional materials, such as sample modules and course resources that explicitly connect resilience concepts to foundational engineering principles.

The survey reveals that 27% of programs report “not-including resilience” either at the course level or the program level. This lack of explicitness underscores a key limitation of embedding resilience solely as a subcomponent of sustainability: when combined, resilience-specific expectations may be underdefined or overlooked, reducing the likelihood of consistent assessment.

Collectively, these findings indicate that resilience is present in many programs but inconsistently articulated, scaffolded, and assessed. These patterns directly inform the question facing CEBOK4, whether resilience should remain embedded within sustainability or be elevated as a distinct professional competency. An alternative perspective argues that resilience should remain integrated within sustainability to preserve systems-based framing and avoid curricular fragmentation. However, the survey evidence suggests that when resilience is embedded without explicit differentiation, resilience-specific competencies are frequently under-defined and under-assessed. Elevating resilience as a standalone outcome need not diminish sustainability; rather, it may clarify expectations while preserving integrative systems thinking.

Conclusion

Elevating resilience as a distinct outcome within CEBOK4 is warranted based on both contemporary professional practice demands and the empirical evidence presented in this study. Doing so would provide clearer guidance for academic programs, strengthen alignment with accreditation expectations, and promote more consistent assessment practices tied to hazard-informed design, system robustness, and recovery planning. This study’s findings also point to actionable pathways for supporting programs during this transition, including the development of adaptable instructional modules, subdiscipline-specific case studies, assessment practices, and the need for targeted faculty development opportunities.

Future work should prioritize deeper analysis of institutional patterns, the development and piloting of adaptable curricular modules, and the creation of assessment rubrics and instructional resources that can be readily integrated into existing programs.

Collectively, it is our hope that these efforts will support a more consistent and rigorous incorporation of resilience across civil engineering curricula nationwide. Graduates will be better prepared to evaluate and apply resilience principles – including hazard characterization, redundancy, robustness, and recovery planning – in civil engineering design and infrastructure decision-making.

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Appendix A: Survey Instrument

This survey aims to understand how resilience concepts—such as climate adaptation, infrastructure durability, and community well-being—are currently taught across engineering programs. Your responses will help establish a national baseline and inform future curriculum development.

Resilience is defined in this reference as "the ability to plan, prepare for, mitigate, and adapt to changing conditions from hazards to enable rapid recovery of physical, social, economic, and ecological infrastructure" (ASCE PS518, 2021).

ASCE is developing a 4th edition of the Civil Engineering Body of Knowledge, possibly incorporating resilience as a standalone outcome for all civil engineers.

Block 1: Curriculum and Course Content

Q1. *Are resilience concepts integrated into your curriculum?* (Single Choice – Yes/No) **If Yes, next question;   If no⇒ jump to Block 5, Q10**

Q2. *Which of the following courses at your institution currently include resilience-related topics?* (Multiple Choice – Select all that apply)

- First-year design or introductory engineering
- Capstone or senior design
- Environmental engineering core courses
- Environmental engineering electives
- Structural design
- Civil infrastructure systems
- Construction Engineering/Construction Management
- Sustainability-focused electives
- Other (please specify)

Block 2: Instructional Strategies and Faculty Engagement

Q3. *How would you rate the exposure of your students to resilience-related topics and applications in your program?*

Scale (1–5):

1 – Minimal exposure: Only occasional or discrete references to resilience.
2 – Limited exposure: Resilience addressed in 2–3 dedicated course activities.
3 – Moderate exposure: Resilience integrated into 2-3 courses, with applied examples.
4 – Extensive exposure: Resilience consistently embedded across the curriculum, with multiple applications/activities.
5 – Comprehensive exposure: A required, dedicated course on resilience in the curriculum.

Q4. *Which instructional methods does your program use to teach resilience?* (Multiple Choice – Select all that apply)

- Case studies
- Project Based Courses
- Experiential Learning (Co-ops, internships, and etc.)
- Envision Framework
- Community-based projects
- Simulations or modeling
- General information through Lectures
- Guest speakers or industry panels
- Other (please specify)

Q5. *Have you provided or supported professional development for faculty related to resilience instruction in your program?*

- **Response type:** Single Choice – Yes / No

If Yes: Please specify the format, frequency, and any additional details about the resilience training offered (e.g., workshops, credentials such as ENVISION, conferences).

If no, Start Block 3 Q6.

Block 3: Institutional Support and Priorities

Q6. *To what extent does your institution prioritize resilience in its strategic or sustainability goals?* (Scale – 1 to 5) 1 = Not at all, 5 = Very strongly, option "I don't know"

Q7. *Are there any interdisciplinary collaborations at your institution that support resilience education?* (Single Choice – Yes/No) **If Yes:** *Please describe briefly.*

Block 4: Assessment and Outcomes

Q8. Do you assess student understanding of resilience concepts?

If yes, - Q9. *How do you assess student understanding of resilience concepts?* (Open Text)

if no, next question Q10

Q10. *Are resilience-related learning outcomes explicitly stated in your course syllabi or program outcomes?* (Single Choice – Yes/No)

Block 5: Barriers and Opportunities

Q11. *What are the biggest challenges to integrating resilience into your engineering curriculum?* (Open Text)

Q12. *What resources or support would help you start or strengthen resilience instruction in your program?* (Open Text)

Q13. *Would you be willing to share examples of successful resilience-focused projects or activities?* (Single Choice – Yes/No) **If Yes:** *Please provide a brief description or contact information.*

Appendix B: Acronym Glossary

Acronym	**Definition**
ASCE	American Society of Civil Engineers
CEBOK	Civil Engineering Body of Knowledge
CEBOK3	Civil Engineering Body of Knowledge, Third Edition
CEBOK4	Civil Engineering Body of Knowledge, Fourth Edition
FEMA	Federal Emergency Management Agency
IBC	International Building Code
IRB	Institutional Review Board
IRD	Infrastructure Resilience Division of ASCE
ISI	Institute for Sustainable Infrastructure
NDS	National Design Specification for Wood Construction
NIST	National Institute of Standards and Technology
PBD	Performance-Based Design
RQ	Research Question
CEBOK TC	Civil Engineering Body of Knowledge-Task Committee