EPiC Series in Built Environment

Volume XXX, 2026, Pages 1–12

Proceedings of Associated Schools of Construction 62nd Annual International Conference

A Longitudinal Analysis of STEM Rigor in Construction Curricula

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This study investigates the extent to which undergraduate Construction Management (CM) programs in the United States are becoming more engineering and math intensive over time or less. Using catalogs, flowcharts, and accreditation directories, the authors compiled curriculum data from 130 programs across two accrediting bodies: the American Council for Construction Education (ACCE), and the Accreditation Board for Engineering and Technology (ABET). Non-accredited bodies associated with the Associated Schools of Construction (ASC) were also studied. Each program was examined at two points in time (2015 and 2025) for the highest required level of mathematics and highest required level of engineering coursework. Results indicate a national trend toward higher mathematics rigor, with most CM programs now requiring at least Calculus I, while engineering requirements have increased more modestly, with Statics emerging as the most common addition. Compared to ABET-accredited Construction Engineering programs, ACCE and non-accredited Construction Management programs remain less engineering and math intensive, but the gap is narrowing. These findings highlight the evolving identity of CM curricula and their relationship to engineering standards. These findings may help program administrators make decisions relating to math and engineering curriculum by using national trends as a measure.

Keywords: Curricula, Engineering and Math Rigor, Trends

Introduction

Construction Management (CM) as an academic discipline has historically sat between business-oriented management education and an engineering-oriented technical education. A longstanding question in construction education is the level of math and engineering that should be required, as well as whether CM curricula are trending toward or away from engineering and mathematics rigor over time. Accrediting bodies often play a role in shaping this trajectory (Abudayyeh, 2000)

- ACCE accredits Construction Management programs and emphasizes professional outcomes aligned with the construction industry.
- ABET accredits Construction Engineering, Construction Engineering Technology, and Construction Management programs, often applying engineering science standards comparable to Civil Engineering.
- ASC serves as the professional association for construction programs, including both accredited and non-accredited members.

The authors of this study sought to find out the trends of their peer institutions. When faced with decisions relating to the appropriate level of math and engineering rigor whin a CM curriculum, the authors wanted to know what other institutions had adopted over time. This study investigates

whether CM programs are becoming more engineering-intensive by examining changes in required mathematics and engineering courses over the past decade.
The question of how math-technical or rigorous a Construction Management (CM) curriculum should be has shaped construction education for decades. As the profession evolves, programs face pressure to balance managerial and engineering expectations.
Comparative analyses between Construction Management, Construction Engineering and Civil Engineering programs consistently highlight the disparity in quantitative rigor. ASEE's A Data-Driven Comparison of ABET-Accredited Construction Engineering and Construction Management Programs found that ConE curricula consistently require higher mathematics and engineering science loads, Calc II, Differential Equations, Statics, and Strength of Materials, while CM programs often conclude at Business Calculus or Pre-Calculus (Batouli, 2022). Similar conclusions arise from ASC's early comparative accreditation papers, which attributed this divergence to differing missions and accreditor expectations.

Mathematics and physics preparation has been a recurring topic within ASEE's Construction Division. A Texas-based study reviewing catalogs statewide found significant variability in required math and physics courses among CM programs, suggesting institutional differences in defining technical identity (Hatipkarasulu, 2025). Follow-up work on student mathematics preparedness confirmed that performance in design-based courses strongly correlates with prior exposure to calculus and physics (ASEE, 2019).

The integration of Statics into CM curricula has become a touchstone for programs seeking greater technical credibility. ASEE's Construction Management Statics paper argued that Statics provides not only structural understanding but also a mindset for analytical problem-solving within CM contexts (ASEE, 2018). Complementary studies in mechanics pedagogy, such as Project-Based Learning in Statics (Atadero, 2014) and Peer-Led Workshops in Statics (Milcarek, 2025), demonstrate that tailored teaching strategies can make these traditionally engineering-heavy courses accessible to CM students.

While CM programs have moved upward, the upper benchmark remains an adherence to Calc II/Differential Equations and full engineering-science sequences (Batouli, 2022; Vesali, 2025). The Body of Knowledge for the Construction Engineering and Management Discipline formalized expectations, positioning mathematics and mechanics as foundational domains for professional competence (McCord, 2023).

