

PRECAST CONCRETE

**Infrastructure** *for* **LIFE**  
cpci.ca

# Precast Concrete Your Perfect Partner "Infrastructure for Life"

**L**ong-Lasting  
**I**nnovative  
**F**ast construction  
**E**fficient and safe

Precast prestressed concrete components provide innovative technologies and the ingredients needed to enhance the key objectives of durability, speed of erection, low maintenance and safety.



CANADIAN PRECAST/PRESTRESSED CONCRETE INSTITUTE



## Engagement - The New Competitive Advantage

Canadian Precast/Prestressed Concrete Institute (CPCI) is promoting a new way of doing business, in an attempt to address two problems associated with current methods of Infrastructure Construction. First, the country infrastructure is aging. Much of the highway and water and sewer systems was built in the 1950s and 1960s, arriving at an important stage of their service lives. Depending on materials used, some have already failed or are in great need of rehabilitation or replacement. Precast concrete elements have generally performed well and can be easily repaired to prolong their service life. Secondly, traffic demand has grown tremendously without a corresponding increase in highway capacity. The result is an increasingly high level of congestion. Large building construction projects simply compound traffic problems during lengthy construction periods. The traveling public demands high quality, longer-lasting highways, bridges and structures but they want any construction-related activity completed quickly. In order to address this problem, public and private authorities need to adopt a new philosophy of “Get in Get out -Stay out.”



Accelerated construction is a means to achieve the reconstruction and new construction of major projects while minimizing delay and community disruption. However, accelerated construction is not simply “building things faster.” Rather, it includes a range of techniques, processes, and technologies to achieve the desired result of reducing congestion due to construction while improving quality and life.

The purpose of Infrastructure for LIFE program is to advance longer-lasting infrastructure using innovative technologies and practices to accomplish fast construction of efficient and safe infrastructure. The Infrastructure for LIFE Program can provide the financial incentives to clients while demonstrating and promoting the state-of-the-art technologies, elevated performance standards, and new business practices in the construction process that results in improved safety, faster construction, reduced congestion from construction, and improved quality and user satisfaction.

- Regulatory authorities are realizing that precast concrete components can be used to minimize interference to the public during municipal construction projects. Traffic holdups also have an adverse impact on the environment. The use of precast concrete components for many new or replacement bridge and/or water and sewer projects, have demonstrated significant reductions in construction time, reduced impacts on traffic flow and the environment, as well as long life performance.

- Precast infrastructure components include conventionally reinforced and pre-tensioned or post tensioned structural elements such as beams, I-girders, bulb Tees, Double Tees, stemmed members, box girders, solid slabs, full or partial depth bridge deck slabs, conventional and integrally insulated wall panels, hollowcore slabs, joists, stairs, seating members, railroad ties, piling, sheet piling, piling caps, retaining wall elements, median barriers, parapet walls, sound barriers, vaults, box culverts, pipe and manholes.

## LONG-LASTING

- Precast concrete infrastructure components provide durable construction, especially when prestressed concrete components are used.
- A continuous evolution of new material technologies has produced concrete with enhanced properties for corrosion and chloride resistance, fire resistance and improved durability.
- Plant cured precast concrete structural components are delivered to the site with most of the concrete shrinkage having already taken place. This reduces the potential for further cracking and future maintenance costs.



