

# Structural Precast/Prestressed Concrete

Technical Brochure



Canadian Precast/Prestressed Concrete Institute

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## 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 and architectural precast/prestressed concrete throughout North America.

### Members

CPCI is a unique combination of trade and professional association, with a representative mix of companies and individuals. Its membership includes precast producers (Active members), suppliers (Associate Members 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 for more information and an application form.

### Technology

CPCI members are committed to developing innovative solutions to meet the demands of the construction industry. Three annual 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. Through investigations and research, new engineering processes are established to improve quality and product design.

### Professional Development

CPCI professional development education seminars (Pathways To Our Future) study systems and procedures to improve the coordination and dissemination of information relevant to our member's manufacturing processes. In addition, our seminars seek to improve managerial aspects of precast manufacturing and marketing through education and professional development. The aim is to improve to the efficiency and effectiveness of the industry as a whole.

### The CPCI Difference

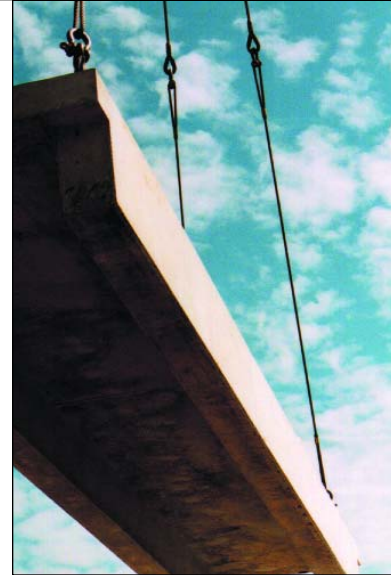
CPCI members are precast professionals; capable and willing to help you complete your next project. Involve your precast partner at the early stages of project planning. Whether the challenges are structural, aesthetic, timing or economic, CPCI members can provide invaluable input. You will find CPCI members are dedicated, committed and competent to contribute to the realization of the standards you have set for your projects. They will be there to advise and assist you from concept to completion. **Consult the CPCI website: [www.cpci.ca](http://www.cpci.ca) for the members near you.**

# Structural Precast/Prestressed Concrete

## Benefits

### Speed

Structural precast concrete elements are manufactured under controlled plant conditions at the same time as site foundation work is being prepared. When the site is ready, the precaster can immediately commence with the erection of the components, dramatically shortening construction time. This reduces on-site congestion, financing costs, while accelerating the occupancy date.



### Quality/Durability

Lasting benefits of precast concrete are inherent. High strength, high density, quality controlled precast concrete is superior to other building products for durability, corrosion resistance, impact resistance, fire resistance, security and long lasting low maintenance.

The assurance of concrete product quality is achieved through environmentally controlled manufacturing conditions with a skilled workforce and a stringent inspection and concrete testing program in accordance with the requirements of the CSA precast concrete certification program.



When precast concrete is prestressed, a further benefit to durability and slenderness of construction is realized. This active form of reinforcing keeps the concrete in compression which minimizes cracking and increases the load carrying capacity.

### Long Spans/Heavy Loads

High quality plant cast/controlled concrete produced with optimum curing conditions translates to a high strength, high quality product increasing load capacities and resulting in more efficient sections.



## Flexibility

Custom manufactured precast units are easily incorporated into a building to accommodate non-typical shapes or sizes. Precast elements can be designed for easy removal and/or reuse to accommodate future building expansions and renovations.

## All Weather Construction

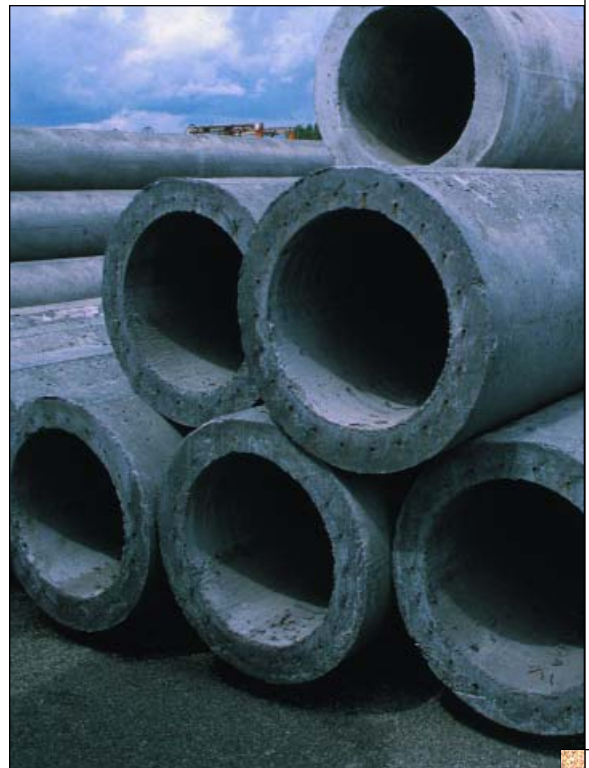
Plant cast concrete units minimize weather incurred construction delays.

## Low Maintenance

Precast reduces costly maintenance shutdowns for painting and other repairs which translates into reduced costs and ensures maximum productivity over the life of a structure.

## Economy

Few materials have the cost benefit advantages of precast/prestressed concrete when life cycle costs are considered. Structural precast/prestressed concrete with faster construction time, low maintenance, long life and potential reduced insurance premiums all contribute significantly to overall savings.



# Structural Precast/Prestressed Concrete

## Flooring/Roofing

### Precast/Prestressed Hollow Core Slabs & Double Tees

#### Hollow Core Slabs

Hollow core slabs are high quality precast/prestressed concrete units. Continuous voids are formed through each unit to reduce weight and improve structural performance.

#### Application

Hollow core slabs can be used for most applications requiring a floor or roof system. Office buildings, condominiums, hotels, senior citizen's apartments, commercial buildings, residential dwellings, houses of worship, nursing homes and educational facilities are all ideal applications.

#### Fast Track Construction

Hollow core slabs are engineered products that are ideal for very demanding construction schedules. Manufacturing of the product proceeds in a precaster's high efficiency plant while site construction is underway. Slabs are delivered to the jobsite and installed to meet the client's schedule regardless of weather conditions. The installed precast deck provides a working platform for other trades. Fast construction means earlier completion and resulting cost savings.



## Hollow Core Slabs *continued..*

### Quality/Durability

CPCI members supplying hollow core precast/prestressed slabs are CSA certified under strict controls to ensure that each slab meets high quality control standards. Hollow core slabs are produced using non-combustible materials. The fire rating of precast/prestressed hollow core slabs provide excellent protection of lives and property. In the event of a fire, hollow core slabs are less costly to refurbish. This fire resistance usually results in reduced insurance rates.

### Spans/Loads

Hollow core slabs are available in 152mm, 203mm, 254mm, 305mm, and 355mm (6", 8", 10", 12" and 14") thickness and can span up to 16.15m (53'0"). Consult your local CPCI member for the sizes available in your area.

Precast/prestressed hollow core slabs combine high compressive strength plant cast concrete with high tensile strand. These materials in combination, allow long column free spans and high load capacity. The smooth ceiling provided by a hollow core slab requires only caulking of the longitudinal joints and a coat of textured paint to give a pleasing finish. The continuous voids can be used as heating/cooling ducts and as raceways for electrical wiring. Hollow core slabs reduce sound transmission and vibrations between floors and eliminate floor squeeks.

Hollow core slabs meet or exceed the requirements of the National Building Code of Canada, the Canada Mortgage and Housing Corporation and the specifications and inspection requirements of the CSA International

### Erection

CPCI hollow core manufacturers have available their own forces to install the precast/prestressed slabs. Services are also available to cut holes and openings up to 152mm (6") diameter for mechanical trades. Openings larger than 152mm (6") should be located on shop drawings at the time of approval. Manufacturers can also provide a suitable top finish to accept the direct application of finished flooring/roofing materials.

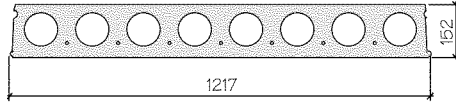
### Support Requirements

Hollow core slabs can be supported on many types of supports designed to carry the dead and live loads required. Precast beams, precast walls, poured concrete, masonry, insulated concrete forming systems, wood, steel studs and structural steel beams are all suitable as load bearing systems.

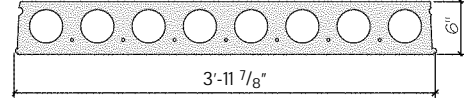


### Prestressed Hollow Core Slabs

152mm slab

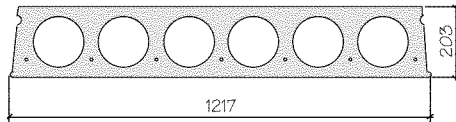


6" slab

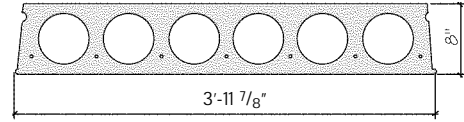


Spans to 7m (23')

203mm slab

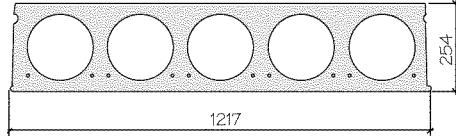


8" slab

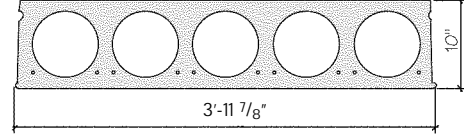


Spans to 9.75m (32')

254mm slab

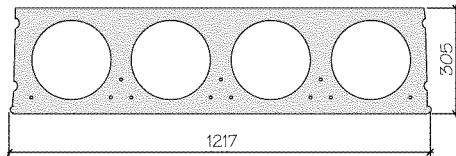


10" slab

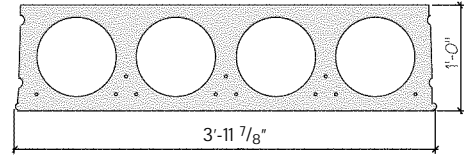


Spans to 11.25m (37')

305mm slab

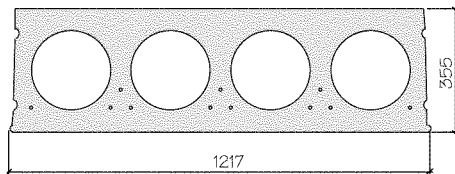


12" slab

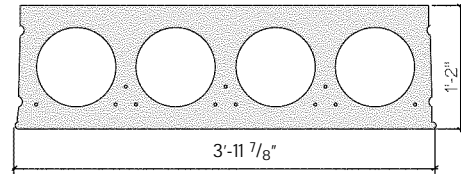


Spans to 13.70m (45')

355 mm slab



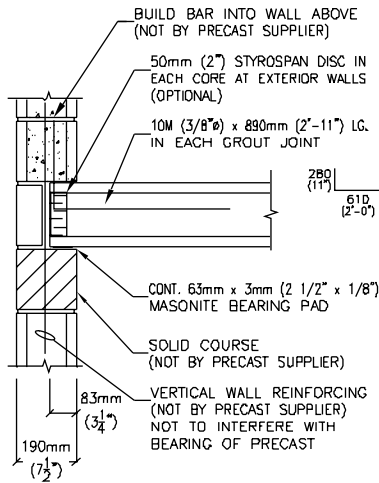
14" slab



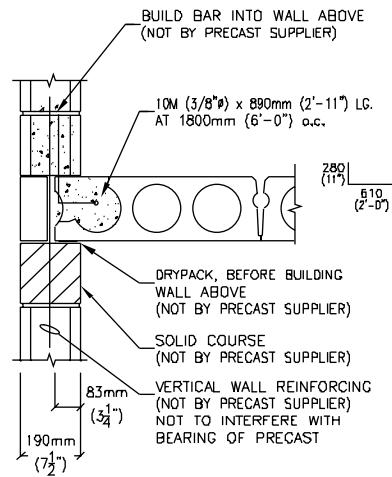
Spans to 16.15m (53')

Contact your local CPCI member  
for specific sizes, span/loading and detailing information.

