PCI Overview

Comprehensive Quality Systems: A Smart Choice for Bridges

2011 Caltrans-PCMAC Precast Bridge Workshop
Sacramento, CA
November 17, 2011

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The April 19, 1990 memorandum from Stanley Gordon served to encourage owners to work with industry to enhance quality, longevity and economy.
Focuses a whole chapter on Continuous Quality Improvement (QI)

Denotes QI as: A Concept for Change
NQI (1994 and updated 1997)

Scope “to achieve a higher quality consciousness”

Objective 1: Promote and Disseminate Information on Quality Enhancement Practices...

Objective 2: Advance Technology & Build Consensus on important Highway Quality Issues

Objective 3: Reward Exemplary QI efforts

Objective 4: Maintain National emphasis on the Continuous Quality Improvement
Adopts International (ISO9000) Quality Standards definitions for QC and QA

Promotes Industry involvement in developing standards
AASHTO Implementation (1996)

- Defined parties roles with respect to QC and QA
- Laboratory Accreditation Program
- Personal certification for sampling and testing
- Detailed examples of dispute resolution and Independent verification testing
Glossary of QA elements
- Explains Pay adjustments
- Examination of Statistics
- Performance Modeling
  - Precision
  - Accuracy
A Resolution of the AASHTO Highway Subcommittee on Bridges and Structures

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 quality 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.
New Market Place Information (2009)

ARE ALL CERTIFICATION PROGRAMS CREATED EQUAL?

Close examination shows certain certification programs that are not the most effective. In some instances, the certification programs may be more about the certification itself than the product or service it is supposed to represent. In other cases, the certification programs may lack the necessary oversight or standards to ensure that the products or services they certify are truly of high quality. It is important for consumers to research and compare different certification programs before making a decision on which one to use.

INSTITUTE CERTIFICATION since 1927

CERTIFICATION RELIRES ON A BODY OF KNOWLEDGE AND CONTINUOUS IMPROVEMENT

A NARS Institute initiative, led by the HPCC, is designed to provide a comprehensive body of knowledge and continuous improvement in various fields. The program is designed to help professionals develop the skills and knowledge necessary to excel in their field. It is an ongoing process that requires dedication and commitment to learning and improvement. The program is open to anyone who wishes to participate, regardless of their background or experience.

The Federal Office of Management and Budget has recently released a report that highlights the importance of continuous improvement in government organizations. The report emphasizes the need for organizations to be adaptable and responsive to changing conditions, and to continuously evaluate and improve their processes. The report also emphasizes the importance of having a clear vision and mission, and of aligning organizational goals with strategic objectives. The report provides a framework for organizations to use as they develop their own continuous improvement initiatives.

Supplement to a SPIRE

Certification - More than a checklist

Certiﬁcation programs are designed to ensure that products and services meet certain standards. They are not just about checking off a list of requirements, but about verifying that the products and services are of high quality and meet the needs of consumers.

The report emphasizes the importance of continuous improvement in government organizations. The report also highlights the need for organizations to be adaptable and responsive to changing conditions, and to continuously evaluate and improve their processes. The report provides a framework for organizations to use as they develop their own continuous improvement initiatives.

It is important for consumers to research and compare different certification programs before making a decision on which one to use. The certification programs should be evaluated based on their effectiveness, the quality of the products or services they certify, and their overall value to consumers. It is important for organizations to continue to improve and evolve their certification programs to ensure that they meet the needs of consumers and stakeholders.
In order for a quality certification program to perform efficiently, it must support **all of the points** addressed above. It is important to note that many of the points listed above originate from a pending joint white paper created by AISC and the Precast/Prestressed Concrete Institute (PCI) that will be available on each respective organization’s website: [www.aisc.org](http://www.aisc.org) and [www.pci.org](http://www.pci.org), respectively.

The white paper breaks down “material barriers” between the concrete and steel industry and demonstrates that while **some consultants and associations may offer certification programs**, only the technical institute serving the corresponding industry has the established body of knowledge to serve as a singular, standardized and accredited certification organization.
Characteristics of Technical Institutes

1. Industry Standing
2. Clearly Stated Purpose
3. Broad Professional Involvement
4. Governance and Consensus
5. Research
6. Validation
7. Dissemination
8. Certification of Purpose
9. Certification of Fabrication Process
10. Independent Audits
11. Feedback and Recourse
12. Continuing Commitment

Introduction
This white paper identifies 12 characteristics essential to any organization offering construction industry certification. Typically, these characteristics 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. Owners and specifiers of both public and private facilities have depended on such organizations for conformity assessment and quality standards for more than 40 years.

