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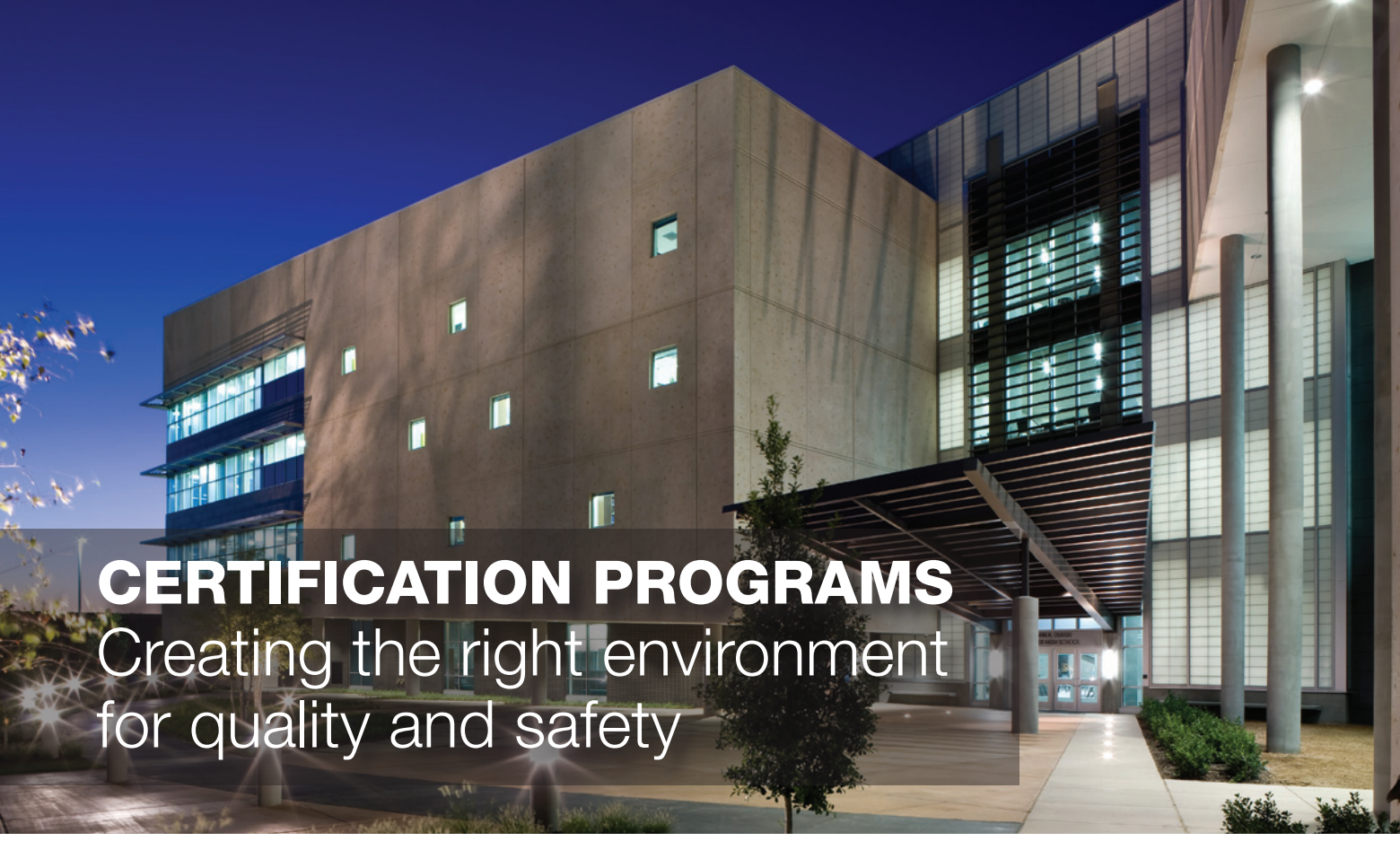


CERTIFICATION PROGRAMS
Creating the right environment for quality and safety

by Brian Miller, PE, LEED AP, and Dean Frank, PE

ASK ANY ARCHITECT, ENGINEER, OR DESIGN PROFESSIONAL IN THE CONSTRUCTION INDUSTRY WHAT HIS OR HER NUMBER-ONE PRIORITY IS, AND THE ANSWER YOU HEAR WILL BE 'SAFETY.'