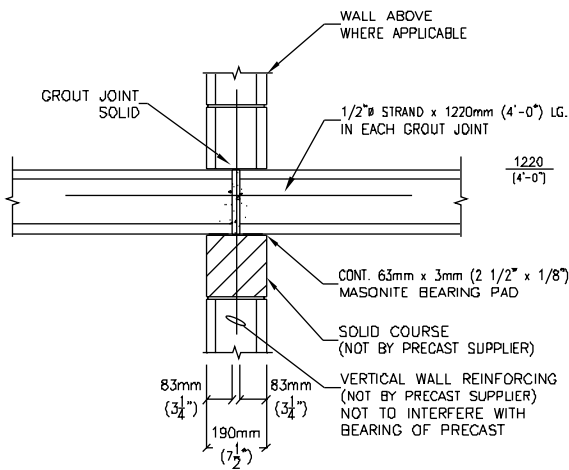
## Connections to Masonry/Steel/Precast



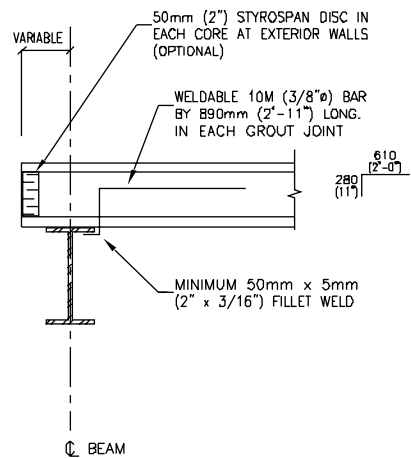
**End Bearing On Block - Half Bearing - Tie Up**  
N.T.S.



**Side Bearing On Block - Half Bearing - Tie Up**  
N.T.S.

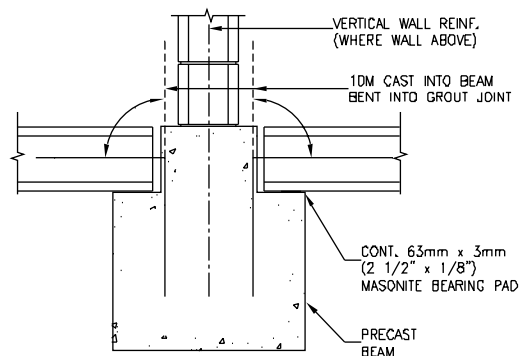


**End Bearing On Block - Abutting - Tie Across**  
N.T.S.



**End Bearing On Steel - (63mm or 2 1/2\" min) - Tie Down**  
N.T.S.

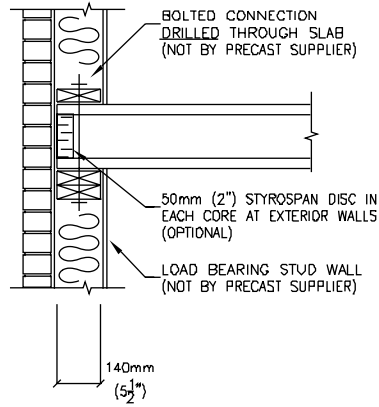
All connections shown are to be used for concept design only.



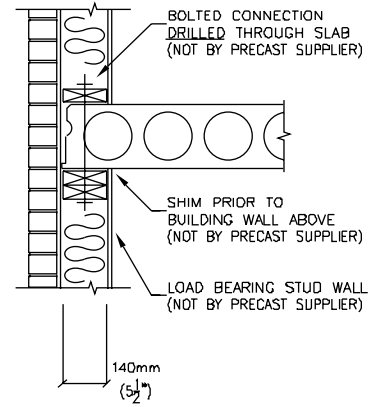
**Precast Slab Bearing On Precast Beam**  
N.T.S.



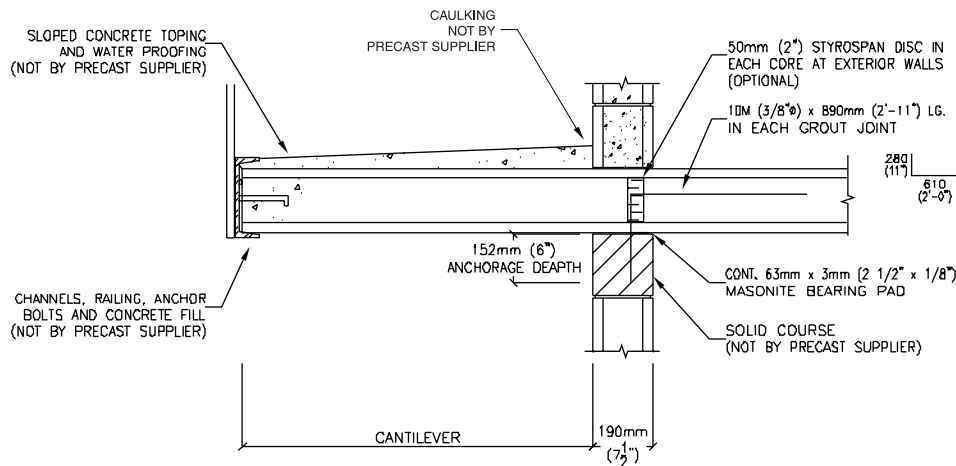
## Connections to Structural Wood & Balcony Details



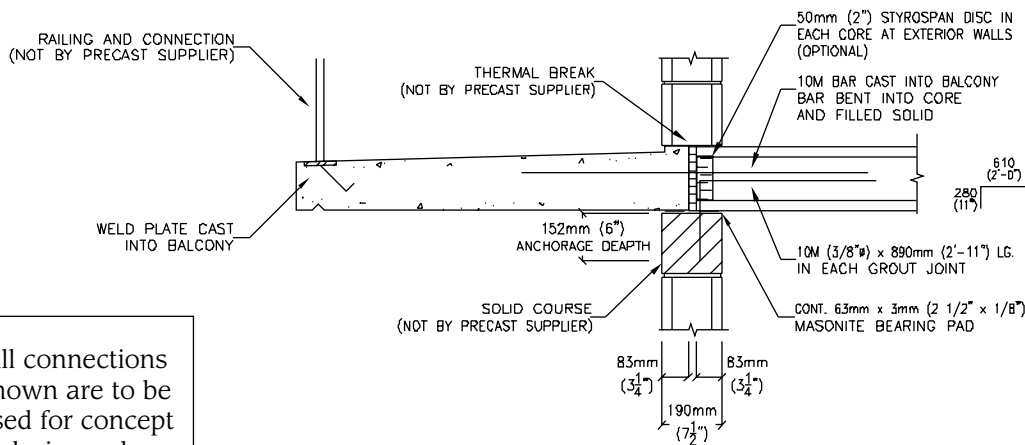
**End Bearing on Wood Studs - Bolted Connection**  
N.T.S.



**Side Bearing - Bolted Connection**  
N.T.S.



**Cantilevered Balcony - Tie Down**  
N.T.S.



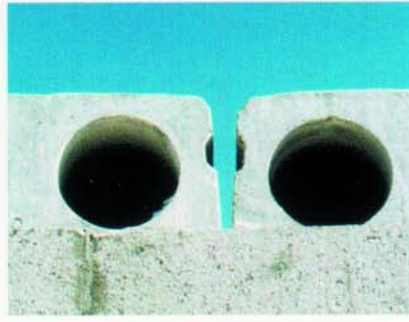
**Solid Precast Balcony (Supported On Wing Walls) - Tie Across & Down**  
N.T.S.

All connections shown are to be used for concept design only.

# Structural Precast/Prestressed Concrete



*Individually identified units being installed.*



*Customized shear key.*



*Grouting of shear key for load transference.*



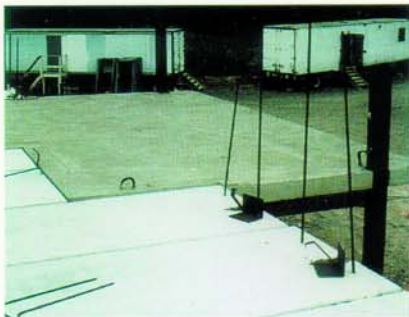
*Fast and efficient installation techniques.*



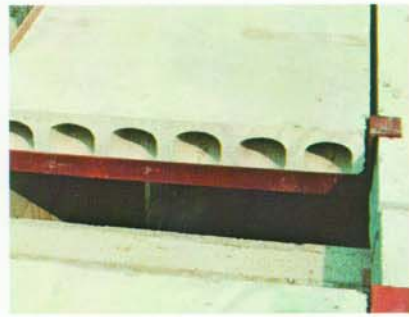
*Clean, neat and open concept.*



*Single level column and beam connection.*



*Custom designed balcony.*



*Steel hangers allow large openings for stairs, ductwork and other mechanical services.*



