

## PCI CERTIFICATION PROGRAMS

### **INTRODUCTION**

Since 1967, the Precast/Prestressed Concrete Institute (PCI) has been a leader in the development of innovative quality programs. It was 1967 that saw the beginning of the PCI Plant Certification Program, a program that would set the pace for other construction-related certification programs that followed in later years (Duggleby, 1992). In 1985, PCI implemented its Plant Quality Personnel Certification Program and in 1999, introduced the Certified Field Auditor and Field Qualification Programs for erectors of precast concrete (Shutt, 2000).

With the ever-increasing demand for quality, the certification of manufacturers, erectors and personnel provides the customer the assurance that quality systems are being followed, personnel are qualified and control is practiced through each step of the construction process. Independent, unannounced audits help to assure process control.

### **PCI PLANT CERTIFICATION**

The certification of a manufacturing plant by PCI ensures that the plant has developed and documented an in-depth, in-house quality system that is based on time-tested national industry standards.

#### **Standards**

Production and quality standards are contained in the PCI publication, *Manual for Quality Control for Plants and Production of Structural Precast Concrete Products* (MNL-116). This manual has been recognized by the construction industry as the standard for the manufacture of precast and prestressed concrete since it was first printed in 1970. MNL-116 is the only such recognized national standard for the industry.

#### **Production Experience**

Each company must have at least one year of production experience in order to qualify for certification.

#### **Quality System Manual**

Every plant must document their specific practices in a custom Quality Systems Manual (QSM). The requirements for the QSM are contained in Division 1 and Appendix A of MNL-116. Fifteen separate sections require that all operations in the plant be addressed thoroughly by management. Each QSM must be approved by PCI prior to certification and must then be reviewed annually and updated if necessary. Plants can obtain additional assistance for compiling a QSM in the PCI publication *Preparation Guidelines for a Structural Plant Quality System Manual* (2000).

#### **Audits/Auditors**

Nearly all new plants undergo a "Precertification Evaluation" after which a plant is audited twice each year. These audits are not announced in advance. Auditors are independent, specially trained engineers. They are employed by a single consulting engineering firm under contract to PCI, which ensures consistency for every plant (Shutt, 1994).

#### **Closing Meeting/Reports**

Every audit ends with a closing meeting. Auditors and key plant personnel meet to review preliminary results. If improvements are needed, they can be started right away. Later, a detailed written analysis documents observations and reasons for required improvements. The report also includes a numerical grade sheet that indicates the level of compliance with the standards.

#### **Grades**

The numerical grade sheet is organized with each section of the gradesheet corresponding to a division (chapter) of MNL-116. During an audit, each division is evaluated separately. Grades in each division must meet or exceed an established mini-

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imum value. Then, the grades for all divisions are combined into an overall grade. A minimum overall grade must also be achieved for certification. Audits are evaluated on a strict pass-fail criteria. A failing grade requires a Special Immediate Audit. Failure of that audit or the subsequent Regular Audit results in loss of Certification.

### **Product Groups**

A plant is evaluated and classified according to the type of products produced. This allows for a more product-specific inspection and analysis of a plant's specialized capabilities. It provides specifiers with more information about the production experience of precast plants.

Plants, including bridge products producers, may be certified in up to four general groups of products. The manuals listed in parenthesis contain the standards for certification in that Group.

<b>Group A</b>	Architectural Concrete Products (MNL-117)
<b>Group B or Group BA</b>	Bridge Products (MNL-116) or the combination of the A and B Product Groups (MNL-116)
<b>Group C or Group CA</b>	Commercial (Structural) Products (MNL-116) or the combination of the A and C Product Groups (MNL-116)
<b>Group G</b>	Glass Fiber Reinforced Concrete Products (MNL-130)

### **Product Categories**

The Product Groups are further divided into Categories that define a product's reinforcement or the ways in which the products are manufactured or used. Product Categories that include prestressing may incorporate pretensioning or post-tensioning or both. Bridge products producers must be certified in one Category from Group B or Group BA.

### **Group B Categories**

- B1 – Precast Bridge Products (no prestressed reinforcement)  
Examples include pile caps, retaining wall components, three-sided boxes or arches, median barriers, parapet walls, railings, fascia panels, abutment panels, sound barriers, pier columns, pier caps, precast diaphragms and conventionally-reinforced segmental units, and partial- and full-depth deck panels.
- B2 – Prestressed Deck and Miscellaneous Bridge Products (non-superstructure)  
Examples include prestressed (pretensioned or plant post-tensioned) pier columns, pier beams, sound walls, fascia panels, piles, sheet piles, partial- and full-depth deck panels.
- B3 – Prestressed Straight-Strand Bridge Beams (superstructure)  
Examples include solid-slab beams, voided slabs, box beams, I-beams, bulb-tees, double tees, multiple-stemmed units, box beam segments with pretensioned or plant post-tensioned prestressing.
- B4 – Prestressed Deflected-Strand Bridge Beams (superstructure)  
Examples include box beams, I-beams, bulb-tees, double tees, multiple-stemmed units and plant post-tensioned precast beams with draped tendons.

