CANADIAN PRECAST/PRESTRESSED CONCRETE INSTITUTE

# ARCHITECTURAL PRECAST CONCRETE

## SPECIFICATIONS

Section 03 45 00

CPCI.ca

## Part 1 General

### 1.1 SECTION INCLUDES

.1 Architectural precast concrete elements

.2 Supports, anchors and attachments

.3 [Perimeter and] intermediate joint seals [and firestops if required].

.4 [Grouting under panels if required.]

### 1.2 RELATED SECTIONS

.1 Section 03 30 00 - Cast-in-Place Concrete: Building structural frame.

.2 Section 03 38 00 - Post Tensioned Concrete: Building structural frame

.3 Section 03 41 00 - Structural Precast Concrete: Building structural frame.

.4 Section 03 47 13 - Site Cast Tilt-up Concrete: Building structural frame.

.5 Section 05 12 00 - Structural Steel: Building structural frame.

.6 Section 03 41 13 – Precast Concrete Hollow Core Planks: Building structural floor system.

.7 Section [_____- _____]: Supporting masonry.

.8 Section 07 62 00 – Metal Flashings: Metal flashings to fit recessed reglets in precast components.

.9 Section [_____- _____]: Surface reglets and metal flashings attached to precast components.

.10 Section 07 84 00 - Firestopping: [[Fire] [Smoke] barrier] [Air] seal between the precast unit and edge of the floor slab.

.11 Section 07 92 00 - Joint Sealants: Perimeter joints with sealant and backing.

.12 Section [_____- _____]: Windows [and glass] site installed in precast components.

.13 Section [_____- _____]: Placement of anchors for [embedding into] [placing in] [welding to] building structural components.

.14 Section [_____- _____]: Window units [and glass] for placement by this section.

.15 Section [_____- _____]: Flashing reglets for placement by this section.

**1.3 REFERENCES**

.1 ASTM International (ASTM):

.1 ASTM A1035/A1035M-23- Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement

.2 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A307-21 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

.4 ASTM A416/A416M-18 – Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

.5 ASTM A555/A555M-22 – Standard Specification for General Requirements for Stainless Steel and Wire Rods.

.6 ASTM A666-23 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

.7 ASTM A1064/A1064M-22 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.8 ASTM C260/C260M-10a (2016) - Standard Specification for Air-Entraining Admixtures for Concrete

.9 ASTM C494/C494M-19E1 - Standard Specification for Chemical Admixtures for Concrete.

.10 ASTM C881/C881M-20a - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

.11 ASTM D2240-15(2021) – Standard Test Method for Rubber Property - Durometer Hardness.

.12 ASTM D2240-15(2021) – Standard Test Method for Rubber Property - Durometer Hardness.

.13 ASTM D7957/D7957M-22 - Standard Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement

.14 ASTM F3125/F3125M-22 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.2 CSA Group (CSA):

.1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Methods of Test for Concrete.

.2 CSA A23.3-19 - Design of Concrete Structures.

.3 CSA A23.4-16 (R2021) - Precast Concrete - Materials and Construction.

.4 CSA A3000-18 - Cementitious Materials Compendium.

.5 CSA G30.18-21 - Carbon steel bars for concrete reinforcement

.6 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel /Structural Quality Steel.

.7 CSA W47.1-19 - Certification of Companies for Fusion Welding of Steel.

.8 CSA W59-18 - Welded Steel Construction (Metal Arc Welding).

.9 CSA W186:21 - Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 CISC/CPMA Standard 2-75 - Quick-drying Primer for Use on Structural Steel

.4 Canadian Precast/Prestressed Concrete Institute (CPCI):

.1 CPCI Design Manual – 5th Edition. CPCI Design Manual

.2 CPCI – Architectural Precast Concrete Walls: Best Practice Guide. Architectural Precast Concrete Walls: Best Practice Guide

.3 CPCI - Architectural Precast Concrete Colour and Texture - Selection Guide. Colour and Texture Selection Guide