*Pipe installation and sealing by mechanical trade follows core drilling.*



*Cores used as raceways by electrical trades.*

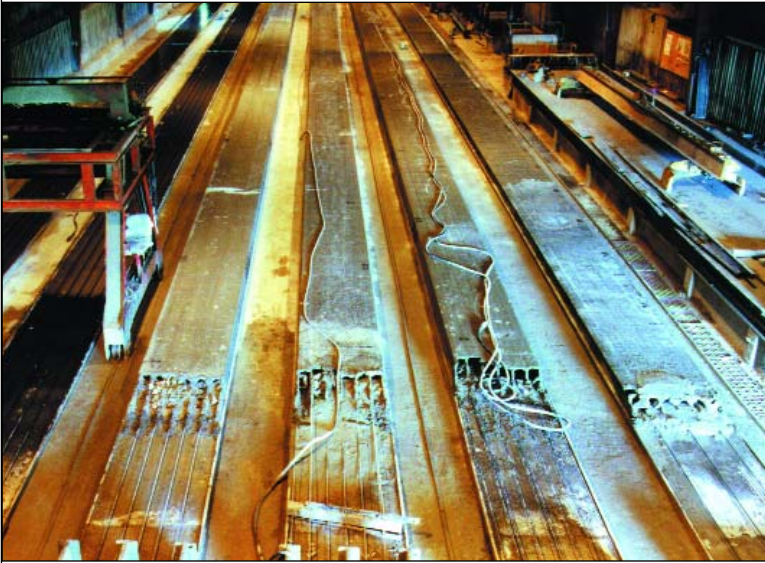


*Attractive stippled exposed ceiling.*

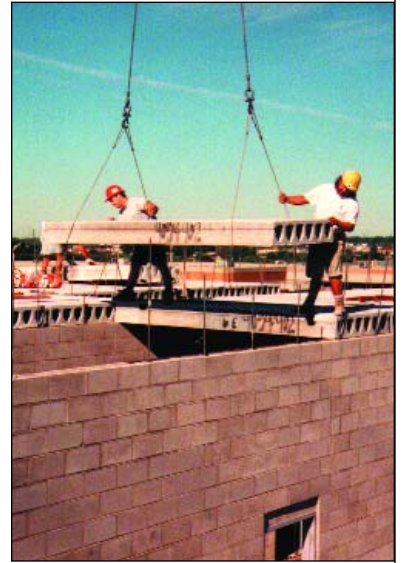


*Top surface prepared to receive flooring materials.*

# Structural Precast/Prestressed Concrete



*Environmentally controlled production facility.*



*All weather construction.*



*Custom produced precast stored in yard while site is being prepared.*



*Precast units loaded on trucks ready for delivery.*

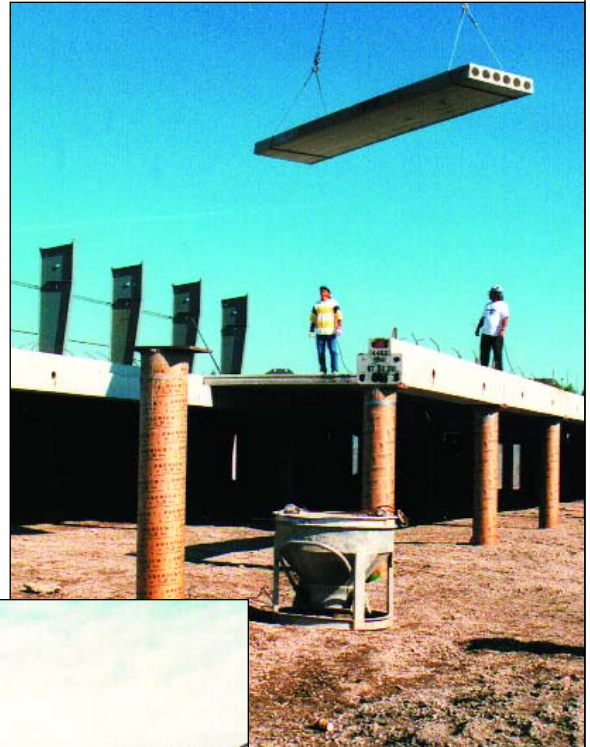


*Timely erection.*

*Flooring/Roofing*

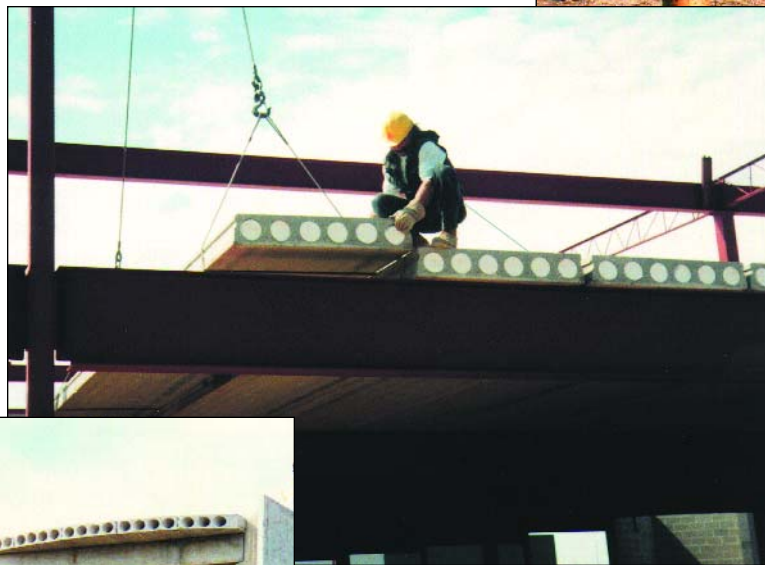


*Residential application.*



*Long spans offer open concept design.*

*Versatile hollow core units can be designed to suit many applications.*



*Hollow core provides an immediate working platform.*

*Precast is ideal for retrofit projects.*





# Structural Precast/Prestressed Concrete

## Hollow Core Specifications

### Section 03410 - Hollow Core Precast/Prestressed Concrete

#### 1.0 General

##### 1.1 Description

- .1 The General conditions of the Contract and Supplementary General Conditions apply to this Division, except as qualified herein and/or excluded.
- .2 Refer to drawings and specifications.

##### 1.2 Related Work

- .1 Cast-in-Place Concrete: Section 03300

##### 1.3 Reference Standards

***Spec Note: List latest standards. Specifier to update specifications to latest edition.***

- .1 Do precast/prestressed concrete work in accordance with CSA A23.4 and CSA A23.3.
- .2 Do welding in accordance with CSA W59 for welding to steel structures and CSA W186 for welding reinforcement.

##### 1.4 Qualifications of Manufacturer

- .1 Manufacturers of precast/prestressed concrete elements to be members in good standing of the Canadian Precast/Prestressed Concrete Institute and certified by CSA in accordance with CSA A23.4 Precast Concrete - Materials and Construction and CSA A251 Qualification Code for Architectural and Structural Precast Concrete Products.

##### 1.5 Design Criteria

- .1 Design precast/prestressed concrete units to CSA A23.3 and to carry handling stresses.
- .2 Design loads in accordance with applicable codes for use and occupancy, wind, temperature, and earthquake.
- .3 Consider vibration characteristics in accordance with NBC.
- .4 Design prestressed units to meet one (1) or two (2) hour fire resistance rating (specify).

##### 1.6 Source Quality Control

- .1 Upon request, provide Engineer with certified copies of quality control tests and inspection related to project as specified in CSA A23.4 and CSA G279.
- .2 Inspection of prestressed concrete tendons is required in accordance with CSA G279.
- .3 Upon request, provide Engineer with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.

## Hollow Core Specifications *continued...*

### 1.7 Shop Drawings

***Spec Note: It is not the Precast Manufacturer's responsibility to confirm and correlate dimensions at the job site.***

- .1 Submit shop drawings in accordance with Section 01340 - Shop Drawings, Product Data.
- .2 Submit shop drawings in accordance with CSA A23.4 and CSA A23.3. Upon request, the following items shall be provided:
  - .1 Design calculations for items designed by Manufacturer
  - .2 Estimated camber
  - .3 Finishing schedules
  - .4 Methods of handling and erection
  - .5 Openings, inserts and related reinforcement
- .3 Each drawing submitted to bear stamp of qualified Professional Engineer registered in the Province of \_\_\_\_\_.

### 1.8 Warranty

- .1 This Contractor hereby warrants that the precast/prestressed elements will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with the General Conditions warranty clause, for a one year period.

## 2.0 Products

### 2.1 Materials

- .1 Cement, aggregates, water, admixtures: To CSA A23.4 and CSA A23.1.
- .2 Prestressing steel: Uncoated 7 wire cable conforming to CSA G279.
- .3 Reinforcing steel: To CSA G30.18.
- .4 Anchorages and couplings: To CSA A23.1.
- .5 Embedded steel: To CSA G40.21, Type M300W
- .6 Welding materials: To CSA W48.1.
- .7 Bearing pads: 3mm masonite smooth one side.
- .8 Insulation: Expanded polystyrene to CAN/CGSB-51-20.
- .9 Air entrainment admixtures: To CSA A266.1.
- .10 Chemical admixtures: To CSA A266.2.

### 2.2 Concrete Mixes

- .1 Use concrete mix designed to produce 41 MPa (6000 p.s.i.) compressive cylinder strength at 28 days with maximum water/cement ratio to CSA A23.1, Table 7 for Class D exposure.
- .2 Air entrainment of concrete mix: To CSA A266.4.
- .3 Admixtures: To CSA A266.4, CSA A266.5.
- .4 Do not use calcium chloride or products containing calcium chloride.

### 2.3 Grout Mix

- .1 Cement grout: One part type 10 Portland cement 2½ parts sand, sufficient water for placement and hydration.

### 2.4 Manufacture

- .1 Manufacture units in accordance with CSA A23.4.
- .2 Mark each precast unit to correspond to identification mark on shop drawings for location on part of unit which will not be exposed.
- .3 Provide hardware suitable for handling elements.
- .4 Provide 50mm (2") thick insulation plug at each cell end of hollow core at exterior. (optional)

## Hollow Core Specifications *continued..*

### 3.0 Execution

#### 3.1 Erection

- .1 Erect elements within allowable tolerances indicated or specified.
- .2 Non-cumulative erection tolerances in accordance with CSA A23.4, Section 10.
- .3 Install 3mm masonite bearing pads, smooth side up on bearing ends of concrete or masonry.
- .4 Set units in a tight, level position on true level bearing surface provided by others. Minimum bearing 90mm (3½") on masonry and 75mm (3") on structural steel.
- .5 Fasten precast/prestressed units in place as indicated on reviewed shop drawings.
- .6 Level differential elevation of horizontal joints with grout to slope not more than 1:12.
- .7 Clean field welds with wire brush and touch up with primer.
- .8 Field cut holes and openings up to 150mm (6") diameter for mechanical trades. Openings larger than 150mm (6") to be located on shop drawings at time of approval and to be cut in field. Do not cut reinforcing without approval of precast hollow core slab manufacturer and Engineer.

#### 3.2 Topping

- .1 This contractor shall provide a suitable top finish to accept direct application of finished flooring/roofing as per room finish schedule.
- .2 Where concrete topping (minimum 37mm [1½"]) is to be applied, refer to appropriate specifications. The top surface of the precast/prestressed slabs is to be raked (roughened) for bonding of topping.

#### 3.3 Exposed Ceilings

- .1 Caulk exposed ceiling longitudinal joints, using standard caulking.
- .2 The underside of precast shall be finished as per CSA A23.4 (clause 24.2.2) STANDARD FINISH.

#### 3.4 Clean-Up

- .1 Upon completion of the work of this section, all surplus material and debris shall be removed from the site.

End of Section

**Spec Note:** *\*Items relating to precast/prestressed slabs to be carried out by other trades, and covered in their respective specifications;*

- (1) *Drypacking of gap between precast/prestressed slabs at all locations where load bearing walls are parallel to length of slab.*
- (2) *Perimeter caulking.*
- (3) *Electrical holes.*
- (4) *Concrete topping (37 mm [1½"]±)*

## Precast/Prestressed Double Tees

Double tees offer beauty and flexibility in design. These precast/prestressed concrete units are ideal for floor and roof systems requiring long, uninterrupted spans and extra heavy load carrying capabilities.