- CPCI manufacturing members have consistently promoted the use of High Performance Concrete (HPC). HPC provides higher compressive strengths (above 50 MPa) as well as increasing stiffness and abrasion resistance while reducing permeability.
- HPC provides reduced initial construction costs due to longer and wider precast components. Long-term costs are also reduced as fewer repairs are required and replacement can be significantly delayed.
- Concrete pipe and culverts have a proven service life of more than 100 years and require minimal maintenance after proper installation.
- Precast concrete components in the 60 to 100 MPa range are already being used. Precast concrete components featuring ultra high-performance concrete, with compressive strengths as high as 200 MPa can also be provided and are expected to further increase service life.
- For third party analytical studies on the long life and durability aspects of concrete, see HYPERLINK "[http://www.cpci.ca/downloads/Life\\_Cycle\\_Assessment\\_of\\_Precast\\_Commercial\\_Buildings.pdf](http://www.cpci.ca/downloads/Life_Cycle_Assessment_of_Precast_Commercial_Buildings.pdf)" Life Cycle Assessment of Precast Concrete Commercial Buildings (HYPERLINK "<http://www.sustainableprecast.ca>" [www.sustainableprecast.ca](http://www.sustainableprecast.ca)) and the Concrete Sustainability Hub | Massachusetts Institute of Technology (HYPERLINK "<http://www.rediscoverconcrete.ca/research>" [www.rediscoverconcrete.ca/research](http://www.rediscoverconcrete.ca/research))



## INNOVATIVE

- Precast concrete infrastructure components use technologies that impact aesthetics, durability, initial and long-term costs, speed of construction, efficiency and safety.
- Bridges utilizing integral full or partial depth precast concrete decks achieve high span-to-depth ratios, creating slender, aesthetically pleasing structures with increased clearances.
- Expanded use of coloured concretes, textures and finishes allow precast infrastructure projects to blend in with the local environment, including replacement, historically significant projects.
- Total precast concrete systems are being used with more frequency. These systems offer unmatched speed of construction, single source responsibility and the just-in-time delivery of components.
- Self-consolidating concrete (SCC) is now an option in many infrastructure applications. Increases in the workability and fluidity improve the final appearance of the components, create higher density concrete and allow for the creation of more complex shapes when needed.
- Carbon and Glass Fiber Reinforced Polymer (CFRP and GFRP) reinforcement shows potential for offering even higher strength-to-weight ratios and higher resistance to corrosion.
- Spliced girder technology allows precast concrete infrastructure components with spans that are continually being extended. Projects are now being designed with spans as long as 100 m. Additional approaches, such as cantilever designs and higher strength concrete, can further extend these spans.



- Precast concrete pipe can provide innovative energy and air quality solutions such as the geothermal and ventilation system at Earth Rangers Center in Woodbridge, ON.
- Precast concrete drainage products, such as concrete pipe, manholes, catchbasins, and box units also provide economical solutions to sustainable drainage systems with a variety of products for collection, treatment, grey water re-use, infiltration, attenuation and conveyance.
- The value-engineering of infrastructure designs using precast concrete options can save construction time, money and reduce environmental impact. This process can also create more attractive designs requiring less maintenance.

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## FAST CONSTRUCTION

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- Infrastructure projects must be built expeditiously in order to reduce the impact on the public. Precast components achieve this goal with plant fabrication proceeding while site preparations are underway.
- The ability to cast and erect precast components, even in inclement winter weather, minimizes costly weather delays.
- Precast bridge piers can be erected in one working day. The girders can be erected immediately after the piers are in place.
- With advanced preparation, contractors can erect a precast concrete bridge in as little as one weekend of traffic disruption. The precast industry has provided accelerated construction capability for more than ten years.
- The speed of erection of components makes precast an ideal design solution for emergency situations (fire, floods, accidents, earthquakes). Infrastructure can be replaced along with the support structure in a very short time frame.
- With total precast concrete systems, a precaster, working with a familiar and controlled material, can adhere to a firm schedule of erection for the entire structure in virtually any type of weather.
- Precast deck panels are ideal for rapid deck replacement to reduce traffic delays.
- Concrete pipe is manufactured in controlled production facilities where the quality standards are built into each pipe to ensure watertight joints are manufactured to close tolerances to speed up installation, and reduce inflow and infiltration for reduced maintenance and potential replacement costs for the life of the project.
- Precast box units and project specific designed manhole structures are replacing the need for cast-in-place concrete structures. These precast components expedite the timeline for construction which in turn reduces social and economic impacts of traditional in-situ construction methods.