Society relies on professionals to design and build structures that are safe, not only during construction, but also throughout service life and even during deconstruction. However, safe design is not enough. Structures must be built and must perform as designed and specified, otherwise safety, along with the likelihood of a project's success, can be compromised.

How does one ensure a structure is actually built in accordance with its safe design? The answer is quality assurance (QA). Therefore, safety and QA are directly linked. Quality assurance also applies to all other expectations of a product or system (*e.g.* aesthetics, durability, and performance), but is vital to building a safe structure.

Quality and safety are a mindset and commitment, succeeding only when a system of plans, procedures, and events are in alignment. They are part of an integrated process that cannot be turned on or off for a given project, but must be a continuous part of an operation.

Quality assurance can be thought of as an ongoing system of knowledge, programs, activities, people, inspections, tests, documentation, and assessment, with the sole goal of ensuring structures meet their intended design and specifications. Certification helps guarantee the essential components of a quality assurance system are present and functioning properly, resulting in the highest probability of meeting specifications and building a successful project. Therefore, certification is a vital component of a quality assurance system, but does not itself constitute a QA system.

Certification facts

Certification is more than a checklist. Programs should be closely tied to the body of knowledge for a related industry and backed by essential key elements. The following section focuses on certification for fabricators of pre-manufactured components such as structural steel and precast concrete.

Cost

Contrary to a common misperception, certification does not really increase the pre-manufactured component expenses. Most of the cost typically associated with subscribing to a certification program represents the price of doing the job right. If a fabricator is not executing all necessary steps

The American Association of State and Highway Transportation Officials (AASHTO) recently produced a resolution stating that certification should be provided by technical institutes to ensure the best production of high-quality components and projects.

Photo © BigStockPhoto.com/Peter Anderson

The Precast/Prestressed Concrete Institute's (PCI's) certified auditors compare products against project specifications and minimum requirements as spelled out in the institute's manuals.

Photo © Paul Grigonis. Photo courtesy PCI.

Plant quality personnel certification programs provide instruction and evaluation for various levels of trained and certified quality control personnel.

Photos courtesy PCI

required to be certified, one may ask, 'why not?' What are the consequences to quality and safety? Or, what is the increased risk assumed?

Other certification costs involve administrating audits by third parties to examine evidence that the fabricator is following the required procedures and processes. This is already incorporated into ongoing certification programs. The other option is to require special inspections for a project, typically increasing the owner's project costs.

Common standard

Specifying products from certified fabricators ensures a uniform yardstick of performance is being equally applied to all bidders. This reduces the temptation to cut corners, often in ways not readily apparent.

Reliable project partner

Certified fabricators have made significant investments in plants, procedures, and people to meet stringent certification standards. They have also developed a habit of measuring and achieving quality, and a documented history of consistent production to meet specifications. As noted above, this cannot be turned on or off for a given project, but must be part of the organization's culture.

'As-designed' becomes 'as-built'

A designer's vision and reputation for quality depend heavily on the fabricator and installer's capabilities. Certification ensures the finished project meets the designer's expectations and requires less supervision and field inspection, saving time and money.

Selecting the right certification program

A proliferation of certification options has caused some confusion in the marketplace. This has led some specifiers to believe all programs that are calling themselves 'certification' offer similar benefits and are interchangeable. Unfortunately, this is simply not the case.

The most effective certification programs are those that are part of a comprehensive quality system. These are the programs created and managed by industry-specific technical institutes, such as the Precast/Prestressed Concrete Institute (PCI), the American Institute for Steel Construction (AISC), and the American Concrete Institute (ACI). Institute-based certification programs are part of an integrated knowledge development and continuous improvement process connecting directly with the industry's body of knowledge. This is critical, since it is this knowledge that everything related to a specific industry is based on.