Meanwhile, a shift toward outcomes-based accreditation has changed how rigor is interpreted. Rather than prescribing specific credit-hour minimums, recent ACCE manuals focus on demonstrable competencies. ASC and ASEE publications exploring industry evaluations of ACCE outcomes show employers increasingly call for graduates who are not only communicators and leaders but also technically literate in math and science (Jobe 2025).

Curriculum-change studies capture the practical side of raising rigor. Papers like Construction Curriculum of the Future (Saad, 2019) and numerous ASC proceedings reveal that adding courses such as Statics requires faculty retraining, revised sequences, and adjustments to student advising. Despite such challenges, these studies show that CM programs are indeed adding technical depth, often aligning math/physics sequences with engineering prerequisites or pairing them with new digital construction technologies.

Prior literature offers valuable but fragmented insights with state level snapshots, course level pedagogical studies, or single-accreditor comparisons. What is missing is a national longitudinal analysis connecting these efforts to measurable trends in curriculum evolution. The current study fills that gap by comparing CM and CE programs across accreditor types (ACCE, ABET, non-accredited) and over time (2015–2025), operationalizing rigor through the highest required level of mathematics and engineering/science rather than raw credit counts. This outcome-aligned approach builds directly on the trajectory set by past research while providing the most comprehensive quantitative portrait to date of where CM stands on the continuum of STEM related curricula.

Methodology

The authors approached this study with a practical question in mind: Are Construction Management programs becoming more engineering oriented over time? Rather than tallying credit hours, which vary widely and often allow multiple course options, the authors decided to capture the highest course level that every student within a program is required to complete. This choice aligns with outcome-based accreditation practices and lets very different programs be compared on a common scale. The authors deliberately included three program groupings to represent the full spectrum of U.S. construction education: (1) ACCE-accredited Construction Management programs, (2) ABET-accredited programs (Construction Engineering and Construction Engineering Technology, and (3) ASC-member programs without ACCE/ABET accreditation to reflect baseline practice. After deduplication, this yielded a dataset of 130 distinct undergraduate programs.
The time window to observe meaningful change while ensuring data availability, the authors selected a ten-year comparison: 2015–2016 (±1 year when necessary) and 2024–2025. Archived catalogs are consistently available in this span, and a decade is long enough for curricular committees to implement and institutionalize revisions. While current data was readily available, past data was harder to find, in cases where no past data was found, it was assumed no change had taken place. This represented a small portion of the data set.

The authors were able to operationalize rigor by coding mathematics into ordered levels: College Algebra; Trigonometry; Pre-Calculus; Calculus I (including Survey/Business Calc); and Calculus II or beyond (e.g., Differential Equations). Engineering/science was coded as: Physics only; Physics + Statics; Physics + Statics + Strength of Materials; and Physics + Statics + Strength + Soils/Structures. These categories were intentionally simple (for coder reliability) yet sufficiently granular to distinguish management-heavy from engineering-intensive programs.

For data sources and recording, the authors relied on official university catalogs, check sheets, and curriculum flowcharts, preferring primary sources over websites and marketing pages. For each institution, both snapshots were recorded in a one-row schema: institution, program, accreditor, snapshot years, current/past highest math, current/past highest engineering, and coded change (increase, decrease, no change).

The authors summarized results cross-sectionally (current distribution) and longitudinally (change 2015→2025) and compared Construction Management (ACCE + ASC) to Construction Engineering (ABET). Tables report counts and percentages, and figures visualize distributions to make national patterns immediately identifiable.

Results and Discussion

The findings indicate an upward trend in mathematics and engineering rigor. CM programs, which once commonly required only Algebra, now generally require Pre-Calculus, if not Calculus I. This may reflect increasing recognition of the value of quantitative rigor in CM education.

Engineering requirements also increased, with Statics now common. However, few programs have added Strength of Materials or Soils, which remain concentrated in ABET programs. This highlights a spectrum of rigor: ASC-only programs at the low end, ACCE programs in the middle, and ABET programs at the high end. This spectrum raises questions about disciplinary identity. As CM programs strengthen their math and engineering foundations, they move closer to Construction Engineering. The field continues to decide whether to continue this convergence or preserve distinct educational pathways.