## EFFICIENT AND SAFE

- Precast components are fabricated in a controlled environment, off site. Delivery of all precast elements not only satisfies “just in time” delivery, but also reduces site congestion, ultimately enhancing worker safety.
- Erection of major components at night and with delivery during off-peak traffic hours reduces user disruption and further improves crew safety.
- Precast prestressed concrete infrastructure projects are typically lower first cost since they minimize on-site forms, cranes, skilled field labour, scaffolding and shoring. One crane can erect everything, from piers to girders and finally the deck slabs.
- Longer spans result in fewer piers, resulting in less impact on the environment. This also improves worker safety when working over rugged terrain.
- Savings are enhanced due to low maintenance costs over the life of a structure. Precast prestressed projects, designed and built in accordance with highway or railway specifications, require little maintenance. No painting is required and fatigue problems are nonexistent. In addition to protecting future funding shortfalls, this feature provides safety by minimizing future on-site maintenance.
- Contractors benefit from precast concrete designs which allow a greater volume of work to be accomplished in a shorter period of time with fewer weather delays and less dependence on site-delivered concrete (very important for remote projects).
- Precast deck panels provide an immediate working surface that is secure and safe for construction workers.
- Longer spans reduce the number of expansion joints, providing a smoother ride for motorists and reducing future bridge maintenance costs.
- Concrete pipe can be safely and efficiently installed with mechanical installation equipment specifically designed to handle pipe and manhole products.
- Highly chemical resistant concrete pipe ensures the safe movement of sanitary effluent improving the environment of communities. Similarly, concrete pressure pipe used for drinking water is tested and certified ensuring that they do not contribute to potential adverse human health effects.
- Precast Concrete components reduce environmental impact - manufacturing in a controlled factory environment is more efficient than traditional construction, with less noise, air pollution and debris on site and it uses recycled materials in production, and allows benefits of thermal mass to be incorporated into designs.
- Precast is emission-free. In its daily use, precast concrete is a totally inert substance, so it will not emit any gases, toxic compounds or VOCs (volatile organic compounds). This means that precast does not contribute to “sick building syndrome.”
- Precast Concrete helps create healthy indoor environments. The simple lines and smart edges of precast concrete are easy to clean, and it’s hard, smooth finish does not accumulate dust, thereby creating a healthier indoor environment.



## WHAT IS PRECAST PRESTRESSED CONCRETE?

- Components are prefabricated in manufacturing plants using controlled production and quality assurance procedures. All CPCI plants are certified by the *CPCI Certification Program for Structural, Architectural and Specialty Precast Concrete*, in accordance with the requirements of CSA A23.4 *Precast Concrete Materials and Construction* and the requirements of the PCI Quality Control Manuals, MNL-116 and MNL-117 (USA).
- Prestressed concrete components are manufactured using a combination of high strength concrete and high tensile strength steel strands. The strands are prestressed in the plant or post tensioned at the site to create a material with superb load carrying and long-span capabilities as well as long-term durability.
- Plant casting produces more consistency in appearance and more uniformity of dimensions, minimizing required field adjustments.

