Teaching Students to Read and Interpret Construction Specifications and Drawings

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The outcome of careful and detailed design efforts for construction projects is the creation of construction specifications and drawings. These documents are used for cost estimating and scheduling, and they become the input for constructing concrete structures.

Despite the emphasis on construction specifications and drawings in the construction industry, many engineering and construction management graduates are ill-equipped as to how to read these documents when they enter the industry. One might assume that because reading and interpreting these documents are essential skills in the construction industry, students preparing for careers in that industry would learn these skills in college. The truth is that many interns and recent graduates lack a strong understanding of how to read and interpret construction drawings because they were never taught, while most employers assume that new hires are sufficiently prepared.

State of the Curricula in Construction-Related Programs

Reviewing the curricula of civil engineering, construction management, and construction engineering programs reveals gaps in current practices. Most students in these programs gain some experience reading construction specifications and drawings if they take a cost-estimating course.[1]

The Accreditation Board of Engineering and Technology (ABET) establishes the curriculum standards for accreditation of university engineering, technology, and applied science programs.[2,3] However, universities can choose to surpass these ABET requirements. Let's review the requirements for construction engineering, civil engineering, and construction management programs.

- For an accredited construction engineering curriculum, ABET requires the application of "knowledge of construction methods, materials, equipment, planning, scheduling, safety, and *cost analysis*" (emphasis added).
- For an accredited civil engineering curriculum, ABET does not require the application of construction cost analysis for all students.
- For an accredited construction management curriculum, ABET requires knowledge of "cost estimating, including types, levels, and accuracy."

The American Society of Civil Engineers' (ASCE's) Civil Engineering Body of Knowledge[4] does not list cost estimating as a required area of knowledge for civil engineers. However, the required Civil Engineering Body of Knowledge does include engineering economics.

We know that many construction engineering and construction management graduates are employed by contractors. These employees were probably exposed to cost estimating and related construction specifications and drawings while in college. However, civil engineering graduates may not have been exposed to those same project documents in college. We can all agree that the ability to read and interpret specifications and drawings is an essential skill for a variety of roles in engineering and construction, without which many graduates will struggle within their first year.

Building Students' Foundational Knowledge

In academia, there is a reason we have prerequisites. They are designed to help students gain the foundational knowledge they need to be well prepared for upper-level courses.

We should think of reading and interpreting construction specifications and drawings as an important type of prerequisite knowledge. Instead of covering these foundational concepts only in upper-level courses, introducing this knowledge in prerequisite classes could prepare students for courses such as cost estimating and project scheduling where their skills could be reinforced through practice. Furthermore, the prerequisite knowledge can help students see how what they learn in

their design courses translates to project specifications and drawings.

Civil engineering programs should consider the future of their students who choose to work in the field. These students must complete many design requirements to graduate, but they may never apply them day to day. Such students would benefit from college instruction and practice in reading and interpreting construction specifications and drawings, as they will need this foundational knowledge to work effectively in the industry.

How to Bridge the Gap

As I previously mentioned, students are typically exposed to reading specifications and drawings if they take a cost-estimating course. However, civil engineering students at some universities do not have that option, or they may not elect to take cost estimating.

The civil engineering program at the University of Cincinnati offers construction cost-estimating courses to its students, but we still face challenges such as getting students to take the appropriate cost-estimating courses and teaching plan-reading skills to students who choose not to take a cost-estimating course.

Possible strategies to overcome the gap in students' education about specifications and drawings include the following:

- Emphasize to students the importance of taking a cost-estimating course.
- Expand coverage of project documents in courses on construction materials and methods. It has been shown that this type of course can be modified to include exercises in reading and interpreting construction specifications and drawings.[5]
- Find opportunities in every design course to showcase how designs are translated and represented for use in the construction phase. For example, mini case studies could be presented in each design course to help students build their awareness of what specifications and drawings look like and how to read and interpret them.
- Include reading, understanding, and preparing construction documents in the design capstone course that is required in ABET-accredited programs.
- Direct students to checklists for reading construction specifications and review a table of typical drawing elements based on items of work. **Figure 1** shows typical sections of specifications for the purpose of organizing checklists.

Conclusion

In academia, we sometimes fail to adequately prepare students in construction-related programs to read and interpret construction specifications and drawings. This knowledge is critical for success in their careers. In some cases, students gain exposure to this fundamental knowledge through cost-estimating courses. However, ABET accreditation does not require cost analysis for civil engineering programs, and ASCE does not include the topic as a core knowledge area. The reality is that our graduates need this knowledge to excel in the field. While cost-estimating courses are important, design courses could also incorporate brief case studies to demonstrate the relationship between design decisions and construction specifications and drawings.

References

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Figure 1. Specification review checklist sections. Figure: University of Cincinnati.

Scope of Work	+	Coordination	+
Submittals	+	Regulations	+
Standards	+	Access Restriction and Constraints	+
Products and Materials	+	Related Sections	+
Named Responsible Party	+	Contract Pay Item	+
Construction Requirements and Quality of Workmanship	+	Incidental Work	+
Quality Control	+	Measurement and Payment	+
Off-Site Fabrications	+	Commentary - Construct if Included in the Contract	+
Activities (Work Tasks)	+	Commentary - Make No Assumptions	+