The analysis of 130 programs reveals a national shift toward greater mathematical and engineering rigor in construction curricula between 2015 and 2025. Within mathematics nearly 80% of programs now require at least Calculus I, compared to many that stopped at Algebra or Pre-Calc a decade ago. Fifteen programs (all ABET-accredited) require Calculus II and Differential Equations. Among the courses related to engineering, the most common requirement is now Physics + Statics, followed by Physics I only. A smaller subset includes Strength of Materials, and only ABET programs trended toward requiring the full suite (Physics I & II, Statics, Strength, and Soils/Structures). Table 1 and Table 2 show a program type comparison between programs identified as Construction Management and those identified as Construction Engineering. The results show that CE programs require full engineering rigor, while CM programs have increased but remain at a lower level.

Table 1. Program Type Comparison Math CM and Con E

Program Type	**Average Math Level (0-5: College Algebra to Differential Equations)**
Construction Engineering	4.5 with majority being Calc II+ Differential Equations
Construction Management	3.9 with majority being Calculus I

Table 2. Program Type Comparison Engineering CM and Con E

Program Type	**Average Engineering Level (0-4: Physics to Engineering Core)**
Construction Engineering	3.2 with majority being Physics I and II, Statics, Strengths of Materials, and a combination of Soils/Structures
Construction Management	2.0 with majority being Physics + Statics

The 2025 distribution of mathematics requirements reveals an upward shift in quantitative expectations across Construction Management–related programs. Calculus I is now the single most common requirement (51 programs), signaling that a full calculus sequence once confined largely to engineering curricula has become a normative threshold for CM degrees. Nearly as many programs (46) still require Pre-Calculus, suggesting that while the field is trending toward higher mathematical rigor, a sizable contingent remains at the transitional level between algebraic competence and full calculus fluency. Only two programs continue to stop at College Algebra, a sharp decline compared with data reported a decade ago in similar studies. The appearance of Calculus II + Differential Equations in 15 programs, almost all ABET-accredited Construction Engineering degrees, illustrates the upper boundary of rigor within the dataset. These programs mirror traditional engineering mathematics sequences. Smaller clusters of Business Calculus (4) and unspecified Calculus (10) requirements represent hybrid approaches, often found in programs bridging business and technical emphasis. Taken together, these figures demonstrate that mathematics instruction in CM and related programs has undergone a meaningful escalation: the field is increasingly treating calculus not as optional enrichment but as an essential component of professional preparation. Table 2 provides a visual representation of math requirements within construction curricula.

Table 3. Distribution of Current Math Requirements (2025)

Math Level	**Number of Programs**
Calculus II + Differential Equations	15
Calculus I	51
Calculus (unspecified)	10
Business Calculus	4
Pre-Calculus	46
College Algebra	3

Table 3 provides a snapshot of how mathematics expectations have evolved across Construction Management and Construction Engineering programs in 2025. The data show that Calculus I has become the modal requirement, appearing in more than fifty programs evidence that calculus competency is now a defining feature of modern construction curricula. Pre-Calculus, required in forty-six programs, marks a transitional tier between business-style quantitative skills and full analytical rigor, while the near disappearance of College Algebra (only three programs) underscores a decisive move away from purely managerial math preparation. The presence of Calculus II + Differential Equations in fifteen programs (all ABET-accredited Construction Engineering degrees) establishes the upper boundary of rigor and reflects full alignment with traditional engineering standards. Smaller clusters of unspecified or Business Calculus courses suggest hybrid approaches in programs straddling business and engineering orientations. Overall, the distribution confirms that mathematics requirements across U.S. construction programs have advanced significantly: calculus has shifted from a differentiator to an expectation, signaling a broader disciplinary migration toward STEM-level analytical preparation.