Technical Institutes
Technical institutes are usually national or international in scope. Each is recognized as the preeminent forum for exchanging information and as the principal body of knowledge for the industry it serves. National technical institutes facilitate the exchange of knowledge between many different industry stakeholders, including subject matter experts, academics, designers, contractors, owners, code officials, fabricators, engineers, and manufacturers. With well-organized membership bases and a focus on collaboration and dissemination of information, technical institutes provide a framework that independent industry organizations cannot.

While any number of associations may serve an industry for a variety of professional and economic reasons, there is only one technical institute. When one industry overlaps with, or is a subset of, another, the technical institutes involved typically have well-established collaborative relationships with one another to effectively combine their bodies of knowledge. Technical institutes are not developed overnight, establishing expertise, standard-setting authority, and a reputation for reliability over time, often decades.

Certification Programs
Because their properties may be difficult to verify at the construction site, precast/post-tensioned components must be manufactured to meet contract requirements and to ensure quality and reliability. Direct independent observation and assessment of a fabricator’s quality management system saves time and money, and provides assurance that a particular product has met a minimum level of acceptable quality standards. Specifiers need to rely on the nationally recognized certification program of an industry’s technical institute to provide assurance that a fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability, and commitment to produce quality work.

In order to successfully and reliably perform this important function, a certification program cannot stand alone; it must be part of a comprehensive quality system specific to the engineered components addressed. The essential functional elements of a comprehensive quality system are listed in the attached discussion.
Certifying the certifiers.

NCCA extensive standards range from governance to competency testing.

ISO 65 outlines the public’s perception of what a creditable certification program entails.

NIST and IAS accreditation recognized by some state Building officials as “validating Certification entities.”

The framework set forth by white paper for fabrication facility certification follows these same rigorous tenants.
Notes that Certification Schemes range from the simple to the complex.

Certification has been around in various forms since the 4th Century

Fundamental to Deming’s approach is “quality comes not from inspection, but from improvement of the production process”
Other Technical Institutes

- Examples of Technical Institutes

- American Iron and Steel Institute (AISI) plate standards;
- AISC for best practices and plant certification;
- American Segmental Bridge Institute (ASBI) for best practices and grouting-personnel certification;
- American Concrete Institute (ACI) for best practices and personnel certification;
- ASTM International for materials and test standards;
- American Welding Society (AWS) structural welding code, after-welding distortion tolerances, best practices, and personnel certification;
- Concrete Reinforcing Steel Institute (CRSI) reinforcement dimensions, bending and placement standards, and epoxy coating plant certification;
- PCI for best practices, plant certification, and personnel certification; and
- Post-Tensioning Institute (PTI) for best practices, hardware standards, and personnel certification.
1. Industry Standing
   • Apply broad and diverse knowledge base
   • Maintain recognition in industry
   • Facilitate exchange of knowledge
• Federal and Industry agreement for shared funding of the advancement of Precast Prestressed Concrete Pavements
  – Developing Consensus based guidance documents
National Concrete Bridge Council

- American Coal Ash Association
- American Segmental Bridge Institute
- Concrete Reinforcing Steel Institute
- Expanded Shale, Clay, and Slate Institute
- National Ready Mixed Concrete Association
- Portland Cement Association
- Precast/Prestressed Concrete Institute
- Post-Tensioning Institute
- Slag Cement Association
- Silica Fume Association
- Wire Reinforcement Institute
Prefabricated Concrete Bridge Elements
What are Prefabricated Bridge Elements & Systems?

• **Superstructures**
  – Deck Panels: Partial & Full-Depth
  – Prefabricated Beams: Optimized for ABC, Optimized Shape, or Best Selected Section
  – Total Superstructure Systems:
    – Composite Units, Truss Spans

• **Substructures**
  – Pier Caps, Columns, & Footings
  – Abutment Walls, Wing Walls, & Footings
  – Total Substructure Systems

• **Totally Prefabricated Bridges**
Precast Deck on Precast Concrete Girders
Utah DOT
MP200 Bridge

Photo Courtesy of Utah DOT
Utah DOT
Beaver Creek Bridge
GFRP Rebar in Deck Panels

Photo Courtesy of Utah DOT
2. Clearly Stated Purpose

- Serve as engine for quality improvement
- State purpose transparently
- Not-for-profit support overall industry
- Form strategic relationships
3. Broad Professional Involvement