Certification programs established and monitored by industry-specific technical institutes provide specifiers with the highest degree of quality assurance. Technical institutes

Quality control extends to installing engineered components, such as precast prestressed concrete panels, beams, or other components. Using certified producers creates better tolerances that minimize field adjustments, while certified erectors increase safety.

are uniquely qualified to develop, implement, and maintain certification programs. Further, companies going through the rigorous and ongoing procedures to become certified demonstrate their commitment to the quality system.

White paper outlines essential elements

The American Association of State and Highway Transportation Officials (AASHTO) subcommittee on materials and bridges/transportation structures resolved that certification should be provided by technical institutes. Afterward, PCI joined with the AISC to produce a white paper, discussed later in this article, to help designers better understand what it takes to develop and maintain a certification program.

This white paper identifies 12 characteristics essential to any organization offering construction-industry certification. Typically, these are found within the national not-for-profit technical institutes established to provide a consensus-driven forum for the development and continuous refinement of engineering, design and quality standards, and related certification programs.

Industry standing

Technical institutes serve as the principal body of knowledge within their industries. They facilitate exchanging and encouraging new ideas and test those concepts across the full spectrum of stakeholders. Their programs are based on decades of experience. They can also join to assess noncompetitive issues aiding their industries, thanks to the all-encompassing scope of their membership and responsibilities.

Clearly stated purpose

Certification programs run by nonprofit technical institutes transparently state their purpose and foundation. They ensure no hidden agenda in their direction, and no individual person or company stands to profit from their programs.

Broad professional involvement

Both a technical institute's membership and its committee participation reflect a diverse mix of industry professionals—including engineers, manufacturers, and academicians. In contrast, most trade associations are generally dominated by a single interest. An institute's diversity of input ensures every perspective is considered and best practices are identified. Documents and other knowledge products created by the organization are subject to review by committees representing all interested parties.

Governance and consensus

Technical institutes are governed by boards with elected officers and members having no ownership interest. They have formal, consistently applied procedures for making decisions and achieving consensus. This formalized process allows a technical institute to create and apply a comprehensive quality system in a fair and balanced manner that reflects a true consensus of the industry and its professions.

Research

Technical institutes base their programs on a body of knowledge that includes formal and informal research activities addressing current industry challenges, emerging technologies, and innovative practices. These activities are ongoing, and new and improved knowledge is directly applied to the institute's quality programs—in many cases, well before being incorporated into published codes and standards.

Institutes also monitor and disseminate results from the global independent research community, keeping the industry updated on all data types. Institutes' research credibility is evidenced by their ability to attract funding and collaborative assistance from outside sources, including corporations, universities, and associations. These vetted efforts further expand the available knowledge base and improve the effectiveness of the certification and quality programs.

PCI offers complete coverage, including personnel, plant, and field certification programs.

Photo © BigStockPhoto.com/Santa Maria

Quality certification programs begin with plant certification, in which two unannounced audits are performed annually. These ensure each type of product fabricated by the plant conforms to consistent procedures that control every aspect of the production.

Photo © BigStockPhoto.com/Richard Thornton

Validation

Certification programs developed by technical institutes provide a rigorous review process that includes oversight committees and review panels of experts and stakeholders. Each element is examined and documented to ensure it helps meet the goal of achieving high quality standards.

Dissemination

Technical institutes have access to a wide range of communication media that can immediately alert the industry to concerns, best practices, regulatory issues, and technical matters. They also offer educational programs with qualified instructors to spread new information and explain new developments.

Certification of personnel

A comprehensive quality system must validate the competence of the personnel involved with quality control and other key activities. Quality is not an endpoint, but a continuous examination of best practices that continue to develop and improve quality performance consistently over time. Technical institutes ensure both fabricator personnel and auditors have the capabilities to review project requirements, audit records, interview personnel, and observe practices and equipment to ensure procedures reinforce quality goals.

Certification of fabrication process

The primary focus of a manufacturing certification program is to ensure high-quality component fabrication meets specifications on a consistent basis. Technical institutes base their audits on their own promulgated standards, procedures, and research, creating a foundation for auditors and fabricators to understand the reasoning behind requirements.