The remarkable strength of a double tee is the result of a design and manufacturing system that uses the best attributes of steel and concrete. Consider double tees for longer spans and heavier loads which exceed the capacity of hollow core slabs.



## Special Features

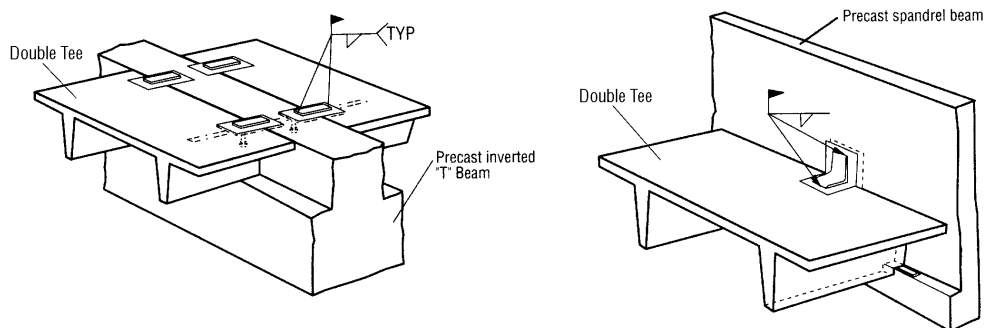
Double tees are known for their great resiliency. Long spans with exposed ceilings require no additional finishes. A superior smooth steel form finish as well as excellent fire ratings are provided by double tee construction.

Double tees can be designed to allow openings to be placed in the flange areas between the stems. This allows for the installation of windows/skylights and mechanical ducts.

Typical building uses for double tees include parking decks, water/sewage treatment plants, food processing plants, heavy industrial buildings, warehouses, indoor pools and gymnasiums.

## Design Stage Assistance Available

CPCI hollow core and double tee manufacturers can provide budget pricing and technical assistance at the preliminary design stage for your next project.



Typical Double-Tee Detail

Note: Double Tees may or may not receive a field applied topping.  
Contact your local CPCI member for further details.



# Structural Precast/Prestressed Concrete



*Consistant quality  
unmatched by  
field casting.*

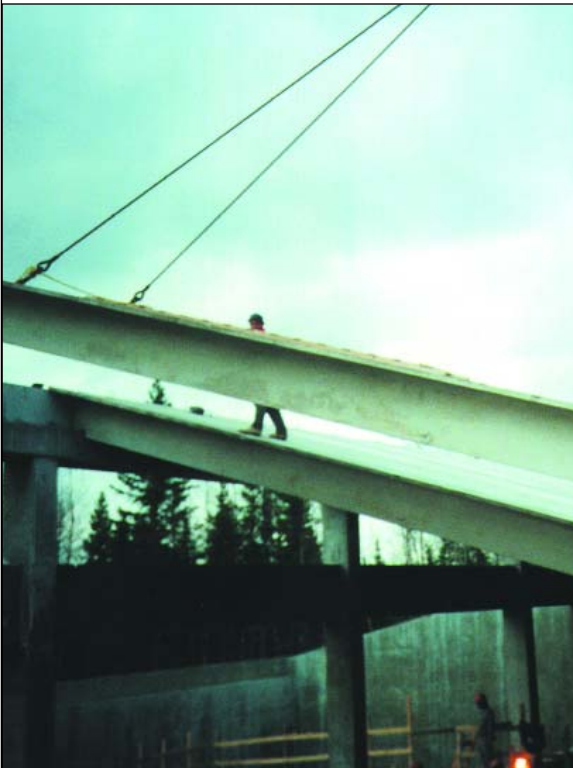


*Dense durable  
material with  
excellent resiliency.*

*Speedy installation  
allows immediate  
access for subsequent  
trade contractors.*



*Double Tees provide  
uninterrupted long-  
spans for this water  
treatment facility.*



# Structural Precast/Prestressed Concrete

## Framing

### Shape and Design

Precast/prestressed components are custom manufactured to match design requirements. Unusual shapes, sizes and specific technical requirements are expertly fabricated in CPCI member precast plants. Repetition of shapes and sizes will greatly enhance the economical use of precast components.

### Precast Efficiency

The continuous, uninterrupted erection of precast structural components lends itself perfectly to fast track construction schedules.

Savings on financing costs, (faster return on investments resulting from bringing the structure into productive life sooner) is just one of the benefits provided by a complete precast building system.

### Precast Structural Components

Precast concrete beams, columns and stairs are the ideal solution for owners and builders who want to achieve wide open spans, fire resistance, energy savings and attractive design with one structural system.

These components are suitable for both low and high-rise structures. Highly durable, these concrete units can be installed in all weather conditions.

Precast beams may be either continuous with single story columns or single span beams with multi-story columns. The use of standardized forms accelerates the manufacturing process.

The quality of smooth formed finishes produced in a precast plant saves money by allowing designers to expose the structure in a finished building.





*Open shear wall designed to take horizontal load transfer.*



*Multi-level beam and column framing*



*Post tensioned transfer beam.*

*Single storey beam structure.*



*Long span double tees are ideal for food processing facilities.*



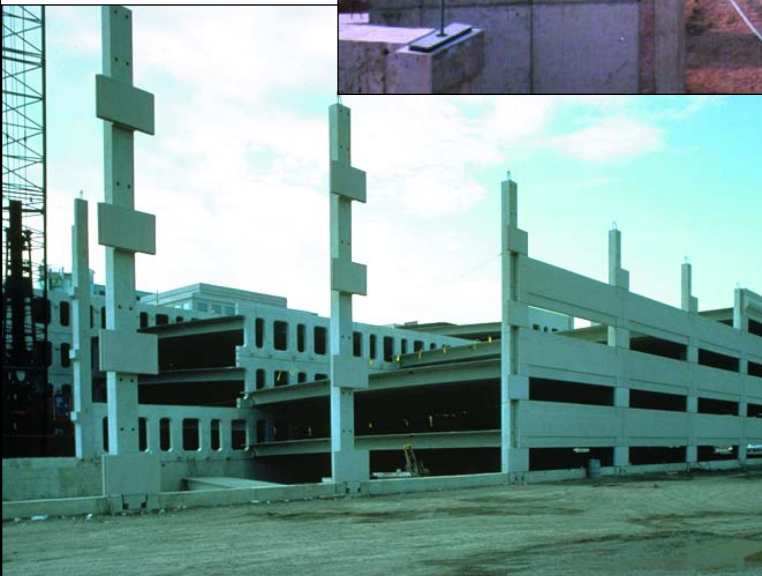


*Framing is quickly assembled immediately after site work.*



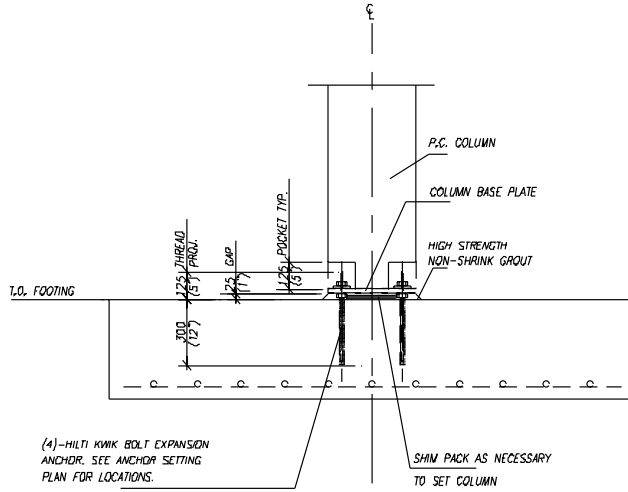
*Construction of a multi-level parking structure.*

*Precast concrete raker beams are ready to receive bleacher seating.*

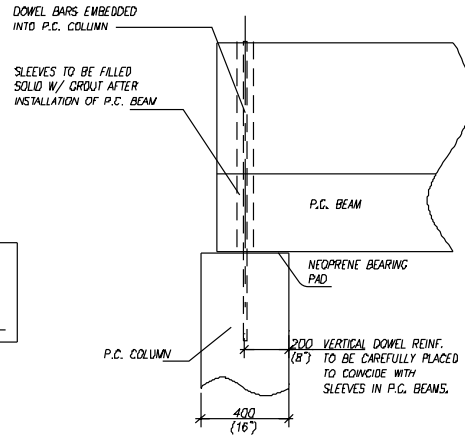


*Placement of a raker beam.*

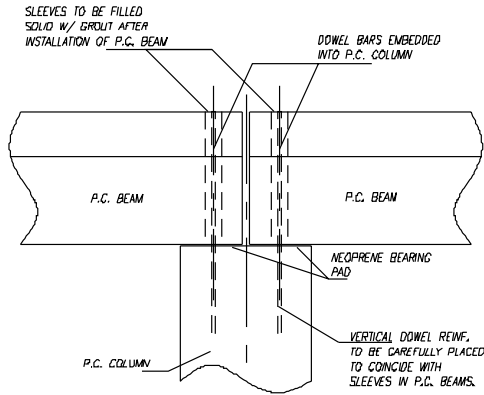




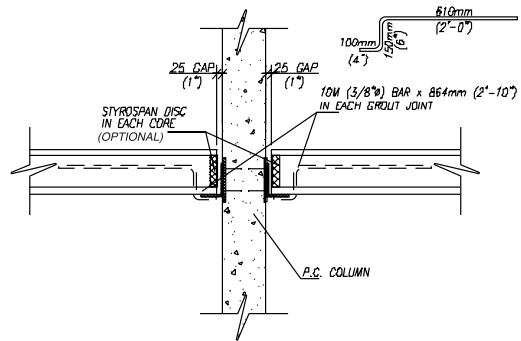
**Col.-Ftg. Connection**  
N.T.S.