### **Group BA Categories**

- Group B Category products with an architectural finish (see additional information that follows)
- B1A – Precast Bridge Products with Architectural Finish (no prestressed reinforcement)
- B2A – Prestressed Miscellaneous Bridge Products with Architectural Finish (non-superstructure)

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B3A – Prestressed Straight-Strand Bridge Beams with Architectural Finish (super-structure)

B4A – Prestressed Deflected-Strand Bridge Beams with Architectural Finish (super-structure)

Producers may also be certified in one or more of the following Groups and Categories.

**Group A Categories**

AT – Miscellaneous Architectural Trim Units

A1 – Architectural Precast Concrete Products

**Group C Categories**

C1 – Precast Concrete Products (no prestressed reinforcement)

C2 – Prestressed Hollow-Core and Repetitively-Produced Products

C3 – Prestressed Straight-Strand Structural Members

C4 – Prestressed Deflected-Strand Structural Members

**Group CA Categories**

Group C Category products with an architectural finish  
(see additional information that follows)

C1A – Precast Concrete Products with Architectural Finish (no prestressed reinforcement)

C2A – Prestressed Hollow-Core and Repetitively-Produced Products with Architectural Finish

C3A – Prestressed Straight-Strand Structural Members with Architectural Finish

C4A – Prestressed Deflected-Strand Structural Members with Architectural Finish

Within a Product Group, the Categories listed above are intended to be in ascending order of production complexity. A producer qualified to produce products in a given Category is automatically qualified in the preceding Categories but not in succeeding Categories. See the following Guide Qualification Specifications and accompanying notes for more details.

For more descriptive information about the types of products and projects that are represented by these Categories, contact PCI, visit the PCI website at [www.pci.org](http://www.pci.org), or refer to other more-detailed program literature from PCI.

**Architectural Finishes –  
Product Groups BA and CA**

Beginning with the Fourth Edition of MNL-116 (1999), an additional product distinction was made available to the specifier. The new classification defines products that have architectural finishes applied to more traditional structural products. Before now, these products were not addressed in either MNL-116 or MNL-117. The special requirements for finish, texture, color, tolerances and quality control are included at the end of each division of manual MNL-116.

**Identification of BA and  
CA Producers**

The architectural finishes designation may be applied to any “B” or “C” category. Qualified producers will be identified with the suffix “A” following their normal designation of “B1” through “B4” and “C1” through “C4.” For example, if a precaster is certified to produce precast sound barrier wall panels with conventional steel reinforcement and with an exposed aggregate surface finish, the appropriate designation will be “B1A.” A bridge-products producer that manufactures prestressed fascia panels

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with an architectural finish for a bridge would be required to hold “B2A” certification. Refer to the Guide Qualification Specification near the end of this appendix for information about how to specify this and other Bridge Groups and Categories.

### **List of Certified Plants**

A current listing of all PCI Certified Plants is published quarterly in PCI’s *ASCENT* magazine. A convenient searchable list is regularly updated on the PCI website at [www.pci.org](http://www.pci.org), or contact Director of Certification Programs at PCI.

### **Endorsements**

PCI holds a National Evaluation Report (NER QA-105) as an approved Quality Assurance Agency by the National Evaluation Service (NES). The NES includes:

- Building Officials and Code Administrators Evaluation Service Inc. (BOCA ES)
- Southern Building Code Congress International, Public Safety Testing and Evaluation Services Inc. (SBCCI PST&ESI)

PCI holds a separate registration (AA-658) as an approved Quality Assurance Agency by the International Conference of Building Officials Evaluation Service Inc. (ICBO ES).

PCI Plant Certification is included in the MasterSpec of the American Institute of Architects and is required in the specifications of the following federal agencies:

- U.S. Army Corps of Engineers, Civil Works Division & Military Programs
- U.S. Naval Facilities Engineering Command (NAVFEC)
- Federal Aviation Administration
- General Services Administration
- U.S. Department of Agriculture, FSIS
- U.S. Department of Interior, Bureau of Reclamation

Plant Certification is strongly endorsed in correspondence by the Federal Highway Administration (Kane, 1996) for precast concrete bridge products and is required or accepted by more than two-thirds of the individual state departments of transportation (Merwin, 1995).