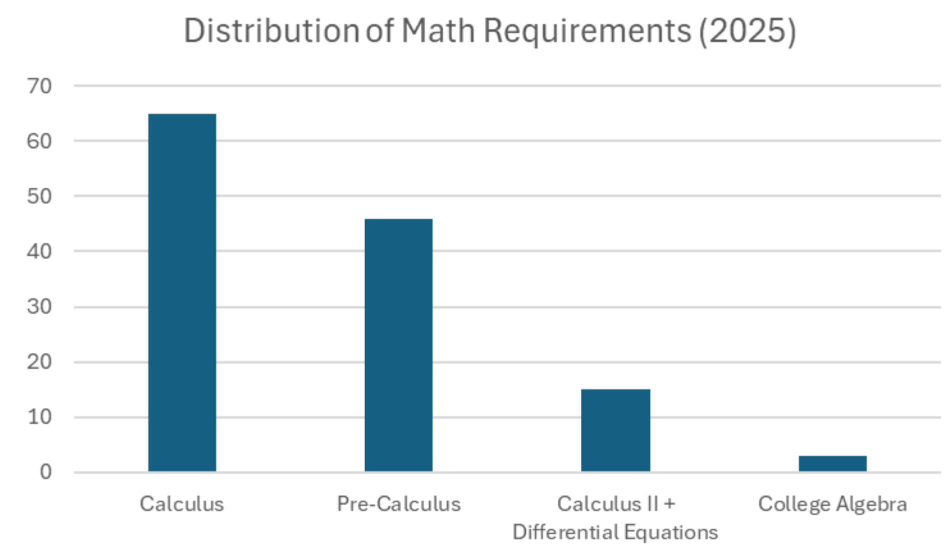

Figure 1. Distribution of Math Requirements among Construction Programs

The distribution shown in Figure 1 demonstrates a substantial national movement toward higher mathematics expectations in Construction Management and Construction Engineering curricula. Programs that once satisfied quantitative requirements with algebra now largely expect students to complete calculus sequences. This evolution suggests that mathematics has become an intentional gatekeeper for analytical and technical readiness in the construction field. The near disappearance of Algebra-only programs signals that CM is no longer viewed solely as a management pathway but as a discipline requiring strong quantitative reasoning comparable to many engineering programs. The growth in Calculus I requirements, coupled with an emerging presence of Calculus II and Differential Equations in ABET-accredited programs, may reflect a cultural shift in which math competence is increasingly synonymous with professional competence.

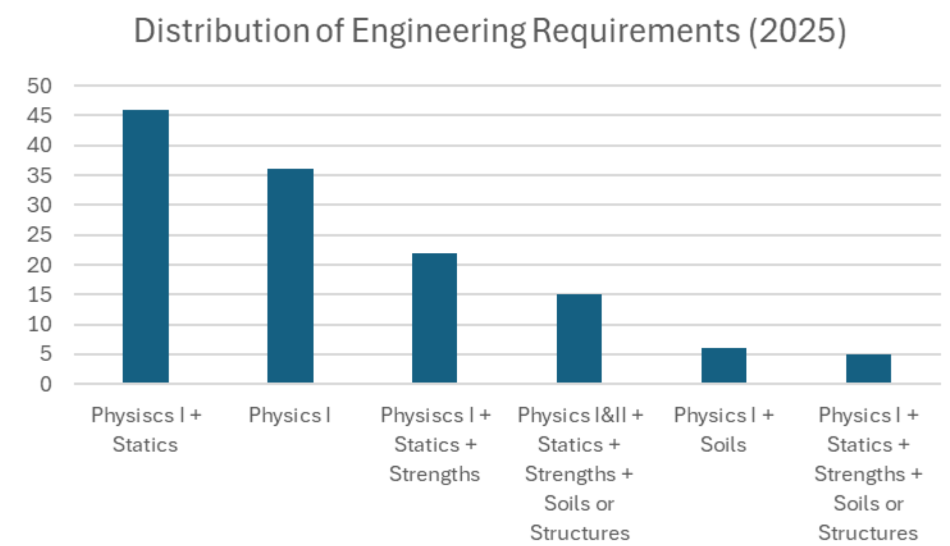

Figure 2. Distribution of Engineering Requirements among Construction Programs

Statics has become common among CM programs but only ABET Con E programs require the full engineering suite. Figure 2 illustrates how engineering content within CM curricula has deepened, though unevenly, across the national sample. The dominance of Physics + Statics indicates that CM programs are adopting the analytical frameworks traditionally reserved for engineering degrees, focusing on equilibrium, forces, and load paths as essential professional knowledge. A considerable number of programs still stop at Physics I, showing that portions of the field remain grounded in managerial and applied learning models. Only ABET-accredited Construction Engineering programs consistently integrate the full suite: Physics I & II, Statics, Strength of Materials, and Soils/Structures, thereby aligning fully with Civil Engineering expectations. The overall trend is notable: CM programs are progressively embracing engineering concepts, but the transition is not universal, forming an identifiable stratification of technical depth especially by accreditor.