Independent audits

Credible certification programs require periodic on-site audits by independent, technically qualified, and professionally accredited personnel who have no financial or employment interest in the institute or the audited fabricators. Auditor-qualification programs should verify the quality and effectiveness of the individual auditors themselves and include periodic training to remain current with evolving quality standards.

Feedback and recourse

Technical institutes can take advantage of their various communication media—including publications, technical conferences, educational programs, and auditor feedback—to gather and immediately apply enhancements to the audit process. A credible certification program must include a formal procedure establishing consistent rules under which fabricators can dispute and/or address identified nonconformance. The goal is to raise the bar on quality to achieve a consistent, continuous level and ensure fabricators are accountable for their quality.

Continuing commitment

A vast array of stakeholders provide the foundation for technical institutes, which have provided long-term service to their industries and are supported through various funding sources. This history provides a stable basis for certification programs and ensures they will remain in place as consistent, continuously improving systems for assessing quality processes.

Essentials of a quality system

The Federal Office of Management and Budget (OMB) has noted that government agencies are encouraged to reference nonprofit, consensus-based standards and participate with these institutes, rather than create their own requirements. Programs lacking the foundations of strong research, organization of technical committees to gather consensus, or ongoing commitment to a continuous improvement process will fail to meet the standard development requirements of the American National Standards

HOW TO SPECIFY PCI CERTIFICATION

To ensure accredited certification is used on each project, the Precast/Prestressed Concrete Institute (PCI) recommends specifying architects reference the following.

Manufacturer qualifications

The specifying process should begin with a list of required precast concrete products, from which the appropriate product group and category for each product can be determined based on the product's use, the reinforcement method, and special surface finishes. PCI recommends manufacturer qualifications according to the following specification:

Precast Concrete Manufacturing Plant: Certified under the PCI Plant Program at the time of bidding in the following groups and categories:
[Choose one or more of the following, as applicable]

GROUP A: ARCHITECTURAL PRODUCTS
AT–Architectural Trim Units
A1–Architectural Precast Products

GROUP B OR BA: BRIDGE PRODUCTS
B1 or B1A–Precast Bridge Products (No Prestressed Reinforcement)
B2 or B2A–Prestressed Miscellaneous Bridge Products (Non-superstructure)
B3 or B3A–Prestressed Straight-Strand Bridge Beams (Superstructure)
B4 or B4A–Prestressed Deflected-Strand Bridge Beams (Superstructure)
[Group BA products require an architectural finish.]

GROUP C OR CA: COMMERCIAL (STRUCTURAL) PRODUCTS
C1 or C1A–Precast Concrete Products (No Prestressed Reinforcement)
C2 or C2A–Prestressed Hollow-Core and Repetitive Products
C3 or C3A–Prestressed Straight-Strand Structural Members
C4 or C4A–Prestressed Deflected-Strand Structural Members
[Group CA products require an architectural finish.]

GROUP G: GLASS-FIBER-REINFORCED CONCRETE PRODUCTS (GFRC)

In the specifications, each precast concrete product should be listed; every required group and category must be included in the project's scope.

Personnel qualification guide specification

PCI's Plant Quality Personnel Certification Program provides instruction and evaluation for three levels of trained and certified quality-control personnel. The project specifications should require these personnel in the manufacturing plant. PCI recommends the manufacturer employ personnel according to the following qualifications specification:

The manufacturer shall employ a minimum of one person, regularly present in the plant, who is certified by PCI for Plant Quality Personnel, Level II.

All PCI-certified plants are required to employ at least one individual, certified by the institute.

Erection qualification

In addition to basic fabrication and manufacturing standards, the precast concrete industry offers certification for the erection of its components. This additional standard provides assurance the high-quality precast concrete components are erected to the exacting standards expected by the owners, developers, architects, contractors, and the precast industry itself. An erector may qualify in one of two structural classifications and/or an architectural classification.

- Category S1 (simple structural systems)—this includes horizontal decking members (*i.e.* hollow-core slabs on masonry walls), and single-lift wall panels attached to a structure;
- Category S2 (complex structural systems)—this includes everything contained in S1 as well as total–precast concrete construction, multi-product structures (*i.e.* those combining vertical and horizontal members), and single- or multi-story load-bearing members, including those with architectural finishes; and
- Category A (architectural systems)—this includes non-load-bearing cladding and GFRC products, which may be attached to a supporting structure.