.4 CPCI (Canadian Precast/Prestressed Concrete Institute) – Precast Concrete Insulated Wall Technical Guide. Insulated Wall Panel Technical Guide

.5 Engineer of Record & Engineering Roles & Responsibilities for Precast Concrete Design. Engineer of Record (EOR) Roles and Responsibilities (2023)

.6 RDH Building Science - Maintenance and Inspection Manual for Precast Concrete Building Enclosures. CPCI Maintenance and Inspection Manual for Precast Concrete Building Enclosures

.7 RDH Building Science – High Performing Precast Concrete Building Enclosures – Rain Control.
High Performing Precast Concrete Building Enclosures - Rain Control

.8 RDH Building Science – Meeting and Exceeding Building Code Thermal Performance Requirements. Meeting and Exceeding Building Code Thermal Performance Requirements

.5 National Building Code of Canada (NBC), current edition

## 1.4 ADMINISTRATIVE REQUIREMENTS

.1 Refer to Section 01 31 00: Project management and coordination procedures.

.2 The roles and responsibilities of the Engineer of Record and the Precast engineer should be set according to the CPCI publication: Engineer of Record & Engineering Roles & Responsibilities for Precast Concrete Design.

## 1.5 SUBMITTALS FOR REVIEW

.1 Refer to Section 01 33 00: Submission procedures.

.2 Shop Drawings and Samples:

Spec Note: It is not the Precast Concrete Manufacturer's responsibility to confirm and correlate job site dimensions. Precast concrete is a pre-fabricated material. The Precast Concrete Manufacturer should be provided with site dimensions, field measurements, grid lines, reference points elevation and survey drawings before the fabrication commences and when requested.

.1 Prepare and submit Shop Drawings in accordance with the General Conditions of the contract, CSA A23.3 and CSA A23.4, and as specified below.

.2 Submit fully detailed and dimensioned drawings showing a method of fastening [and sealing]. Indicate the type of finish and other pertinent information on Shop Drawings.

.3 Show locations of inserts and anchors for interface elements.

.4 Show the system of identifying precast concrete components for erection purposes on Shop Drawings and apply similar marks on components at the time of manufacture.

.5 Each drawing submitted shall bear the stamp and signature of a qualified professional engineer registered in the Province of Work.

.6 Pre-production Samples: Provide samples with dimensions of [300 mm x 300 mm] to illustrate surface finish, colour and texture. Make samples sets until final approval is obtained.

*Spec Note: 300 mm x 300 mm sample size may not be sufficient for certain types of finishes. Larger samples can be requested based on projection requirements. Precast concrete components will have slight colour and texture variations from pre-production samples. It is good practice to provide a series of samples to establish an acceptable finish range (colour and texture).*

.7 Installation Data: Precast Concrete Manufacturer's special installation requirements, indicating special procedures, crane and truck access locations, perimeter conditions requiring special attention, and [_____].

**1.6 SUBMITTALS FOR INFORMATION**

.1 Refer to Section 01 33 00: Submission procedures.

.2 Sustainable Design:

.1 Refer to Section [01 35 18]: LEED documentation procedures.

.2 Provide required LEED documentation for precast concrete components [recycled content] [regional materials].

**1.7 CLOSEOUT SUBMITTALS**

.1 Refer to Section 01 78 10: Submission procedures.

.2 Maintenance Data: Indicate [surface cleaning] [_____] [inspection] [joint sealant repair] instructions.

.3 Sustainable Design Closeout Documentation: [_____].

**1.8 QUALITY ASSURANCE**

.1 Perform work in accordance with the latest CSA A23.1/A23.2, CSA A23.3, CSA A23.4, PCI MNL-135, and CPCI Architectural Precast Concrete Walls: Best Practice Guide

.2 Welding: Perform work to CSA W59 and CSA W186.

.3 Welders: Certified to CSA W47.1. Certificates for welders doing the work shall be provided upon request.

.4 Fabricator:

.1 Precast Concrete Manufacturers to be certified to Canadian Precast Concrete Quality Assurance (CPCQA) Certification Program in the appropriate Architectural Category prior to the time of bid [Category A1, AT, CA1, CA2, CA3, CA4, BA1, BA2, BA3, or BA4].