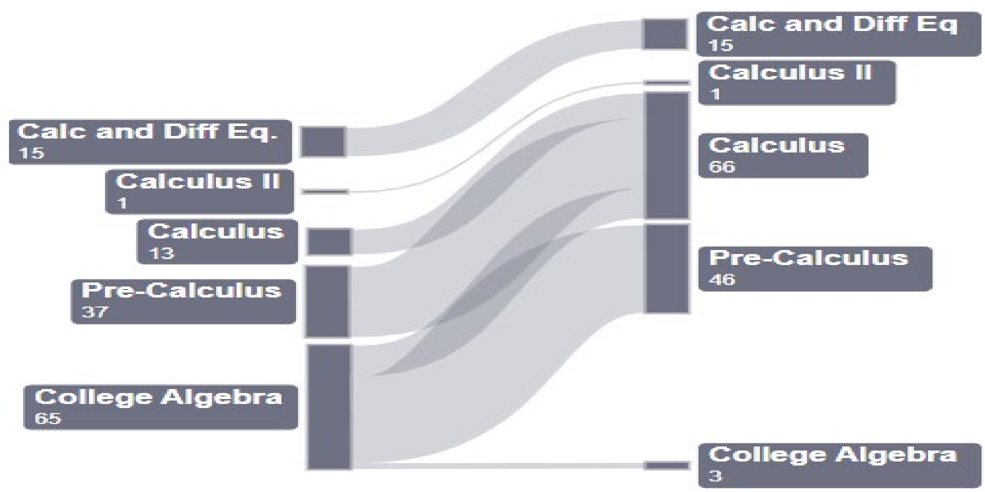

Figure 3. Longitudinal Trend in Math Requirements (2015-2025)

The longitudinal comparison in Figure 3 highlights a decade of movement in mathematics rigor across construction programs. From 2015 to 2025, the proportion of programs requiring Calculus I or higher rose notably, while those capped at Algebra or Pre-Calculus diminished. This steady climb may reflect curriculum committees' recognition that mathematical fluency underpins not only engineering courses like Statics but also modern construction analytics, scheduling algorithms, and technology-based tools such as BIM and simulation modeling. The timeline underscores that change in academia is evolutionary faculty expertise, resource allocation, and accreditation revisions all interact, but collectively these shifts demonstrate a realignment of CM toward the analytical standards of engineering education.

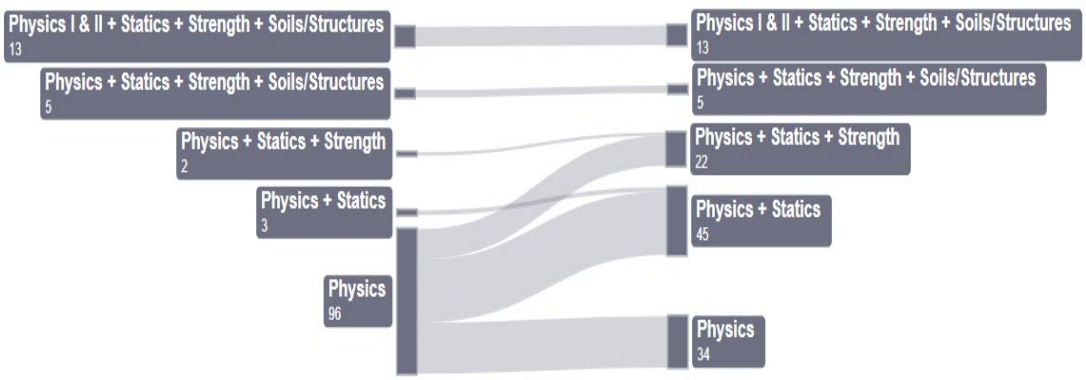

Figure 4. Longitudinal Trend in Engineering Requirements (2015-2025)