PCI recommends manufacturer qualifications according to the following specification:

Erector Qualification: Certified in category[ies] [A, S1, and/or S2] under the Precast/Prestressed Concrete Institute (PCI) Erector Certification Program. **CS**

Institute (ANSI).

Certification is more than just a checklist. It is part of an integrated, comprehensive, continuously improving quality system specific to the products or systems being addressed and directly linked to a substantial body of knowledge. Only a technical institute can provide all the essential components for a comprehensive quality system intimately connected to the evolving body of knowledge for the industry it serves.

Industry stakeholders and project decision-makers must recognize these distinctions and insist they take advantage of the highest levels of quality assurance and quality control available to them. With their vision and support, technical institutes can build on their strong base and provide the market with consistent, continuously improving programs that ensure best practices are used throughout the industry. Such systems are the only way to ensure the highest levels of safety, quality, and client satisfaction.

Building bridges

Recently, AASHTO released a resolution supporting material specification for bridge construction using certified production and quality control procedures. To achieve this goal, the group recognized a national technical institute is qualified to develop and deliver certification programs for its specific industry.

The resolution, endorsed by the organization's Subcommittee on Bridges and Structures during its 2009 general meeting, calls for recognizing "national industry certification programs for personnel, production, and quality control related to fabricated structural bridge components and processes." It notes technical institutes offer a good source for providing certification programs because they are the source of the body of knowledge:

Whereas, the State Departments of Transportation (DOTs) recognize that it is in the public interest to ensure that fabricated structural components made for highway, transit, and pedestrian bridges are manufactured to the high standards to ensure safety through consistency of results and quality; and,

Whereas, the State Departments of Transportation rely on proven certification programs in accepting fabricated structural components, and such certification programs have as their goals: training and evaluation of personnel, evaluation of production and quality control procedures as measured against national industry standards and agency specification requirements; and,

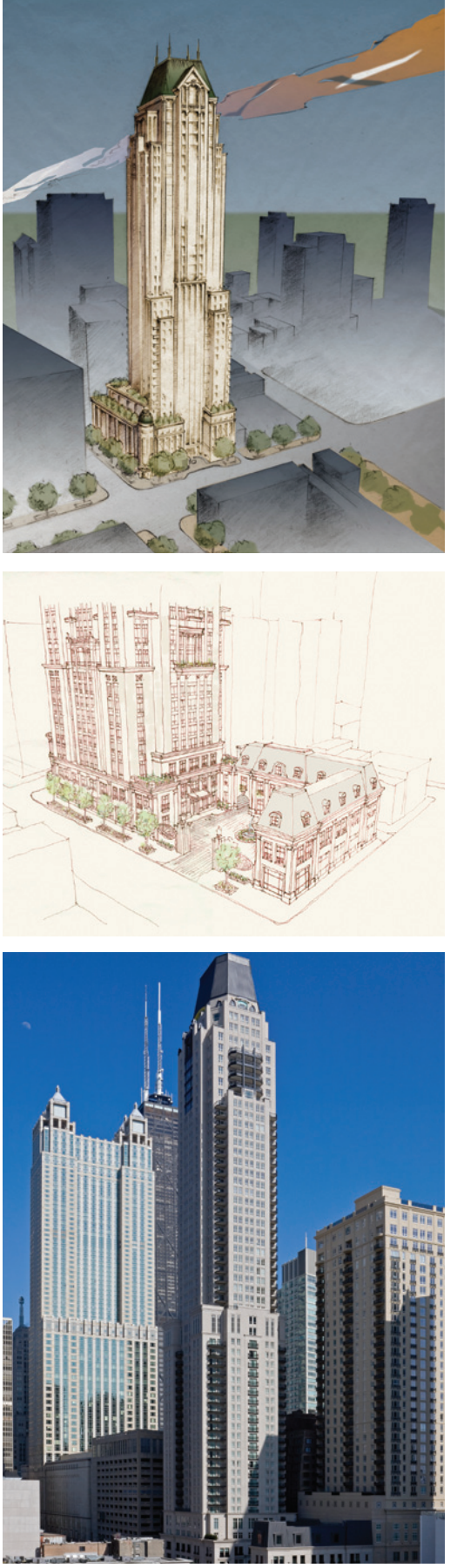
Whereas, it is accepted that nationally recognized technical institutes are comprised of membership representing all segments of bridge stakeholders and develop consensus standards for their industries; sponsor relevant research; draw upon and energize established technical committees; publish technical training, design, and standards manuals; have staff positions held by engineers and subject experts; and qualify and monitor their third-party independent auditors who are trained to provide critical assessment and bring consistency to their work; and,