.2 Precast fabrication to meet the requirements of CSA A23.4, [PCI MNL-116, PCI MNL-117] and CPCQA certification requirements.

.3 Only precast elements fabricated under the CPCQA plant certification program are acceptable, and plant certification shall be maintained for the duration of fabrication, [erection,] and until the warranty expires.

.5 Erector: A company specializing in performing the work should have documented experience in erecting architectural precast concrete structures

.6 Design precast concrete members under the direct supervision of a Professional Structural Engineer experienced in the design of this Work and licensed to practice engineering in the [province/state] where the Project is located.

**1.9 MOCK-UP**

.1 Fabricate and erect [at site] [in plant], [one (1)] [____] full size panel, illustrating shape, lifting device, attachment points, and finish in accordance with approved sample. Reviewed and accepted mock-up panels shall remain as part of the Work.

**[OR]**

.2 Fabricate and erect [at site] [in plant], [one (1)] [____] full size panel, with [typical window,] [fully glazed,] [insulated panel,] [sealants,] [and] [_____]. The mock-up panel shall illustrate the shape, lifting devices, attachment points, and finish in accordance with the approved sample. Material and labour for [windows], [doors],[flashing] shall be provided by others. Reviewed and accepted mock-up panels shall remain as part of the Work.

**1.10 DELIVERY, STORAGE, AND PROTECTION**

.1 Deliver, handle and store precast concrete components in a method approved by the Precast Concrete Manufacturer. Components shall not come into contact with earth or staining influences. Do not rest a component on its corners.

.2 Blocking and Lateral Support during Transport and Storage: Clean, non-staining spacers that do not cause harm to exposed surfaces shall be placed between each unit. Temporary lateral supports should be provided to prevent bowing and warping.

.3 Protect precast concrete components to prevent staining, chipping, or spalling of concrete. Protect holes and reglets from water and ice during freezing weather.

.4 Mark precast concrete components with a date of production in a location not visible to view when in the final position in the structure

**Part 2 Products**

**2.1 DESIGN AND PERFORMANCE REQUIREMENTS**

.1 Conform to applicable national and provincial requirements of [National Building Code of Canada (NBC)] [CSA A23.3] [Province of _____], current edition, and local authorities having jurisdiction.

.2 Design and provide reinforcement, anchors and supports as required by codes for the Consultant's approval. Submit relevant design data prepared by a qualified structural engineer for approval if requested by the Consultant.

**[OR]**

.1 Design precast concrete components to withstand specified loads, including superimposed dead loads, live loads, wind, and thermal loads.

.2 Seismic Loads: Design and size precast concrete components and connections to withstand specified seismic loads and sway displacements.

.3 Design precast concrete components to accommodate code allowable construction tolerances, specified deflections of building structural members, and clearances of intended openings.

.4 Insulated precast concrete components to achieve building energy performance as required by Contract Documents.

.5 Design non-insulating precast concrete panels with pressure equalized joints and cavity compartmentalization in accordance with established design principles for rain screen and pressure equalization of wall systems.

.6 Design insulated precast concrete panels with internal weep and drainage system, providing continuous insulation and sealed joints between panels.

.7 Design concrete reinforcement and steel connections required by the Contract Documents to withstand design loadings indicated and in accordance with requirements of the Building Code as follows:

.1 Design and fabricate panels, brackets and anchorage devices to tolerances as specified in CSA A23.4 and PCI MNL-135.

.2 Design panels to resist handling, transportation, and erection stresses. Compensate for structural deflection of span/360 due to live load and distortion of the structure, under design criteria conditions, without imposing a load on panel assembly.

.3 Sustain precast panel loads, superimposed wind, snow and rain loads, and seismic loads, without exceeding deflection of 1/360.

.4 Permit no water infiltration into the building under design loads.

.5 Wind Loads: 0.50 kPa 1/50 year occurrence in accordance with the Building Code and commentary I of the structural commentaries of the NBC.