## PRECAST CONCRETE INFRASTRUCTURE COMPONENTS:

- **Piles, piers and columns** provide support for infrastructure projects. Piles come in many different shapes and sizes, ranging from 250 mm square piles to 900 mm diameter cylindrical piles. Columns can be cast in virtually any shape.
- **Pier caps** can be precast and mounted on the infrastructure substructure.
- **Girders and beams** can be manufactured in a variety of shapes. These include I-girders, Bulb-T girders, NU girders, hollow slabs and long span box girders.
- **Deck slabs** consist of precast concrete panels (partial depth or full depth) that are used to create a durable road surface that is quickly put in place.
- **Insulated precast wall panels** consist of two, conventionally reinforced or prestressed concrete wythes with a continuous layer of rigid insulation placed between. They can be mass-produced in standard widths on long line casting beds or individually when special finishes and shapes are required. With attractive sculptured exterior surfaces and steel trowelled or form finished interior faces, they inexpensively provide a strong, durable, energy efficient, fire resistant cladding system.
- **Hollow core slabs** produced using patented dry cast extrusion systems where very low slump concrete is forced through a machine and compacted around cores formed with augers or tubes are very economical. The continuous slab voids can be used as heating/cooling ducts and as raceways for electrical wiring. Hollow core slabs reduce sound transmission and vibration between floors and eliminate floor squeaks. A 203 mm (8") hollow core slab can span up to 9 m (30 ft) depending on the loading and a 305 mm (12") hollow core slab can span up to 15 m (50 ft) depending on the loading.
- **Double tee slabs** are also produced on long line casting beds that are normally 100 m to 150 m long (300 ft to 450 ft). Bulkheads are placed in the casting bed to form the required double tee lengths for individual projects. Plain steel reinforcement and connection hardware is placed in the form to suit individual slab requirements and high strength steel strands are pretensioned prior to placing the concrete.
- **Precast Concrete Septic Tanks** are a key part of household and commercial septic systems. Septic systems treat sewage waste in an environmentally responsible way. Tanks are available in a range of sizes to match the sewage load of any project, from 600 to 19,000 gallons.

## PRECAST CONCRETE INFRASTRUCTURE COMPONENTS CONTD:

- **Reinforced Concrete Pipe** are made in standard diameters of 250 mm to 3000 mm with full range of accessories and fittings available for all pipes, including bends, tees, end sections, headwalls and anchor blocks.
- **Precast Concrete Catch Basins** (CBs) are inlet devices that collect stormwater offline, and convey this flow to the storm system. Catch basin specifications vary region to region.
- **Precast Box Culverts** are high quality, low maintenance concrete components that have a large number of applications including storm sewers, service tunnels, or small bridges and pedestrian crossings.
- **Precast Concrete Tunnel Liners** are manufactured to a specific design radius in a series of components that are installed in the field to form a complete ring or arch, that can support excavated soils.
- **Detention/infiltration Precast Concrete Products** take a unique approach, connecting individual precast concrete modules into a configuration that meets each project's requirements. This delivers a simple and flexible design solution without compromising above ground land use.

## PRECAST CONCRETE RESOURCES

**A variety of additional resources are available from CPCI to provide details and specifics of infrastructure/bridge materials, applications and benefits.**

**These include:**

- Designers' Knowledge Bank resource information: [www.cpci.ca](http://www.cpci.ca).
- CPCI 4<sup>th</sup> Edition Design Manual.
- CPCI Guide Specifications.
- CPCI Infrastructure Technical Brochure.
- CPCI Total Precast e-brochure.
- CPCI Project of the Month.
- CPCI Precast Infrastructure/Bridge applications DVD.
- CPCI Research such as the Life Cycle Assessment Study and the Hollow Core Shear Capacity Research from the University of Manitoba.
- PCI Bridge Design Manual.
- PCI International symposia on high-performance concrete proceedings.
- PCI concrete infrastructure/bridge conference proceedings.
- Peer-reviewed technical papers as published in the PCI JOURNAL.
- PCI Annual Infrastructure/Bridge Design Award winners in a variety of categories.
- Case histories, including high-quality digital images, a variety of infrastructure/bridges emphasizing dairies aspects of precast, prestressed concrete.
- Design Manuals and Technical Resources from the Canadian Concrete Pipe Association, Ontario Concrete Pipe Association, Tubécon. and the American Pipe Association





## WHAT IT MEANS TO BE A CPCI MEMBER

The Canadian Precast/Prestressed Concrete Institute is a non-profit corporation founded in 1961 for the purpose of advancing the design, manufacture and use of structural, architectural and specialty precast/prestressed concrete throughout Canada

### Members

CPCI is a unique association of trade and professional interests, representing a mix of companies and individuals. Its membership includes precast manufacturers (Active Members), suppliers (Associate and Supporting Members), engineers and architects (Professional Members), plus affiliate and student members. These members receive CPCI & PCI technical information and discounts on conventions and publications. Consult the CPCI website at [www.precastsearch.com](http://www.precastsearch.com) for a manufacturer near you.