**Beam - Column Connection**  
N.T.S.

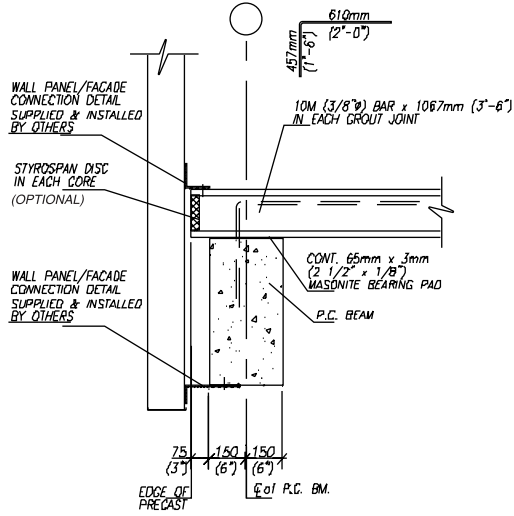


**Multiple Beam - Column Connection**  
N.T.S.

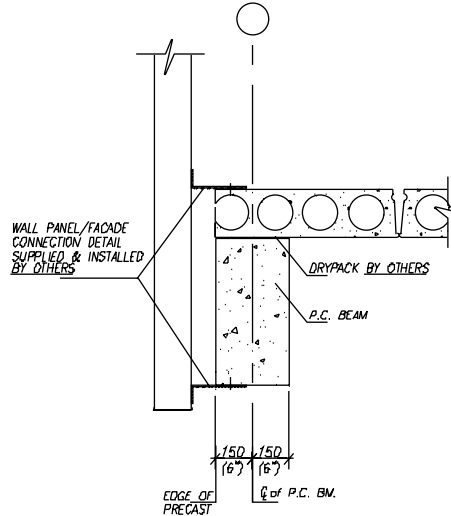


**Precast Slab Connection to Column**  
N.T.S.

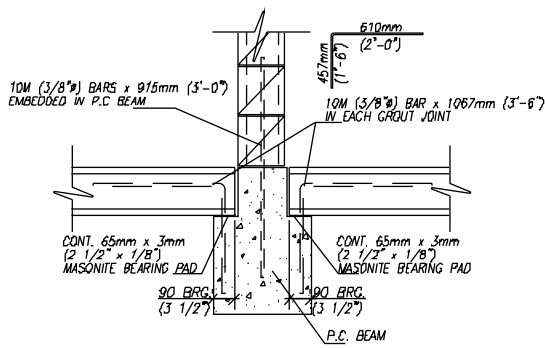
All connections shown are to be used for concept design only.



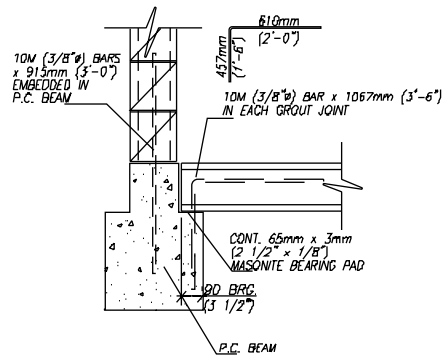
**Precast Slab Bearing on Precast Beam**  
N.T.S.



**Precast Slab Side Bearing on Precast Beam**  
N.T.S.



**Precast Slab Bearing on Precast Beam**  
N.T.S.



**Precast Slab Bearing on Precast Beam**  
N.T.S.

All connections shown are to be used for concept design only.

# Structural Precast/Prestressed Concrete

## Structural Specifications

### Section 03410 - Structural Precast/Prestressed Concrete

#### 1.0 General

##### 1.1 Description

- .1 The General conditions of the Contract and Supplementary General Conditions apply to this Division, except as qualified herein and/or excluded.
- .2 Refer to drawings and specifications.

##### 1.2 Work Included

- .1 Design, supply, delivery and installation of:

**Spec Note:** *This section includes structural precast/prestressed concrete units including the following:*

- Double tee slab units
- Structural framing units
- Parking structures
- Structural precast/prestressed concrete

**Spec Note:** *This section specifies products of standard or special shapes that are reinforced using steel reinforcement, pre-tensioning or post-tensioning and through application become an integral structural part of the project.*

- .1 The specifications cover precast/prestressed structural concrete construction.
- .2 This section includes product design, manufacture, transportation, erection and other related items such as anchorage, bearing pads, inserts and similar accessories required for work under this contract.
- .3 Take delivery and cast into precast work boxes/inserts/openings required and supplied by other trades only if supplied prior to casting.
- .2 Supply information required for the installation of bracing, supports, inserts and similar accessories required for the work under this contract supplied and to be installed by others.

##### 1.3 Related Work

- .1 Section 03300 - Cast-in-Place Concrete
- .2 Section 03300 - Cast-in-Place Concrete: Setting only of insert or anchors unless otherwise noted on Structural Drawings
- .3 Section 03410 - Hollow Core Precast/Prestressed Concrete
- .4 Section 03450 - Architectural Precast Concrete and/or Insulated Precast Concrete Wall Panels
- .5 Section 05100 - Structural Metal Framing

**Spec Note:** *For parking structures add reference to concrete topping and deck waterproofing.*

## Structural Specifications *continued...*

### 1.4 Reference Standards

**Spec Note:** *Latest standards are listed. Specifier to update specifications to latest edition.*

- .1 CSA A23.1-00, Concrete Materials and Methods of Concrete Construction
- .2 CSA A23.2-00, Methods of Test for Concrete
- .3 CSA A23.3-94, Design of Concrete Structures
- .4 CSA A23.4-00, Precast Concrete-Materials and Construction
- .5 CSA A251-00, Qualification Code for Architectural and Structural Precast Concrete Products
- .6 CSA A283-1980, Qualification Code for Concrete Testing Laboratories
- .7 CSA G30.5-M, Weld Steel Wire Fabric for Concrete Reinforcement
- .8 CSA G30.15-M, Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- .9 CAN/CSA G30.18, Billet Steel Bars for Concrete Reinforcement
- .10 CAN/CSA G40.21, Structural Quality Steel
- .11 CAN/CSA-G164-M92, Hot Dip Galvanizing of Irregularly Shaped Articles
- .12 CSA W186-M1997, Welding of Reinforcing Bars in Reinforced Concrete Construction
- .13 W47.1-97, Certification of Companies for Fusion Welding of Steel Structures
- .14 ASTM A775/A 775M [94d], Specification for Epoxy-Coated Reinforcing Steel Bars.
- .15 ASTM 412-[92], Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
- .16 ASTM 2240-[95], Test Method for Rubber Property - Durometer
- .17 CAN/CGSB-1.40-[M89], Primer, Structural Steel, Oil Alkyd Type
- .18 CAN/CGSB-1.181-[92], Ready Mixed Organic Zinc - Rich Coating
- .19 CAN/CGSB-51.20-[M87], Thermal Insulation, Polystyrene, Boards and Pipe Covering

### 1.5 Qualifications of Manufacturer

- .1 Fabricate precast/prestressed concrete elements certified by the CSA International in the appropriate category(ies) according to CSA Standard A23.4 "Precast Concrete - Materials and Construction". The precast concrete manufacturer shall be a member in good standing of the Canadian Precast/Prestressed Concrete Institute and shall be certified in accordance with the CSA Certification program for Structural Precast/Prestressed Concrete prior to submitting a tender and must specifically verify as part of his tender that he is currently certified in the appropriate category(ies):

**Spec Note:** *Delete the categories which do not apply.*

- (A) Precast Concrete Products - Architectural
  - (I) Non-Prestressed or (II) Prestressed
- (B) Precast Concrete Products - Structural
  - (I) Non-Prestressed or (II) Prestressed
- (C) Precast Concrete Products - Speciality
  - (I) Non-Prestressed or (II) Prestressed

Only precast concrete elements fabricated by certified manufacturers are acceptable to the Owner. Certification must be maintained for the duration of the fabrication and erection for the project. Fabricate precast concrete elements in accordance with \_\_\_\_\_(Provincial) Building Code requirements.

- .2 The structural precast/prestressed concrete manufacturer shall have a proven record and satisfactory experience in the design, manufacture and erection of structural units specified. The company shall have adequate financing, equipment, plant and skilled personnel to detail, fabricate and erect the work of this Section as required by the Specification and Drawings. The size of the plant shall be adequate to maintain the required delivery schedule.

### 1.6 By-Laws and Codes

- .1 Conform with applicable requirements of \_\_\_\_\_(Provincial) Building Code, National Building Code and local authorities having jurisdiction.



## Structural Specifications *continued...*

- .2 Design and provide reinforcement, anchors and supports as required by codes and to Consultant's approval. Submit relevant design data prepared by a professional engineer registered in the province of \_\_\_\_\_ for approval if so requested by the Consultant.

### 1.7 Allowable Tolerances

- .1 Conform with requirements of CSA A23.4-Section 10.
- .2 Refer to related Sections of this Specification and fabricate work to accommodate the specified tolerances.

### 1.8 Source Quality Control

- .1 Make available copies of quality control tests related to this project as specified in CSA A23.4.
- .2 Inspect prestressed concrete tendons in accordance with CSA A23.4.
- .3 Make available records from in-house quality control program based upon plant certification requirements for inspection and review.
- .4 Make available certified copy of mill test reports of steel reinforcement supplied, showing physical and chemical analysis.
- .5 In addition to quality control, an independent inspection and testing company may be appointed by the owner to verify compliance with this Specification.
- .6 Cooperate with Inspector to facilitate his work.
- .7 Cost of an independent inspection is to be paid for by the owner.

### 1.9 Shop Drawings

**Spec Note:** *It is not the Precast Manufacturer's responsibility to confirm and correlate dimensions at the job site. Precast concrete is a prefabricated material. Site dimensioning would require the foundation/structure to be complete before fabrication could commence.*

- .1 Prepare and submit shop drawings of precast/prestressed structural concrete elements in accordance with the General Conditions of the contract, CSA A23.4 and CSA A23.3, and as specified below. Submit in accordance with Section 01330.
- .2 Submit fully detailed and dimensioned drawings showing and including but not limited to the following:
  - .1 Design calculations for items designed by manufacturer.
  - .2 Typical details of prestressed and non-prestressed members, reinforcement and connections.
  - .3 Estimated Camber.
  - .4 Finishing Schedules.
  - .5 Methods of handling and erection.
  - .6 Openings, sleeves, inserts and related reinforcement.
- .3 Show the exact location of inserts and anchors required to be cast into precast/prestressed units for interface elements.
- .4 Show the system of identifying units for erection purposes on shop drawings and apply a similar mark on all units at the time of manufacture.
- .5 Provide the Shop Drawings to obtain approvals from the Authorities having jurisdiction prior to fabrication of structural precast/prestressed units.
- .6 If requested provide drawings of all precast members.

### 1.10 Finishes of Formed Surfaces

- .1 Finishes shall be (a) Commercial Grade, (b) Standard Grade, (c) Finish Grade B, or (d) Finish Grade A in accordance with clause 24 of CSA A23.4 as shown on the contract drawings.
- .2 Finishes shall be (a) Commercial Grade, or (b) Standard Grade unless otherwise noted.

### 1.11 Warranty

- .1 Provide standard CPCI warranty with a duration of one (1) year in accordance with the General Conditions. Warranty shall be in writing and shall warrant work under this Section to be free from defects for the period stipulated.

## Structural Specifications *continued...*

### 1.12 Delivery, Storage and Protection

- .1 Accept full responsibility for delivery, handling and storage of units.
- .2 Deliver, handle and store precast/prestressed units using methods approved by the manufacturer. Do not permit units to contact earth or staining influences or to rest on corners.

### 1.13 Design

- .1 Requirements: Design and fabricate precast/prestressed structural concrete elements, brackets and anchorage devices so that when installed they will:
  - .1 Compensate for allowable construction tolerances in the structure to which they are secured.
  - .2 Tolerate a structural deflection of span/360 due to live load.
  - .3 Adequately sustain themselves, and superimposed loads, specified by the engineer, without exceeding deflection of 1/360.
- .2 Design loads shall be as specified by the \_\_\_\_\_(Provincial) Building Code.