- Apply best professional qualifications and experience
- Maintain diverse membership
- Maintain balanced committee participation
• 333 Producer Members
• 101 Supplier Associate Members
• 141 Erector Associate Members
• 1,953 Individual Members
  – 1,237 Professionals
  – 151 Associate Professionals
  – 237 Affiliates
  – 254 Students
  – 74 Life Members
4. Governance and Consensus
   • Apply body of knowledge reflecting true consensus
   • Maintain defined governance structure
   • Follow ANSI standard development process
5. Research

- Address problems
- Drive continuous improvement
- Support/fund practical research
- Publish internal research results
- Disseminate external research results
The Effects of As-Cast Depth and Concrete Fluidity on Strand Bond

Robert J. Peterman, Ph.D., P.E.
Harley A. Day Distinguished Professor in Engineering
Virginia Tech University
Alexandria, Virginia

This paper presents the results from strand and slip measurements and load tests of members that were fabricated at six different process concrete plants over the past 25 years. All of this work reported herein is based on specimens that were produced using standard concrete mixture and placement techniques. As such, the data presented are believed to be representative of current industry practice.

This study revealed that the occurrence of the so-called top-bar effect (top-bar effect for precast beams or the presence of the amount of concrete in the beam rather than the amount of strain) is critical. In accordance, the results of this investigation indicate that the current design assumptions for bond in precast members are conservative for members having top bars. The study concluded that the bond between SCC and precast members in precast concrete members is poor. The PCI study had the following two objectives:

1. Demonstrate the ability of the current practice and procedures to determine the bond between precast concrete members and prestressed concrete members.

In 2004, the Prestressed Concrete Institute (PCI) conducted an extensive investigation to ensure the bond between SCC and prestressed members in precast concrete members. The PCI study had the following two objectives:

1. Demonstrate the ability of the current practice and procedures to determine the bond between precast concrete members and prestressed concrete members.

In recent years, the use of self-consolidating concrete (SCC) has been increasing steadily among prestressed concrete producers in the United States. SCC is defined as a highly workable concrete that can flow through densely reinforced or geometrically complex areas. It is characterized by its self-consolidation, meaning that it is sufficiently fluid to fill voids and to avoid segregation or excessive bleeding and without the need for vibration. In 2004, the Prestressed Concrete Institute (PCI) conducted an extensive investigation to ensure the bond between SCC and prestressed members in precast concrete members.

Editor's quick points

- This paper focuses on the development of a simple test that produces results to verify the bond at precast concrete reinforcement to concrete.
- Due to the continued increase in complexity of the field, this test is especially important to ensure the bond at the precast concrete reinforcement to concrete.
- A better understanding of the mechanisms that affect bond is needed.
PCI Blast Research
Air Force Research Lab
Tyndall Air Force Base, Panama City, FL
• $1.6 million congressional appropriation
• Collaborative Research and Development Agreement (CRADA)
• Portland Cement Association (PCA) and Air Force Research Laboratory (AFRL)
  – PCI, TCA, NCMA, NCRMA, ICFA, CRSI
• Industry support with product donations and technical expertise
Diaphragm Seismic Design Methodology (DSDM)
• $2.5 million research program
  – National Science Foundation
  – George E. Brown Jr. Network for Earthquake Engineering Simulation
  – Charles Pankow Foundation
  – Precast/Prestressed Concrete Institute
  – Precast, prestressed concrete industry
  • Central Pre-Mix Prestress Co.
TOOLS OF THE TRADE

• **LCA: Life Cycle Assessment**
  – Energy impacts
  – Environmental impacts
  – Economic impacts
  – Cradle to grave (disposal)

• **LCCA: Life Cycle Cost Analysis**
  – Economic impacts only
  – Cradle to grave (disposal)
LCA Research

Life cycle of building products

- Resource Extraction
- Manufacturing
- On-site Construction
- Occupancy / Maintenance
- Recycling / Reuse / Disposal
- Demolition
An LCA is:

- Evaluation of total environmental impact due to:
  - Extraction of materials and fuel used for energy
  - Manufacture of building components
  - Transportation of materials and components
  - Assembly and construction
  - Operation: energy consumption, maintenance, repair, renovation, etc.
  - Demolition, disposal, recycling, reuse

- Complete assessment, not single criterion
- Scientific, not subjective
6. Validation

- Validate knowledge and quality standards
- Provide consensus-based program development
- Provide oversight committees
- Provide expert review panels
- Provide public review
7. Dissemination