### **PCI PLANT QUALITY PERSONNEL CERTIFICATION**

Conducting an effective quality control program requires knowledgeable and motivated testing and inspection personnel. Each must understand quality basics, the necessity for quality control, how products are manufactured, and precisely how to conduct tests and inspections. PCI has been training quality control personnel since 1974. In 1985, the first technician training manual was published by PCI and the first qualified personnel attained certification.

There are three levels of Plant Quality Personnel Certification.

#### **PCI Plant Quality Personnel Certification, Level I**

Level I requires six months or equivalent of approved industry experience. It requires a basic level of understanding of the many quality control issues normally encountered in a precast plant, such as:

- Quality and quality control programs, testing and measuring
- Prestressing concepts and tensioning procedures for straight strands, including basic elongation calculations

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- Basic concepts about concrete – water-cementitious materials ratio (w/cm), types of cements, accelerated curing concepts
- Control of purchased materials
- Precast production procedures
- Welding practices including welding of reinforcing bars and studs
- Interpretation of basic shop drawings

Certification at Level I requires current certification in the American Concrete Institute (ACI) Concrete Field Testing Technician Program, Grade I. The ACI certification requires a closed-book written test and precise field demonstration of seven ASTM methods to test properties of fresh concrete.

Certification at Level I is accomplished by passing a closed-book written examination. Examinations may be administered locally by a PCI-approved proctor or at a PCI-conducted training school. A manual for training and self-study (TM-101) is available from PCI. Level I must be renewed by testing every five years unless a higher level of PCI certification has been attained.

### **PCI Plant Quality Personnel Certification, Level II**

Level II certification requires one year of approved industry experience or equivalent plus PCI Level I and current ACI Level I as prerequisites. Other requirements for Level II include a greater level of knowledge of most of the topics previously described for PCI Level I, as well as:

- Tensioning and elongation corrections that account for temperature effects, chuck seating, abutment movement and bed shortening. Calculations for elongation and corrections are required.
- Effects of accelerated curing and importance of w/cm are further emphasized. Corrections to mix proportions must be calculated to account for excess moisture in the aggregates.
- Material control tests are further explored including aggregate gradations and analysis. Calculations are required for gradation analysis.
- Plant topics include more detail in reading shop drawings and in procedures for welding reinforcing bars and studs.

Certification through Level II is accomplished by passing a closed-book written examination. Examinations may be administered locally by a PCI-approved proctor or at a PCI-conducted training school. A manual for training and self-study for Level II (TM-101) is available from PCI. Level II must be renewed every five years by testing unless Level III has been attained.

### **PCI Plant Quality Personnel Certification, Level III**

Level III provides significant instruction in concrete materials and technology. Certification at this level requires two years of approved industry experience (or equivalent) and attendance at a four-day PCI school. The candidate must pass a closed-book written examination at the school. PCI Level II certification is a prerequisite. Certification at Level III is valid for life. There is a training manual (TM-103) available from PCI that covers all course topics, including:

- Properties of:
  - Basic concrete materials
  - Admixtures
  - Fresh concrete
  - Hardened Concrete

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- Mix designs using normal and lightweight aggregates
- Architectural concrete
- Troubleshooting and fine-tuning concrete mixes
- Finished product evaluation
- Stud welding and welding of reinforcing steel
- Deflected prestressing strands and the calculation of deflection forces

### **Agency Requirement**

Plant Quality Personnel Certification is required by nearly a third of the individual state departments of transportation. They require certification for plant quality personnel and for their own materials inspectors and quality assurance personnel.

### **SUMMARY**

The precast, prestressed concrete industry, through PCI, has taken bold steps to establish industry quality standards. The standards apply to personnel, to production and operations, to quality control, and to field operations. The standards have been published and widely disseminated and are open for evaluation and written comments, all of which will be given consideration.

The PCI industry standards for quality production are demanding to achieve. Once attained and practiced regularly, adherence to these standards contributes to improved and continuing customer satisfaction. Following these standards has been shown to reduce the “cost of quality” for the owner as well as the producer.

Certification by PCI assures compliance to the published standards for quality production. Certified personnel and producers choose to demonstrate their proficiency by voluntarily undergoing examinations and audits by accredited third-party assessors.

PCI Plant and Personnel Certification are reliable means for qualifying personnel and precast concrete producers. Use the Guide Qualification Specification that follows to require PCI Certification Programs for your projects.

### **GUIDE QUALIFICATION SPECIFICATION**

The following guide specification can be used to qualify a precast concrete manufacturer to submit a bid on your project. Generally, the easiest procedure would be to list the precast product or the various precast products included in your project. Then, determine the appropriate Product Group and Category for each product, considering the use of the product, the method of reinforcement and special required surface finishes, if any. Show each of the products and the required Group and Category in the project specifications. Refer to the following “Notes to Specifiers” for additional discussion. Product categories that include prestressing may incorporate pretensioning or post-tensioning or both.