***Spec Note: 1.14 applies to specifications for parking structures. Edit accordingly.***

### 1.14 Special Surface Treatments

- .1 All anchors, plates, etc. exposed to the elements (less than 1½" concrete cover) to be hot dipped galvanized, except for inserts and treated items which shall be electro zinc plated.
- .2 Hardware protected from exposure to the elements or by a minimum of 1½" concrete shall be shop coated with grey oxide primer.
- .3 Double tee side weld plates, where exposed to the elements, shall be stainless steel.

## 2.0 Products

### 2.1 Materials

- .1 Reinforcing steel: to CSA A23.1.
- .2 Forms: to CSA A23.4.
- .3 Hardware and miscellaneous materials: to CSA A23.1.

***Spec Note: Re 2.1.4: Type 400W is weldable structural grade steel having a yield strength of 400 MPa. Refer to CSA G40.21 for other grades and yield strengths available.***

- .4 Anchors and supports: to CSA G40.21, Type [400] [(epoxy coated)(galvanized)(primed after fabrication)]
- .5 Welding materials: to CSA W47.1-97 and CSA W186-[M1997].
- .6 Steel primer: to CGSB 1-GP-40M.
- .7 Air entrainment admixture: to CSA A266.4.
- .8 Bearing pads: neoprene, [60] durometer hardness to ASTM D2240, and [17] MPa minimum tensile strength to ASTM D412, moulded to size or cut from moulded sheet. (Random oriented fiber reinforced neoprene.)
- .9 Shims: [plastic] [steel].
- .10 Zinc-rich primer: to CGSB 1-GP-181M.
- .11 Surface retardant: to CSA A266.2.

### 2.2 Concrete Mixes

- .1 Unless otherwise noted or specified, use concrete mix designed to produce a minimum of 35 MPa compressive cylinder strength at 28 days, with a maximum water/cement ratio to CSA A23.4.
- .2 Use cement and supplementary cementing materials which conform to CSA A23.1.
- .3 Air Entrainment of Concrete Mix: Refer to CSA A23.1
- .4 Use of calcium chloride not permitted.

### 2.3 Reinforcement and Anchors

- .1 Attach anchors securely in accordance with CSA W.186.70.
- .2 Galvanize anchors after fabrication and touch up anchors with zinc rich primer after welding.
- .3 Reinforcing Steel: To CSA G30.16, CSA G30.12, CSA G30.18 [epoxy coated]

## Structural Specifications *continued...*

### 2.4 Fabrication

- .1 Fabricate precast/prestressed concrete units to CSA A23.4.
- .2 Mark each precast/prestressed unit to correspond to identification mark on shop drawings for location.
- .3 Mark each precast/prestressed unit with date cast.
- .4 Cast members in accurate rigid moulds designed to withstand high frequency vibration. Set reinforcing anchors and auxiliary items to detail. Cast in anchors, blocking and inserts supplied by other Sections as required to accommodate their work. Vibrate concrete during casting until full thickness is reached. Provide necessary holes and sinkages for flashings, anchors, cramps, etc. as indicated. Separately and accurately batch cement and aggregates uniformly by weight to ensure maintenance of even and uniform appearance.
- .5 Anchors, lifting hooks, shear bars, spacers and other inserts or fittings required shall be as recommended and/or designed by manufacturer for a complete and rigid installation. Each shall conform to requirements of local building By-Laws. Lift hooks shall be adequately sized to safely handle panels according to member dimension and weight. Anchors/inserts shall be concealed where practical.
- .6 Burn off lift cables paint and fill in recesses if required.

**Spec Note:** *If special architectural finish is required for exposed structural precast import the appropriate paragraph from section 03450 Architectural Precast Concrete. Identify surfaces requiring these specific finishes.*

### 2.5 Finishes

- .1 Finish units to [commercial grade] [standard grade] [finish grade A] [finish grade B] to CSA A23.4 Clause 24.

### 2.6 Parking Structures

- .1 Precast/prestressed floor and roof units shall be double tee components with prestressed reinforcement as required by design. The finish of the underside of the double tees shall be a standard form finish.
- .2 Precast beams and columns shall be of the dimensions shown on the drawings with prestressed and/or non-prestressed reinforcement.  
Architectural finish and colour: (specify)
  - A grey cement, standard form finish.
- .3 Precast spandrel panels shall have a profile and thickness as shown on the drawings.  
Architectural finish and colour: (specify)
  - A grey cement, light sandblast finish for the exterior surfaces exposed to view.
  - The exposed interior surface of spandrel panel shall have a standard wood float finish.
- .4 All other structural components shown on drawings shall have a grey cement, standard form finish.
- .5 Prestressing tendons shall be uncoated 7 wire strands conforming to CSA Standard A23.4.

### 2.7 Double Tee Slab Units

- .1 Precast/prestressed floor and roof units shall be double tee components with prestressed reinforcement as required by design. The finish of the underside of the double tees shall be a standard form finish.
- .2 Prestressing tendons shall be uncoated 7 wire strands conforming to CSA Standard A23.4.

### 2.8 Structural Framing Units

- .1 Type: Precast/prestressed concrete structural framing units.
- .2 Furnish units free of voids or honeycombs.
- .3 Provide standard finish to precast units.
- .4 Where ends of strands will not be enclosed or covered, cut flush and cover with a high-strength mortar bonded to unit with an epoxy-resin bonding agent.
- .5 Reinforce units to resist transportation and erection stresses.
- .6 Include cast-in weld plates where required.
- .7 Coordinate with other trades for installation of cast-in items.

Structural Specifications *continued...***3.0 Execution**

## 3.1 General

- .1 Erect precast/prestressed work in accordance with CSA A23.4.

**Spec Note:** *It is not the Precast Manufacturer's responsibility to confirm and correlate dimensions at the job site. Precast concrete is a prefabricated material. Site dimensioning would require the structure to be complete before fabrication could commence.*

- .2 Supply anchors for precast units required to be cast into cast-in-place concrete frame to Contractor for installation. Provide such items in ample time to meet construction program. Supply layout drawings locating accurately the position of all cast in items to be installed by other Sections.

## 3.2 Installation

- .1 Set precast/prestressed concrete units, straight, level and square.

- .2 Do welding in accordance with CSA W59, for welding to steel structures and CSA W186, for welding of reinforcement.

**Spec Note:** *Select one only of the two following paragraphs.*

- .3 Erect precast/prestressed elements within allowable tolerances as [indicated] [specified].

- .4 Non-cumulative erection tolerances to be in accordance with CSA A23-4, Section [10].

**Spec Note:** *Where bearing pads are required, specify locations if not clearly indicated on drawings.*

- .5 Set elevations and alignment between units to within allowable tolerances before connecting units.

**Spec Note:** *Check if required. Do not grout under elastomeric pads.*

- .6 Grout underside of precast units with shrinkage compensating grout where indicated.

- .7 Secure with bolts using [lockwashers] [or] [tack-weld nut to bolt].

- .8 Do not weld or secure bearing plates at sliding joints.

- .9 Use grout to align elevations at surface of joints in situations where allowable tolerances have been exceeded or as noted on consultants drawings in critical locations.

- .10 Clean field welds with wire brush and touch-up [shop primer with primer] [galvanized finish with zinc-rich primer].

- .11 Fasten units in place as per approved connection detail shop drawings. Protect work from damage by weld splatter.

- .12 Clean field welds with wire brush and touch up with galvafruid paint or zinc rich primer.

## 3.3 Handling and Erection

- .1 Precast/prestressed components shall be handled and erected in accordance with CSA Standard A23.4 and as per the manufacturer's instructions.

- .2 Precast/prestressed components shall be delivered and handled in such a manner as to avoid warpage.

- .3 Holes and reglets shall be protected from forming of ice during freezing weather.

- .4 Lifting devices shall be protected from rusting at all times.

- .5 All precast/prestressed components shall be erected by experienced workmen under the supervision of a qualified superintendent with a minimum of five (5) years experience.

- .6 Welding of the precast units shall be performed by certified welders in accordance with CSA Standard A23.4, Clause 32.

- .7 Units shall be set plumb and true with joints parallel and uniform.

- .8 All necessary precautions shall be taken to prevent weld burn or splatter on to exposed surfaces.

- .9 Patch damaged, or chipped components as required.

## 3.4 Cleaning

- .1 If required, clean exposed face work by washing and brushing only, as precast is erected. Use approved masonry cleaner if washing and brushing fails to achieve required finish. Remove immediately materials which may set up or harden. This section is not responsible for soiling or damage by others.

End of Section

# Structural Precast/Prestressed Concrete

## Long Span Parking Garages

Parking structures often represent the first and last impression a visitor has when visiting a facility. Excellent parking structures are designed specifically for the types of visitors a structure will serve. Unless a parkade is safe, secure and easy-to-use, parkers will find other options.

Creating the best parking structure to fit the site requires a careful balance of all elements and a logical plan from start to finish. The involvement of your local CPCI member from the beginning while key design decisions are being made can make a dramatic difference to the final result. Their expertise and input can minimize the time and cost required to complete a project. Precast parkades offer fast construction, versatility of design, attractive exterior finishes, durability and economy making precast prestressed concrete a popular choice for commercial, municipal and institutional clients.

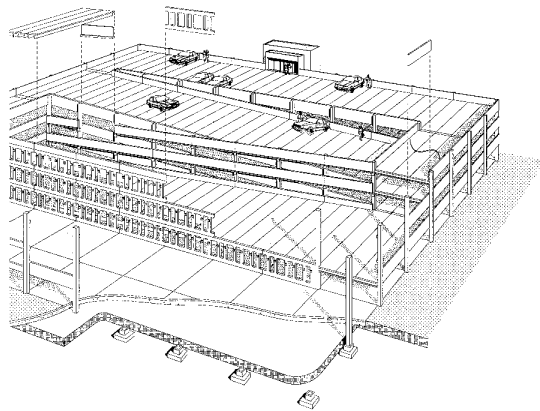


### Exterior Finishes

Precast parking garage exteriors can be delivered with a wide range of shapes and finishes ranging from smooth dense structural units to any number of architectural treatments.

### Loads and Forces

Precast concrete parking structures allow for volume changes from creep, shrinkage and temperature differences. Components are cured before they are delivered to the site. The connections between members allow the structure to relieve pressures from ordinary expansion and contraction that otherwise could cause cracking in structural elements. Lateral design loads for wind, earthquake or earth can be resisted in a precast concrete structure by transferring loads through the floor diaphragm to shear walls and/or to column beam frames. Care in locating and the isolation of shear walls and isolation (expansion) joints will assure performance.



Loading walls with framing beams or floor members can minimize connections between shear walls to resist uplift forces. Connections can be designed to prevent beam rotation and absorb bumper loads without undue restraint against volume changes.