- Educate industry personnel
- Alert industry to technical and quality issues
- Maintain journals, periodicals, manuals
- Organize conferences
PCI’s Transportation Trifecta

• Bridge Related Research Papers included and vetted in the *Journal*

• *Aspire* showcases Projects and Concepts

• *PCI Bridge Design Manual* gives industry tested engineering solutions in its third edition
State-of-the-art Report On FULL-DEPTH PRECAST CONCRETE BRIDGE DECK PANELS

(PCIC 01-1911)

PCI

Precast/Prestressed Concrete Institute

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State-of-the-Art Report on Full-Depth Precast Concrete Bridge Deck Panels

Prepared by the PCI Committee on Bridges and the PCI Bridge Producers Committee
Under the direction of the Sub-committee for the State-Of-The-Art Report on Full-Depth Precast Concrete Bridge Deck Panels

Credit to

Vince Campbell
Former president of Bayshore Concrete Products Corporation, VA
STATE-OF-THE-ART REPORT ON
FULL-DEPTH PRECAST CONCRETE BRIDGE DECK PANELS

With the sponsorship of
PCI Committee on Bridges and the PCI Bridge Producers Committee
(Technical Activities Council)

Under the direction of the sub-committee for the
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Several others that deserve special recognition for their contributions include: Vince Campbell for his vision to create a document on this topic; Nghi Nguyen, Parul Patel, and Sameh S. Badie who helped with the example in Appendix D and Kromel Hanna who assisted the technical editor to create the final publication.

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PCI Annual Convention

"Think Globally, Build Locally"

The Third International Congress and Exhibition

Incorporating the PCI Annual Convention & Bridge Conference

Washington, D.C.
May 29 – June 2, 2010
Gaylord National Resort
www.fib2010washington.com

- 3 major events under one roof
- Over 700 papers presented
- Thousands of attendees
- Over 100,000 ft² of exhibits
- Over 30 countries represented
- One international venue
8. Certification of Personnel
   • Validate personnel competence
   • Scrutinize employees serving critical functions
   • Review company’s quality management system
   • Confirm proper quality standards and procedures are in place
PCI Personnel Training & Certification

• Plant Quality Personnel Certification
  – Level I
  – Level II
  – Level III

• Field Quality Personnel Certification
  – Certified Field Auditor (CFA)
  – Certified Company Auditor (CCA)
9. Certification of Fabrication Process

- Ensure fabrication process is maintained at a consistent quality standards level
- Promulgate quality standards
- Establish certification procedures
- Publish list of certified facilities
- Provide means to resolve non-conformance and to appeal results
- Maintain committees to set quality standards
PCI Plant and Field Certification

- **Plant Certification**
  - 268 Certified Plants

- **Field Certification**
  - 107 Qualified Erectors
  - 12 Certified Erectors
• For PCI certified plants visit:
  http://www_pci.org/find/manufacturer/index.cfm
10. Independent Audits

- Ensure a facility meets quality standards
- Conduct periodic verification through on-site audits
- Conduct audits using third-party auditors
- Employ auditor verification program
INTERNATIONAL ACCREDITATION SERVICE

CERTIFICATE OF ACCREDITATION

This is to signify that

ROSS BRYAN ASSOCIATES, INC.
1025 16TH AVENUE SOUTH, SUITE 400
NASHVILLE, TENNESSEE 37212

Inspection Agency AA-703
Type A (Third-Party) Inspecting Body

has met the requirements of the IAS Accreditation Criteria for Inspection Agencies (AC-98), has demonstrated compliance with ISO/IEC Standard 17020, General criteria for the operation of various types of bodies performing inspection, and has been accredited, commencing December 2, 2009, to provide inspection services in the approved scope of accreditation.

Patrick V. McCullen
Vice President

C. P. Ramani, P.E.
President

(see attached scope of accreditation for field(s) of inspection, including type, range, methods or procedures)

Print Date: 01/06/2010
11. Feedback and Recourse

- Ensure body of knowledge promulgated within industry
- Ensure feedback is brought into body of knowledge
- Gather/apply feedback during industry events
- Include formal complaint procedures
The bridge’s unique precast chain railing really set it apart from others. In our opinion, the only possible way to make such an aesthetic rail would be to use precast concrete.