.8 Engage a Precast Concrete Manufacturer who utilizes a registered professional engineer to prepare calculations, shop drawings, and other structural data for architectural precast concrete panels that comply with the requirements of this Section.

.9 Retain a delegated design professional engineer registered in the Province of Work to ascertain and report that fabrication and erection of work meets the specific design criteria for materials

**2.2 MATERIALS**

.1 Portland cement, Portland limestone cement, supplementary cementitious materials, aggregates, water and admixture: CSA-A3000, Concrete Materials: in accordance with [CSA A23.4] [and] [CSA A23.1/A23.2]

.2 Reinforcing Steel Bars: [CSA G30.18, deformed steel, unfinished, grade 400W] [ASTM A555/A555M, stainless steel,] [ASTM D7957/D7957M-17, Glass fiber reinforced polymer (GFRP)] strength and size commensurate with precast unit design.

.3 Welded Steel Wire Fabric: ASTM A1064/A1064M, welded steel wire fabric, in [unfinished.] [hot dip galvanized.]

.4 Tensioning Steel Strands: [ASTM A416/A416M,] [ASTM A421/A421M,] Grade [250] [270] [____] ksi

.5 Concrete admixtures in accordance with CSA A23.1/23.2

.6 Surface Finish Aggregates (for exposed aggregate finishes): Aggregates shall be procured from a single source conforming to the approved sample.

Spec Note: *Due to the variety of exposed aggregate finishes for precast concrete and the availability of local aggregates, it may be necessary to preselect colour, texture and finish in cooperation with Precast Concrete Manufacturers. This should be done before the specification is written. Include the generic name of the selected aggregates and sizes of aggregates.*

.7 [Pigment] [Colouring Agent]: [_____] type, [_____] colour resistant to alkalis; [_____]

**2.3 SUPPORT DEVICES**

.1 Connecting and Supporting Devices: conforming to [CSA G40.20/G40.21 carbon steel;] [ASTM A666 stainless steel;] [ASTM A123/A123M hot dip galvanized] plates, angles, [items cast into concrete,] [items connected to steel framing members,] and inserts; fasteners to ASTM F3125/F3125M.

.2 Miscellaneous Plates, Angles, Inserts: CSA A23.1/A23.2.

.3 Protective Finish: [Prime painted.] [Hot-dip galvanized [to ASTM A123/A123M].] [Electroplated.] [Unfinished.]

.4 Bolts, Nuts, and Washers: [ASTM A307,] [ASTM F3125/F3125M]

.5 Prime Paint: [CISC/CPMA Standard 2-75 - Quick-drying Primer for Use on Structural Steel]

**2.4 ACCESSORIES**

.1 Integral Insulation: [extruded polystyrene] [expanded polystyrene] [polyisocyanurate] Insulation type and thickness shall meet the code and contract requirements or approved by consultants to meet building energy requirements

.2 Bearing Pads: [High-density plastic,] [Steel,] [Rubber] [Polytetrafluoroethylene (PTFE)], Bearing pad type and thickness shall be specified by the Precast Engineer.

.3 Shims: [Plastic.] [Stainless Steel.]

.4 Recessed Reglets: [Stainless steel] [Plastic], shaped and flanged to remain in place once cast, [foam plastic filled] [taped closed] to eliminate wet concrete intrusion.

.5 Sealant: Sealant shall be specified by the Precast Concrete Manufacturer.

.6 Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to PCI MNL 117; use plastic materials only.

.7 Grout Materials shall be specified by the Precast Concrete Manufacturer.

**2.5 CONCRETE MIXES**

.1 Concrete mixes shall be designed to CSA A23.4 Clause 16.

**[OR]**

.1 Separate face mix and backup mix:

.1 Face mix (exterior exposure): Minimum Class F1 concrete in accordance with CSA A23.1.

.2 Backup mix (interior exposure): Minimum Class N concrete in accordance with CSA A23.1.

**[OR]**

.1 Use white or grey cement in the facing matrix, as required to achieve an aesthetic appearance.