The engineering trend depicted in Figure 4 parallels the mathematics trajectory. Over the past decade, more programs have incorporated Statics and related engineering-science content, marking a steady progression toward deeper technical foundations. However, the adoption curve flattens beyond Statics, with comparatively few programs adding Strength of Materials or Soils/Structures. This plateau likely reflects institutional constraints such as available faculty, accreditation boundaries, and the perception that advanced engineering courses may exceed CM's professional scope. Even so, the overall direction remains upward, suggesting that technical rigor may be seen as integral to producing competent construction professionals. The data reinforces a field that is converging toward engineering literacy while still preserving a distinctive managerial identity.

Table 4. Level of Math Rigor by Accreditor (2025)

Accreditor	Highest Math	Program Count
ABET	Calculus I	14
ABET	Calculus II + Differential Equations	14
ABET	Pre-Calculus	2
ACCE	Business Calculus	4
ACCE	Calculus	10
ACCE	Calculus I	16

ACCE	Calculus II	1
ACCE	Pre-Calculus	19
ASC only	Calculus I	17
ASC only	College Algebra	3
ASC only	Pre-Calculus	25

Table 5. Level of Engineering Rigor by Accreditor (2025)

Accreditor	Highest Math	Program Count
ABET	Physics + Statics + Strength + Soils/Structures	1
ABET	Physics I & II + Statics + Strength + Soils/Structures	14
ABET	Physics I + Statics	7
ABET	Physics I + Statics + Strength	7
ABET	Physics I only	1
ACCE	Physics + Statics	4
ACCE	Physics + Statics + Strength	4
ACCE	Physics + Statics + Strength + Soils/Structures	4
ACCE	Physics I + Soils	6
ACCE	Physics I + Statics	14
ACCE	Physics I + Statics + Strength	6
ACCE	Physics I + Statics + Strength + Soils	1
ACCE	Physics I only	10
ACCE	Physics only	1
ASC only	Physics I + Statics	17
ASC only	Physics I + Statics + Strength	4
ASC only	Physics I only	24

In Table 4 and Table 5 it can be observed that levels of rigor differ between the accrediting bodies for the programs. Generally, math and engineering rigor increased among the programs that were accredited (ABET and ACCE). With ABET having the highest levels of math and engineering among their programs. These tables demonstrate that both mathematics and engineering rigor vary systematically by accrediting body, confirming accreditation as a primary driver of curricular expectations. ABET-accredited programs exhibit the highest levels of rigor, with most requiring calculus beyond Calculus I and a full engineering-science sequence including Physics I and II, Statics, Strength of Materials, and often Soils or Structures. ACCE-accredited Construction Management programs occupy an intermediate position, with widespread adoption of Calculus I and Physics plus Statics, but less consistent inclusion of advanced mathematics or upper-level engineering courses. ASC-only programs show the lowest overall rigor, most commonly requiring Pre-Calculus and Physics I, though many have added Statics in recent years. Collectively, these patterns indicate a gradient of technical depth aligned with accreditation intensity and suggest that while Construction Management programs are increasingly incorporating engineering and mathematics content, they continue to differentiate themselves from Construction Engineering programs by stopping short of a full engineering core.

Conclusion

Taken together, the data paints a picture of a discipline steadily raising its technical bar. In mathematics, Calculus I has become the prevailing requirement, with many programs now extending into Calculus II and Differential Equations, while the once-common College Algebra requirement has nearly vanished. In engineering content, Statics has emerged as a standard component of Construction Management curricula, providing students with the analytical foundation long associated with Construction Engineering. Over the ten-year window from 2015 to 2025, these changes represent more than incremental course adjustments; they signal a philosophical shift in what it means to prepare construction professionals. Although Construction Engineering programs (ABET) continue to operate at the highest level of technical rigor, Construction Management programs (ABET, ACCE and non-accredited ASC programs) have clearly moved closer to that benchmark. The field now occupies a continuum ranging from management-focused programs with limited technical depth to engineering-intensive curricula that mirror civil engineering in scope. This trend toward higher STEM rigor suggests a future in which construction graduates, regardless of program type, will enter the profession with stronger analytical skills and a more integrated understanding of the technical systems they manage.

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