Whereas, such certification programs have as additional goals, continuous quality improvement, the identification of best practices, the discovery of potential problems and issues, and the dissemination of these topics to the entire industry; and,

Whereas, AASHTO bridge design and rating specifications are developed and calibrated to levels of safety provided by the quality inherent to such industry certification programs; and,

Whereas, reductions in DOT staff and the wider use of performance based construction specifications will lead to increased effort to evaluate and assess quality; and,

Now, therefore, be it resolved on the occasion of the 2009 General Meeting of the AASHTO Subcommittee on Bridges and Structures, the members in attendance express their support for and endorse national industry certification programs for personnel, production and quality control related to fabricated structural bridge components and processes.



Employing a certification program can ensure the owner and architect's vision makes the transition from initial sketches to finished project. Shown are stages of the Elysian Hotel in Chicago, Illinois.

Images courtesy Lucien Lagrange Architects

BODY OF KNOWLEDGE IN ACTION

Placing conventional concrete requires adding vibration to fully consolidate the concrete in forms and around the reinforcing steel within the concrete. In the 1990s, self-consolidating concrete (SCC) found its way to the United States with the advent of new chemical admixtures. Precast concrete manufacturers quickly saw the advantages of this new technology and adopted it before code and standard organizations were able to address it.

Since SCC impacts both the quality and safety of precast concrete products, the Precast/Prestressed Concrete Institute (PCI) reacted quickly and developed guidelines for SCC quality assurance and use. It even went so far as to develop new quality control tests, which were later adopted by the concrete industry.

This process occurred years before SCC was addressed in other concrete codes and standards. PCI used its technical institute resources and the body of knowledge to advance this new concrete technology to benefit manufacturers, specifiers, and project owners in order to maintain quality and safety for all industry stakeholders. **CS**

Foundation of certification

The Precast/Prestressed Concrete Institute uses the term "body of knowledge" to refer to the collective information of an industry that is relied on to design and build with a specific material or system. It is from this that building codes, design guides, education programs, and certification is derived.

Several key elements are integrated and required to develop and maintain a body of knowledge. Some of these include industry experts and stakeholders who must be involved via multiple channels, such as technical institute committees and industry organizations. The latter include codes and standards organizations, research and higher learning facilities, and government organizations. Additional elements are research programs used to test and develop concepts and methodologies or address concerns—these feed into the continuous feedback loop created from the end users and the inspection process.

As one can imagine, given the magnitude and complexity, it is impractical, inefficient, and even dangerous to have more than one 'body of knowledge' for a specific industry. Adopting certification programs outside an industry's nationally recognized technical institute effectively fragments the industry's quality assurance machinery and isolates groups of fabricators from immediate access to the industry's official, continuously evolving body of knowledge. More than that, new certification programs may create confusion by establishing parallel but inconsistent procedures, references, and benchmarks. An industry must be attuned to one national standard.

Fortunately, in the construction industry, technical institutes have clearly defined domains of expertise. While there may be many trade associations, there is typically only one technical institute for a specific industry. Quite often, technical institutes collaborate to ensure the quality and safety of the built environment. The white paper created by PCI and the American Institute of Steel Construction (AISC) is an example of institutes placing quality and safety above all else. **CS**

ADDITIONAL **INFORMATION**

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Abstract

Society relies on professionals to design and build safe concrete structures, not only during construction, but also throughout its life and even during deconstruction. Structures must be built and must perform as designed and specified, otherwise safety, along with the likelihood of a project's success, can be compromised.

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