Further, it is recommended that the manufacturer employ trained and certified personnel according to the Personnel Qualifications guide specification that follows.

### **Manufacturer Qualifications – Structural Precast Concrete**

The precast concrete manufacturing plant shall be certified under the Precast/Prestressed Concrete Institute Plant Certification Program. The Manufacturer shall be certified at the time of bidding. Certification shall be in the following Product Group(s) and Category(ies):

[Select and insert one or more of the following applicable groups and categories]

**PCI CERTIFICATION PROGRAMS****Group B – Bridge-Related Products**

- B1 – Precast Bridge Products (no prestressed reinforcement)
- B2 – Prestressed Miscellaneous Bridge Products (non-superstructure)
- B3 – Prestressed Straight-Strand Bridge Beams (superstructure)
- B4 – Prestressed Deflected-Strand Bridge Beams (superstructure)

**Group BA – Bridge-Related Products that Require Architectural Finishes**

- B1A – Precast Bridge Products with Architectural Finish (no prestressed reinforcement)
- B2A – Prestressed Miscellaneous Bridge Products with Architectural Finish (non-superstructure)
- B3A – Prestressed Straight-Strand Bridge Beams with Architectural Finish (superstructure)
- B4A – Prestressed Deflected-Strand Bridge Beams with Architectural Finish (superstructure)

**Notes to Specifiers:**

1. Additional guide specifications, not shown here, are available from PCI for Product Groups “A,” “C” and “G.”
2. Categories in Product Group B are listed in ascending order of production complexity. For example, a plant certified to produce products in Category B4 is automatically certified to produce products in the preceding Categories B1, B2 and B3. However, a plant certified to produce products in Category B2, while certified for Category B1, is not certified for Categories B3 or B4.
3. Categories in Group BA are also listed in ascending order. See Notes 2 & 4.
4. Group BA supercedes Group B in the same Category. For example, a plant certified to produce products in Category B4A is automatically certified to produce products in the preceding Categories B1A, B2A, B3A, and in categories B1, B2, B3 and B4. However, a plant certified to produce products in Category B2A, while also certified for Categories B1A, B1 and B2, is not certified for Categories B3A, B4A, B3 or B4.
5. A Product Group and Category should be determined and shown in the specifications for each type of precast concrete product used in a project. Separating products will enable precasters to submit bids on specific products. For example, on a project that included both prestressed piling and beams, a precaster with expertise in producing prestressed piling (with Certification B2) could submit a price on piles only. On the same project, a producer with Certification B4 could submit a price for the beams and decide to either include or exclude the piling.
6. Specify the most appropriate Product Group and Category for the project. Do not select a higher Category than necessary. Similarly, do not add “A” to a listing when not necessary to meet project requirements. Selecting an inappropriate Group or Category could result in unnecessary cost or could restrict the number of available bidders.

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The Manufacturer shall employ a minimum of one person, regularly present in the plant, who is certified by the Precast/Prestressed Concrete Institute for Plant Quality Personnel, Level II. All other personnel regularly engaged in the measuring, testing or evaluation of products or materials shall be similarly certified, or actively pursuing certification for Plant Quality Personnel, Level I.

**REFERENCES**

Duggleby, J., "Setting a Higher Standard," *ASCENT* Fall, 1992 Precast/Prestressed Concrete Institute, Chicago, IL, pp. 28-31

Shutt, C., "Erector Qualification Brings Precast Quality Assurance Full Circle," *ASCENT*, Fall 2000, Precast/Prestressed Concrete Institute, Chicago, IL, pp. 122-123

*Preparation Guidelines for a Structural Plant Quality System Manual*, QSM-1, Precast/Prestressed Concrete Institute, Chicago, IL, 2000, 50 pp.

Shutt, C., "Ross Bryan Associates Makes the Grade," *ASCENT*, Winter 1994, Precast/Prestressed Concrete Institute, Chicago, IL, pp. 12-16

*Manual for Quality Control for Plants and Production of Structural Precast Concrete Products*, Fourth Edition, MNL-116-99, Precast/Prestressed Concrete Institute, Chicago, IL, 1999, 283 pp.

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Kane, A., Letter (Unpublished), Federal Highway Administration, Washington, DC, 1996

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*Quality Control Technician/Inspector Level I & II Training Manual*, TM-101, Precast/Prestressed Concrete Institute, Chicago, IL, 1987, 246 pp.

*Quality Control Personnel Certification Level III Training Manual*, TM-103, Precast/Prestressed Concrete Institute, Chicago, IL, 1996, 244 pp.