.2 Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at the Precast Concrete Manufacturer.

.3 Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by CSA standard.

.4 Normal Weight Concrete Face and Backup Mixes: Proportion mixes by either laboratory trial batch or site test data methods with materials to be used on Project to provide normal-weight concrete with the following properties:

.1 Compressive Strength (28 Days): [34.5] MPa.

.2 Maximum Water-Cementitious Materials Ratio: [0.45].

**2.6 FABRICATION**

.1 Fabricate architectural precast concrete components to CSA A23.4 and as follows:

.1 Identify pickup points of precast architectural concrete units and orientation in structure with permanent markings, complying with markings indicated on shop drawings.

.2 Mark each precast unit to correspond to the identification mark on shop drawings for location.

.3 Mark each precast unit with the date cast.

.4 Verify that surfaces to receive sealant are smooth and free of laitance to provide a suitable base for adhesion.

.5 Verify that release agents do not deleteriously affect the sealing of the joints.

.6 Precast concrete components shall be cured in accordance with CSA A23.4 [cl. 23.2].

.7 Cast panels face down in accurate rigid moulds designed to withstand high-frequency vibration.

.8 Vibrate concrete if required to reach proper consolidation.

.9 Provide necessary holes and sinkages for flashings, anchors, cramps, and similar insert items.

.10 Lift points shall be sealed according to design requirements. The Precast Concrete Manufacturer shall take into consideration lifting hardware location in externally visible architectural elements. Visible lift points shall be patched to closely match the panel finish.

.2 Maintain plant records and quality control program during the production of precast concrete components in accordance with CPCQA requirements

.3 Use rigid moulds constructed to maintain precast concrete components uniformly in shape, size, and finish.

.4 [Utilize form liners in accordance with the form liner manufacturer's written instructions.]

.5 Maintain consistent quality during manufacture.

.1 Mix the concrete according to the fabricators' mix design requirements in this section. After concrete batching, no additional water may be added.

.2 Place face mix to a minimum thickness after consolidation of the greater of 25 mm or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover.

.3 Place concrete in a manner to prevent seams or planes of weakness from forming in precast concrete components, and in accordance with PCI MNL 117 for measuring, mixing, transporting, and placing concrete.

.4 Thoroughly consolidate placed concrete by internal and/or external vibration without dislocating or damaging reinforcement and built-in items. Equipment and procedures complying with PCI MNL 117.

.5 Precast units with defects shall be examined by the precast engineer to determine appropriate repair methods.

.1 Defects that are cosmetic (non-structural) shall be repaired in a manner so the appearance of the precast concrete component is not impaired.

.2 Defects of structural nature should be assessed by both the Engineer of Record and the Precast Engineer. A repair procedure shall be established and carried out. The completed repair work must be approved by both the Engineer of Record and the Precast Engineer. If repair is not feasible or unsuccessful, then the defective precast concrete component shall be replaced.

.3 Any repair work of precast concrete components after the installation and acceptance of erected structure is the responsibility of the general contractor.

.4 Non-conforming precast concrete components should be removed from site by the responsible party

Note: it is recommended to establish and approve repair procedures before production begins.

.6 Fabricate connecting devices, plates, angles, [items fit to steel framing members,] inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

.7 Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.

.8 Install [window units] [_____] in place while fabricating precast concrete components. Protect assembly from damage.

.9 Cast rigid insulation into precast concrete components as required.

.10 Design and locate hoisting devices so that they can be concealed when the structure is in service. These devices shall be treated so they will not corrode in service.

.11 Cure precast concrete components to develop strength and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking. Cure in accordance with CSA A23.4.

**2.7 FINISHES**

.1 Precast Concrete Surface Finish: [Fluted] [Smooth] [Exposed Aggregate] [_____], Conform to approved range samples.

.2 Non-visible Surface Finish: Element surfaces that are not intended to be visible shall use a float finish

.3 Connecting Supporting Steel Devices: [Prime painted.] [Hot dip galvanized.] [Electroplated.] [Unfinished.] [Stainless Steel Grade 304L/ 316L.]