## Bay Sizes

For maximum economy, bay sizes should be as large as practical and modular with the standard precast concrete floor elements selected. For long span parking, the bay size selected need not be a multiple of the width of the parking stall. Clear spans with fewer columns create an open concept for added security.

## Drainage

Sloping the floors to achieve good drainage is essential to quickly remove rain and salt laden water from the structure. The drainage pattern selected should repeat for all floors wherever possible to allow for repetition in manufacturing the

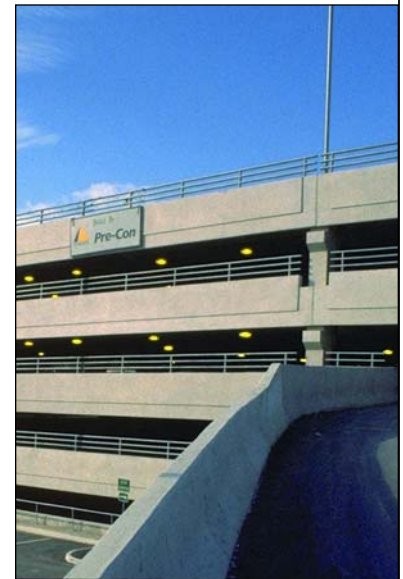
precast elements. Locate isolation (expansion) joints at high points to minimize possible leakage. Slope the floors away from columns, walls and spandrels to promote proper drainage.

## Durability

High strength precast concrete components are cast under controlled conditions in the precaster's plant. When precast concrete elements are prestressed, concrete is cast around highly tensioned pretensioning strands that run through the steel forms. After the concrete has cured, the pretensioning force is released into the beam placing the concrete in compression. Prestressed slabs and beams are virtually crack-free and highly resistant to attack by chloride ions

Where cast-in-place composite topping is used over precast floor members, wire mesh reinforcement should be incorporated in the topping. A high strength concrete topping having a water cement ratio of 0.40 or less, 6% entrained air and five days of curing under wet burlap will produce the best results (see CSA S413).

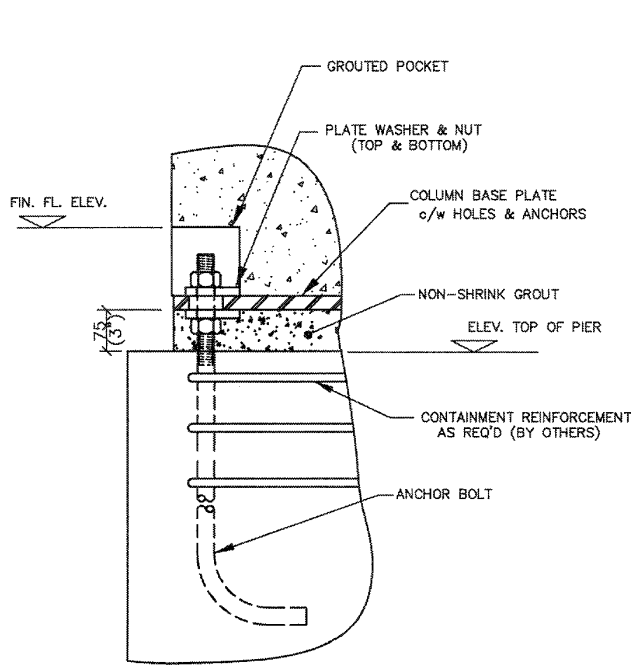
A series of crack control joints should be tooled into the topping above all joints in the precast members below. A V-shaped trowel will produce a 25 mm deep by 12 mm wide joint. Later these joints are prepared by grinding with a V-shaped abrasive wheel and filled with a polyurethane sealant.



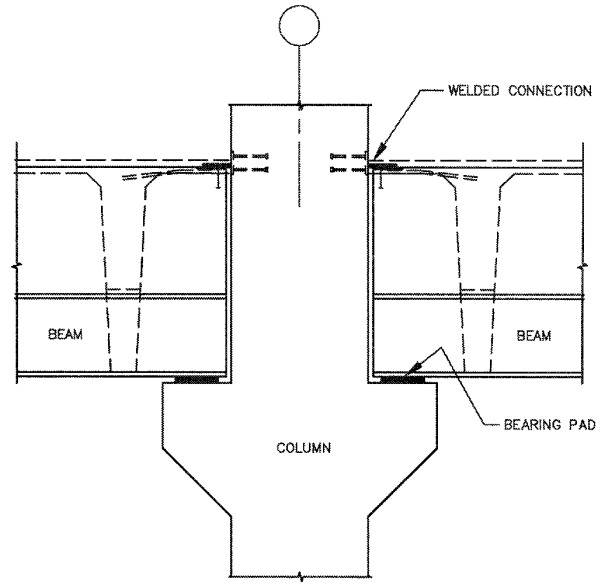
Pretopped double tees are a recommended alternative to field-placed concrete toppings. This system has excellent 35 to 55 MPa plant produced wearing surface - broom-finished to provide improved driving traction. Standard details are used for adjacent camber differential, joint treatments, erection stability and drainage with this system.

Except for column base plates, all connections and exposed hardware often use hot dipped galvanized or stainless steel. Where connections are subsequently welded, the welds should be minimal and located where they can be easily maintained.



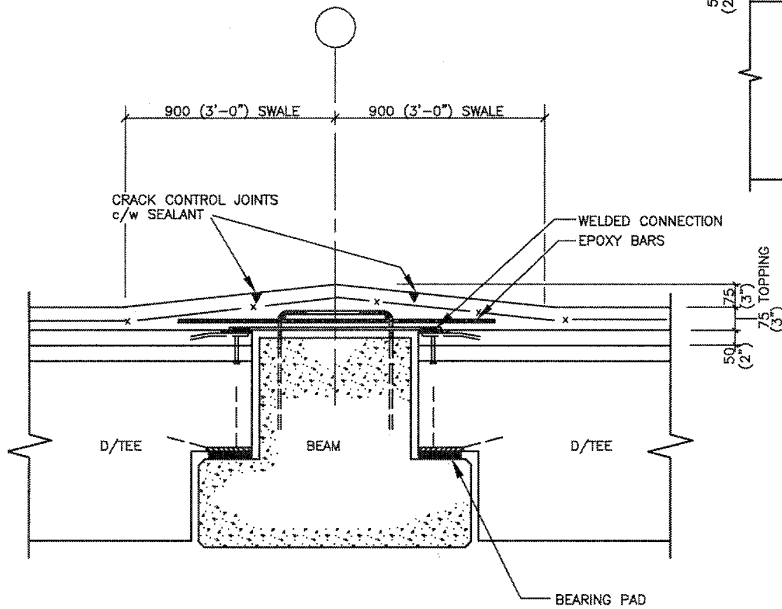


Column Base Detail

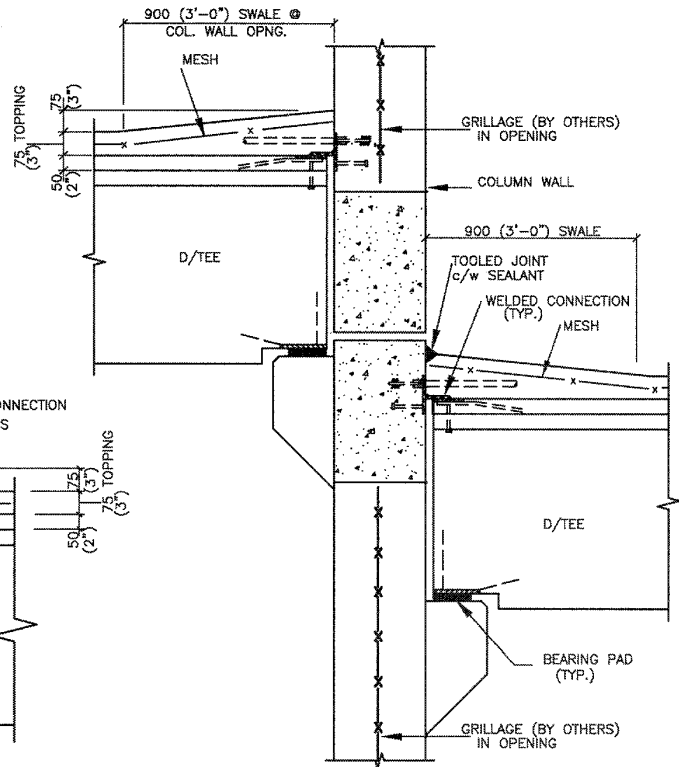


Inverted T/Beam to Column Connection

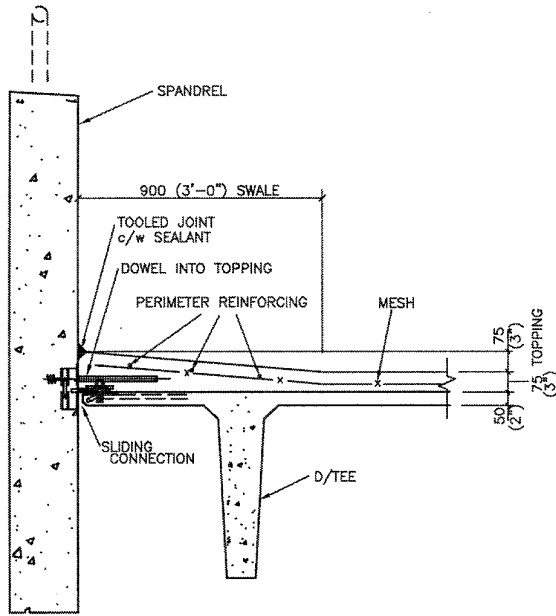
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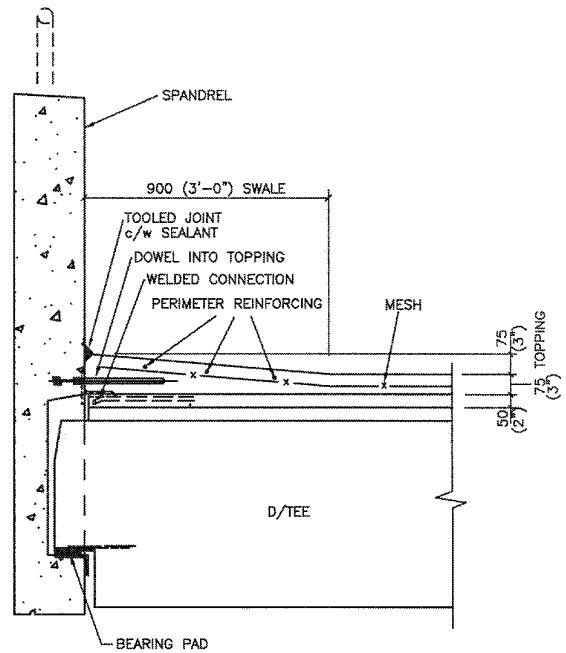
Inverted T/Beam to Double Tee Connection