### Technology

CPCI members are committed to developing innovative solutions to meet the needs of the construction industry. Technical committee meetings are held to collect and disseminate knowledge, statistics, ideas and information relating to the design, manufacture, and use of precast/prestressed concrete. Findings are published by CPCI and in the PCI JOURNAL. New engineering processes are established to improve product design and quality through investigations and research.

### Professional Development

CPCI professional development seminars (Pathways to Our Future) allow members to study systems and procedures to improve the coordination and dissemination of information in order to streamline member manufacturing processes. The seminars help to improve management of precast manufacturing and marketing through education and professional development. Our aim is to improve the efficiency and effectiveness of the precast industry as a whole.

### CPCI Certification

The CPCI Certification Program for Structural, Architectural and Specialty Precast has reintroduced common, measurable, nationwide standards for precast certification with no increased cost to our customers. In accordance with the requirements of the National Building Code of Canada, CPCI Certification is aimed to make certification, a recognized requirement for all project specifications and for all qualified precast operations.

The CPCI certification program is designed to qualify manufacturers who fabricate structural, architectural and specialty precast concrete. Manufacturers must meet the requirements of CSA Standard A23.4, including Annexes A and B, together with the PCI Quality Control Manuals, MNL-116 and 117 (USA) and additional CPCI certification requirements.

Manufacturers are evaluated on their quality system, documentation, production procedures, management, engineering, personnel, equipment, finished products and assemblies. Third party independent professional engineers, the Accredited Certification Organization (ACO) conduct audits twice annually. Each audit is two days in duration and certification confirms a manufacturer's capability to produce quality products and systems. Visit [www.precastcertification.ca](http://www.precastcertification.ca) for more information.





### CPCI Sustainable Plant Program

The goal of the Canadian Precast/Prestressed Concrete Institute (CPCI) Sustainable Plant program is to improve the environmental impact at the manufacturing level while creating a culture of sustainability within the industry. The benefits of sustainable business practices are well documented. As the leading technical resource for the precast concrete industry in Canada, CPCI is providing the tools for its member plants to measure and implement changes that will make a measurable improvement in their environmental and economic performance using a web based Software Tracking Program.



### Overview

The CPCI Canadian Precast Concrete Sustainable Plant Program is a program designed to encourage continuous improvement and compliance to environmental and sustainability regulations and standards. Environmental performance is determined based on the intent of all applicable government environmental policies. Sustainability performance builds on the Canadian Precast Concrete LCA research conducted by CPCI. The CPCI program is not intended to replace municipal, provincial or federal environmental acts and their requirements - it is a program designed to track the improvements implemented by each manufacturer and it is the responsibility of each individual manufacturer to understand and comply with the applicable government requirements. Participating facilities are required to submit confidential benchmark reports on a Quarterly basis. The aggregated results of the program will be communicated to the public through the Canadian Precast/Prestressed Concrete Institute Sustainability Report.

### The CPCI Difference

CPCI members are precast professionals; capable and willing to help you complete your next project. Involve a CPCI member at the early stages of project planning. Whether the challenges are structural, aesthetic, timing or economic, CPCI members can provide invaluable input. You will find CPCI members to be competent, dedicated and committed individuals willing to contribute to the realization of the standards you have set for your projects. They will be there to advise and assist you from conceptual design to completion of your project.



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For above ground infrastructure information, consult the CPCI website: [www.cpci.ca](http://www.cpci.ca) for additional information and for the member nearest you [www.precastsearch.com](http://www.precastsearch.com). For more information, contact CPCI at [info@cpcl.ca](mailto:info@cpcl.ca) or toll free (877) 937 2724



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For drainage product information, consult the Canadian Concrete Pipe Association website: [www.ccpa.com](http://www.ccpa.com) for more information or contact us at [info@ccpa.com](mailto:info@ccpa.com) Tel: 905.877.5369