**2.8 FABRICATION TOLERANCES**

.1 Conform to CSA A23.4

**2.9 SOURCE QUALITY CONTROL AND TESTS**

.1 Provide concrete test reports and mill certificates as required by Contract Documents

.2 Provide mill certificates for stressing strands.

## Part 3 Execution

### 3.1 EXAMINATION

.1 Refer to Section 01 70 00: Verification of existing conditions prior to beginning work.

.2 Erect precast work in accordance with CSA A23.4.

.3 General Contractor to verify site conditions and supporting materials are ready to receive work and field measurements are as indicated on approved Shop Drawings.

.4 Supply anchors required for installation of the precast concrete components to the general contractor. Provide such items in ample time to meet the construction program. Supply layout drawings locating all cast-in items to be installed by other Sections.

.5 [Engineer of Record] [General Contractor] to sign off on building stability prior to precast erection.

### 3.2 PREPARATION

.1 Provide and install sufficient temporary bracing to brace precast concrete components adequately at all stages of construction so that precast components will safely withstand loads to which they may be subjected. This temporary bracing shall remain in position until the required connections have been completed.

### 3.3 ERECTION

.1 Erect precast concrete components without damage to shape or finish.

.2 Erect precast concrete components level, square and plumb within allowable tolerances.

.3 Align and maintain uniform horizontal and vertical joints as erection progresses.

.4 When precast concrete components require adjustment beyond design or tolerance criteria, discontinue affected work; advise [Engineer on Record] [and General Contractor]

.5 [Fasten] [and] [Weld] component securely in place. [Perform welding in accordance with CSA W59 for welding to steel structures and CSA-W186, for welding of reinforcement. Welds shall be performed by a certified CWB welder]. Where bolts are used for installation, tighten with equal torque. Secure bolts with lock washers, jam nuts, or tack-weld nut to bolt, or crimp threads of the bolt after the nut is installed.

.6 Touch up [field welds and] scratched or damaged [primed painted] [galvanized] surfaces.

.7 Set vertical precast concrete components dry, without grout, attaining joint dimension with spacers. [Grout to the base of the unit if required.]

.8 Apply sealant and joint backing in accordance with per details on the Contract documents. All exterior joints are to be vented.

### 3.4 ERECTION TOLERANCES

.1 Erect precast concrete components level, square and plumb, within allowable tolerances as per CSA A23.4.

.2 General building tolerances and interface to other scopes as per Section 01 73 00: Tolerances and National Building Code of Canada (NBC).

**3.5 CLEANING**

.1 Section 01 74 00: Cleaning installed work.

.2 Precast concrete components to be erected in clean condition. Any cleaning of the precast after the installation and acceptance of work is the responsibility of the general contractor.

.3 Clean weld marks, dirt, or blemishes from surface of exposed precast concrete components, caused by erection work

.4 Clean field welds with wire brush and touch up with [primer] [galvanized] paint.

.5 Upon completion of the work in this Section, all surplus materials and debris shall be removed from this site.

**3.6 PROTECTION OF FINISHED WORK**

.1 Section 01 78 40: Protecting installed work.

.2 Protect precast concrete components from damage caused by field welding or erection operations performed by work of this trade. Protection of work after the precast erection is completed is to be the responsibility of the General Contractor.

.3 Provide non-combustible shields during welding operations, as required.

**END OF SECTION**

# BODY OF **KNOWLEDGE**

**CPCI, NPCA and PCI are the leading technical resources (Body of Knowledge (BOK)) for the precast concrete industry in North America. From the BOK, building codes, design guides, educational programs, certification, sustainability programs, and new research ideas and derived. The joint industry initiative develops, maintains, and disseminates the BOK necessary for designing, fabricating, and constructing sustainable and resilient precast concrete structures.**

Canadian Precast/Prestressed Concrete Institute www.cpci.ca

National Precast Concrete Association www.precast.org

Precast/Prestressed Concrete Institute www.pci.org

**For additional technical information**

www.cpci.ca/en/resources/technical_publications

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