Column Wall to Double Tee Connection

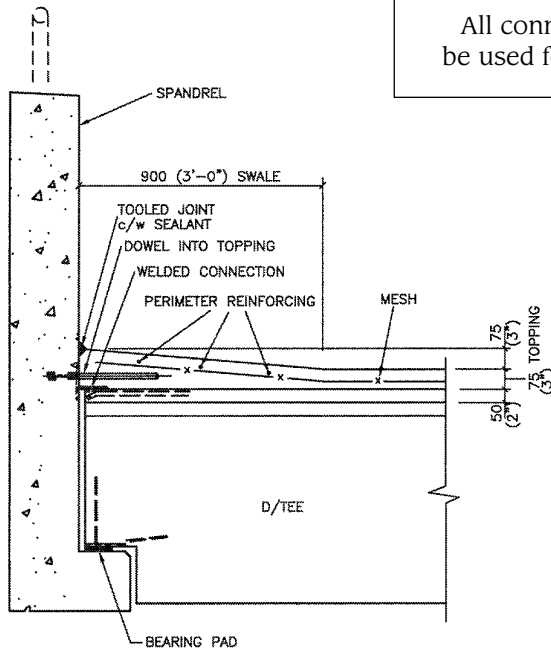


Non Load-Bearing Spandrel  
To Double Tee Connection

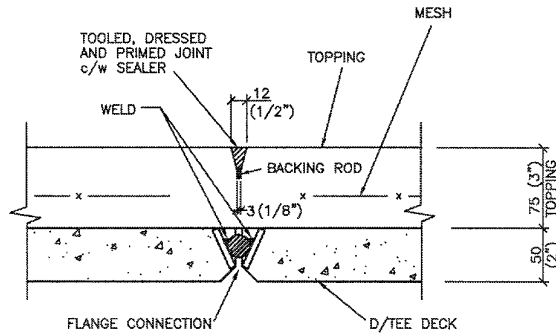


Load-Bearing Pocketed Spandrel  
To Double Tee Connection

All connections shown are to be used for concept design only.



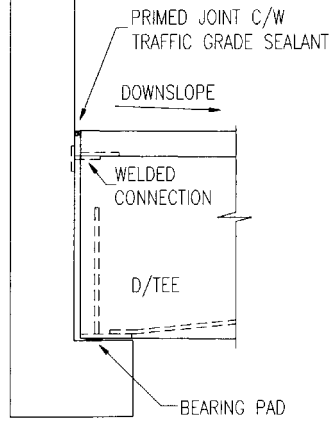
Load-Bearing Ledged Spandrel  
To Double Tee Connection



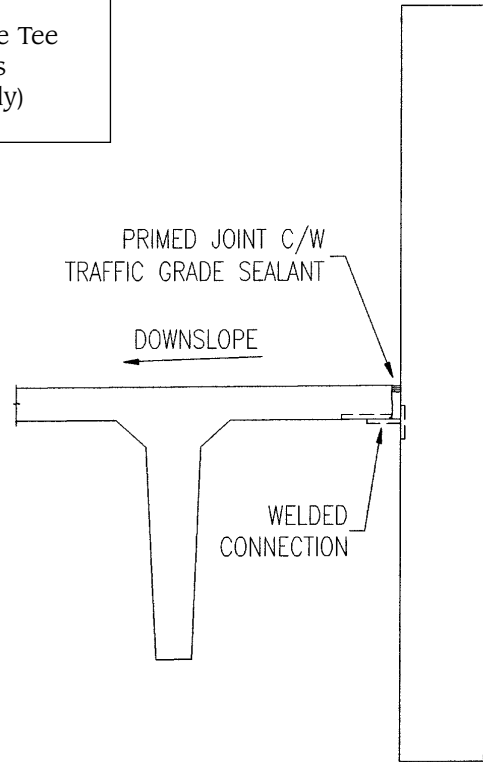
Crack Control Detail  
@ Double Tee Joints



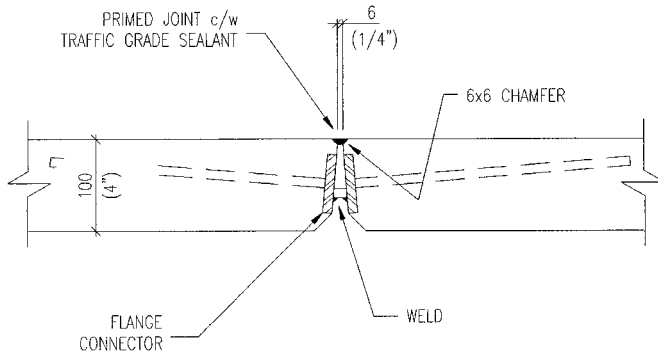
## Pre-Topped Double Tee Typical Details (for concept only)



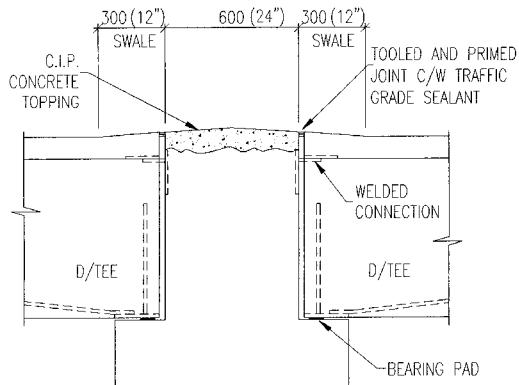
LB Spandrel to  
Pre-Topped Double Tee  
Connection



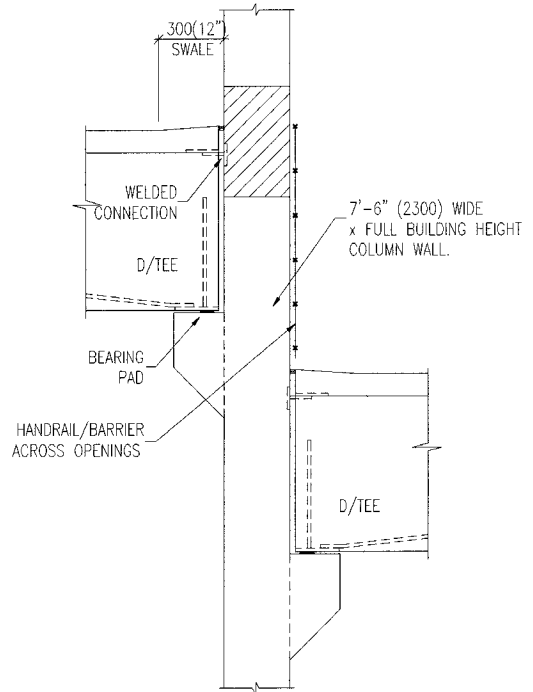
NLB Spandrel to Pre-Topped Double  
Tee Connection



Pre-Topped Double Tee Joint



Pre-Topped Double Tee to Inverted  
T/Beam Connection



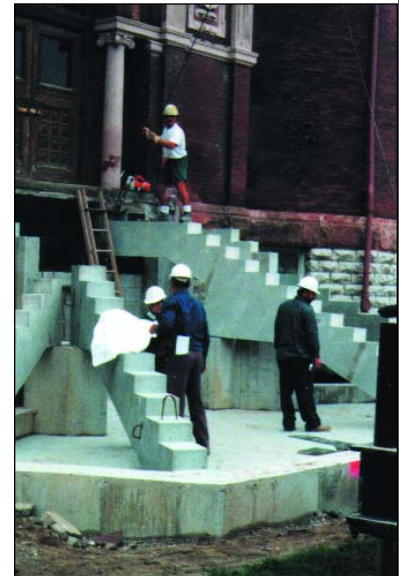
Column Wall to Pre-Topped Double Tee  
Connection

# Structural Precast/Prestressed Concrete

## Specialized Uses



*Precast rakers for custom stairs.*



*Precast  
stadium  
arena/theatre  
seating.*

*Precast stairs.*



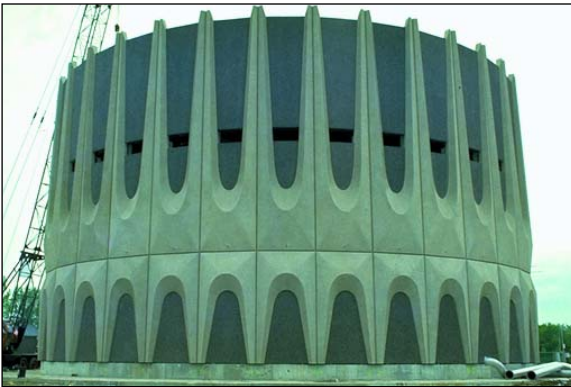
# Structural Precast/Prestressed Concrete



*Sound barrier walls.*



*Custom precast rings for chimney stacks.*



*Storage and holding tanks.*

*Hotels.*



*Interior fire walls.*

*Tunnel liners.*



## Specialized Uses

# Structural Precast/Prestressed Concrete

## Bridges



*Precast requires no painting, minimizing long term maintenance costs.*



*Long spans require fewer piers allowing improved navigation.*

*All weather construction ensures schedules are met.*

*Precast/Prestressed girders eliminate shoring work.*





*Plant cast girders are quickly placed during off-peak times, minimizing traffic interruption.*



*Standard girder sections minimize engineering and manufacturing time, resulting in quick product availability.*



# Structural Precast/Prestressed Concrete

## Heavy Industrial

Precast construction is the answer for heavy industrial projects. Precast framing and cladding can be cost effective both on first cost and when considering life cycle cost projections.

### Applications

Precast Concrete can be used for most heavy industrial applications - specialty and machine buildings (pulp and paper mills, wash buildings, control buildings), food processing, pipe racks, equipment slabs, environmental containment, mat foundations, piles, rotating equipment foundations and more.

### Speed

Fast construction means earlier production, occupancy and reduced financing costs. Winter construction can proceed with few weather delays. Precast components are prefabricated off-site in heated plants and delivered to the jobsite when needed.





*Pulp & Paper Mill.*

## Easy Maintenance

Precast components require little maintenance. Precast concrete resists abrasion, weathering and many harsh chemicals. Precast can withstand washdown, thermal shock and high-pressure hose streams.

## Fire Resistance

Precast concrete is noncombustible and has inherent fire resistance. Precast members can be designed to provide the required fire protection. Precast construction protects occupants and building contents from fire.

Fire damage and downtime is usually minimal in the event of a fire. Many insurance companies recognize this and provide lower rates.



*Insulated panels.*



*Precast pipe racks.*

## Precast Panel Systems

Precast sandwich wall panels are ideal for industrial applications. Panels can be provided with insulation values to suit your requirements. Exterior and interior finishes can be smooth, coloured or textured. Panels can be relocated later on to accommodate building expansions.

## Integration

Precast structures can accommodate most equipment, cranes, monorails, mechanical systems and electrical systems. Often a modular grid of openings and sleeves or inserts is provided for flexibility and to allow for ongoing changes during construction and for future modifications to the building/processes.



For More Information:

*CPCI Design Manual,  
Third Edition  
order from [www.cpci.ca](http://www.cpci.ca)*



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