**BEST REHABILITATED BRIDGE, COWINNER**

**MONROE STREET BRIDGE REHABILITATION**
Spokane, Wash.

**Intrant Firm:**

**Engineer:**

**Owner:**
City of Spokane, Wash.

**General Contractor:**

**Precastor:**
Central Pre-Mix Precast Co., Spokane, Wash.

**JURY COMMENTS:**

“An excellent example of how precast concrete can be included on a historic concrete rehabilitation project. Precast concrete deck panels were used in lieu of cast-in-place concrete. Using the thin-deck panels was unique and allowed for expedited construction. The bridge’s unique precast chain railing really set it apart from others. In our opinion, the only possible way to make such an aesthetic rail would be to use precast concrete. Using current technology, the contractor was able to make an existing bridge look more modern and attractive to the community.”
12. Continuing Commitment

- Maintain stability, reliability, and consistency
- Allocate staff, volunteer time, and funding consistently
- Support industry over the long term
• PCI founded in 1954
• PCI certification established in 1967
• Over 50 on-going technical committees
• Full staff of technical, marketing, and administrative support
• Annual allocated budget
In Summary

Summary Quote
“... The information is intended to be an appetizer... to the Quality improvement process”

Quote from Page 24: A picture of a looped chain....

Vision+Skills+Incentives+Resources+Action Plan=Change

Change is the expected results and all the links are critical to the success. Missing even one link may be fatal to the success of Continuous Quality Improvement.
Comprehensive Quality Systems: A Smart Choice for Bridges

Our Collective involvement and participation advances the engineering practice and an auditor with a checklist is not a comprehensive program rooted in continuous quality improvement.
NHI Session Outcomes

Upon Completion of This Course, Participants Should be able to…

1. Describe the bridge superstructure design and construction process in accordance with the current AASHTO LRFD specifications.
2. Identify the application of appropriate current AASHTO LRFD specification articles dealing with:

- Selection of Bridge Type, Size, and Location
- Bridge Economics
- Bridge Materials
- Evolution of Bridge Design Codes
- Bridge Loads and Load Combinations
2. Identify the application of appropriate current AASHTO LRFD specification articles dealing with:

- Structural Analysis
- Deck Design
- Concrete Bridge Superstructure Design
- Steel Bridge Superstructure Design
- Bearings Selection and Design
3. Demonstrate the use of the current AASHTO LRFD specification requirements for superstructure design through the completion of step-by-step procedures, student exercises and design examples.

4. Successfully complete applicable Learning Outcome Assessments with a combined score of 70% or higher.
Learning Outcomes

A. Identify basic structure types for a variety of span lengths
B. Describe preliminary bridge layout considerations
C. Describe the prefabrication process for pretensioned girders
Structure Types

- CIP and PC Flat Slabs
- Precast, Pretensioned Girders
- SBS Segmental Box Girders
- I-Girders and Box Girders CIP on Falsework
Structure Types

- Spliced I-Girders
- BC Precast Segmental Box Girders
- BC CIP Segmental Box Girders
- Cable Stayed Edge Girder or Box Girder
William’s Observation

- Very Intense week
- Very Structured Curriculum
- As a National Class, strives to deliver total picture without jurisdiction preconceptions
- Instructors give background
- Directed Key References

- “My best and worst in the same Class”
Quality Systems make a difference

Body of Knowledge
IS YOUR CERTIFICATION PROGRAM PLUGGED-IN?

Specify PCI Certification –
There is a Difference!
PCI Certification is built on, and integrated with the Body of
Knowledge for the Precast Concrete Structures Industry. Certifying
Precast/Prestressed Concrete Manufacturers for over 40 years.

Body of Knowledge –
The Foundation of Certification
The Body of Knowledge (BOK) refers to the collective knowledge
of an industry that is relied upon to design and build with a specific
material or system. It is from this BOK that building codes, design
guides, education programs, certification, and everything else
relied upon is derived.

There are 12 essential elements that an organization must have
to develop, maintain and disseminate an industry’s Body of
Knowledge. All of these elements are typically found in the
industry’s technical institute. Effective certification programs
must be an integrated and ongoing part of an industry’s BOK, and
therefore, be developed and managed by an industry’s technical
institute.

PCI is the technical institute for the precast/prestressed concrete
structures industry and at such the PCI Certification program is
an integrated and ongoing part of the precast concrete structures
industry’s body of knowledge. PCI Certification provides owners,
designers and specifiers with the highest probability that precast
concrete products and systems will be manufactured, and perform
in accordance with specifications.

For more information use www.pci.org/certification
or contact Dean Frank, PE, PCI director of quality programs
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Thank you!

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