

Bridge Component Concrete Standard

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

All concrete bridge components supplied for the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (the ministry) must comply with these specifications.

Section A - Cast in Place and Structural Precast Components

1. SCOPE

This Section A, entitled “Cast in Place and Structural Precast Components”, applies to all concrete that is utilized for ministry bridge, culvert, retaining wall and cattleguard projects, including all precast and cast-in-place concrete except concrete roadside barriers and unreinforced interlocking concrete blocks which are covered in Section B, entitled “Precast Concrete Roadside Barriers and Unreinforced Interlocking Blocks.”

2. CONFORMANCE TO CSA STANDARDS

All precast concrete must be designed, mixed, transported, cast, cured and tested according to CSA A23.4 “Precast Concrete - Materials and Construction.”

Precast and cast in place concrete must be designed, mixed, transported, cast, cured, sampled and tested in accordance with CSA Standard A23.1/A23.2, “Concrete Materials and Methods of Concrete Construction /Test Methods and Standard Practices for Concrete.”

Where CSA A23.1/A23.2 or CSA A23.4 differs from these ministry specifications, the ministry specifications shall govern.

Formwork for cast-in-place concrete must be designed, supplied, and installed in accordance with CAN/CSA-S269.3-M, “Concrete Formwork.”

3. PRECAST CONCRETE FABRICATOR QUALIFICATIONS

Fabricators responsible for precast concrete fabrication (except for concrete roadside barriers and unreinforced interlocking blocks which are addressed in Section B) must be certified, at the time of bidding and for the duration of fabrication, in accordance with CSA A23.4 “Precast Concrete-Materials and Construction” as described in Tables 1 and 2 (below) by:

- the CSA Group Testing & Certification Inc.; or
- the Canadian Precast Concrete Quality Assurance Certification Program (CPCQA).

Table 1 – Acceptable CSA A23.4 Fabricator Certification Categories for Precast Structural Components for Ministry Bridges

(Note: fabricators are limited within each category in accordance with any limitations specified by the certifying agency).

Category /Group ID	Category /Group Name	Sub-category ID	Sub-category Name	Examples of Precast Structural Components for Ministry Bridges
B*	Bridges			
		B1	Precast bridge products	Reinforced non-prestressed components: (e.g. slab girders, compo-girders, deck panels, ballast walls, cap beams, footings, abutments, etc.).
		B2**	Prestressed miscellaneous bridge products	No ministry standard or typical components.
		B3***	Prestressed straight strand bridge members	Prestressed (with straight strands) superstructure components (e.g. prestressed box girders or prestressed slab girders).
		B4****	Prestressed deflected strand bridge members	No ministry standard or typical components.

Footnotes:

* If a fabricator is certified in a category that has an A beside the B (e.g. BA1) it indicates the fabricator is certified for a specific Group B category (e.g. B1) and the fabricator is also certified to apply architectural finishes (not required for ministry components) to products in that category in accordance with CSA A23.4.

** also includes certification for products in category B1.

*** also includes certification for products in categories B1 and B2.

**** also includes certification for products in categories B1, B2 and B3.

Table 2 - Acceptable CSA A23.4 Fabricator Certification Categories for Precast Structural Components for Ministry Structures other than Bridges

(Note: fabricators are limited within each category in accordance with any limitations specified by the certifying agency).

Category /Group ID	Category /Group Name	Sub-category ID	Sub-category Name	Examples of Precast Structural Components for Ministry Structures other than Bridges (reinforced & non-prestressed components)
B	Bridges	(all- see Table 1)	(all- see Table 1)	Culverts: - Box culverts, arch culverts; - Footings, pile caps, headwalls, etc. Retaining Walls: - Mechanically Stabilized Earth (MSE) facing; - “L” or “inverted T” walls. Cattleguards: - abutments/sills.
OR				
D	Drainage Products	D1	Standard precast concrete drainage products	

4. CONCRETE MIX DESIGN SPECIFICATIONS

Concrete mixes for bridge components shall conform to the requirements in the following table (Table 3), and the requirements of CSA A23.1.

Table 3 – Concrete Mix Design Requirements

Bridge Component Type	Typical Component Example	Exposure Class (As per CSA A23.1 Table 1)	Minimum Compressive Strength @ 28 days (MPa)	Maximum Water to Cementing Materials Ratio (by mass)	Air Content (%)	Maximum Nominal Size of Course Aggregate (mm)
Precast Components	Slab girders Deck panels Footings “T” Abutments Ballast Walls Pile Caps	F1	35	0.40	5-8	20
Cast-in-Place Components	Footings Abutments Pipe pile in-fill	F1	30	0.50	4-7	28

The supplier of concrete products shall monitor concrete slump and ensure that it is maintained at appropriate values such that the concrete products are produced to meet all required specifications.

The supplier will make the concrete mix design available for inspection by the ministry’s in-plant quality assurance inspector to verify conformance to ministry standards and specifications.

Provided that the supplier’s concrete mix design will conform to ministry standards and specifications, the supplier’s mix design does not need to be reviewed or pre-approved by the Ministry Engineer. However, alternative concrete specifications may be required for bridges that are expected to have substantial chloride exposure. For these bridges, alternative concrete specifications shall be developed on a case by case basis by the Ministry Engineer and provided in the contract documents specific to each bridge.

5. REINFORCING STEEL

5.1 Standards

Reinforcing steel, including tendons, must meet the requirements of CSA Standard A23.1, “Concrete Materials and Methods of Concrete Construction”, and/or CSA Standard A23.3, “Fabrication and Placement of Reinforcement”.

Non-prestressed reinforcement must conform with CSA Standard G30.18.

Welded wire reinforcement must conform with ASTM A185M.

5.2 Epoxy Coating

In adverse conditions, such as a bridge deck that will be regularly exposed to road salt or portions of structures in the splash or spray zone of salt water, epoxy-coated reinforcement shall be provided if specified by the ministry.

6. CONCRETE FINISHING

Surface finishes shall be in accordance with the following table (Table 4).

Table 4 – Concrete Surface Finish Requirements

Surface	Finish*
Submerged or buried surfaces	Class 1
Underside of decks or slab girders	Class 1
Outer face of deck panels, concrete slabs, or concrete girders	Class 2
Exposed faces of ballast walls, pile caps, retaining walls, abutments, piers	Class 2
Top of deck	Transverse broom finish
Bearing seats	Magnesium trowelled finish

* Finish Description

Class 1 – Class 1 finish is the basic finish to be produced on all formed surfaces not exposed to view unless a better finish is specified or required by the Drawings or Special Provisions.

- In order to produce a Class 1 finish, the formwork shall be mortar tight. Panel marks and texture are of no importance.
- All ties, bolts, nails and other metal specifically required for construction purposes shall be removed or cut back to a depth of 50 mm from the surfaces of the concrete and the resulting holes filled.
- No dry ties shall be permitted; form tie rods shall remain embedded and terminate not less than 50 mm from the formed face of the concrete. Removable embedded fasteners on the ends of the rods shall be such as to leave holes of a regular shape for reaming and filling.
- Honeycombs and voids over 500 mm² in area shall be filled.
- Honeycombs and voids shall not be repaired until inspected by the Ministry Representative as special methods of repair may be required where occurring in structural elements.
- Otherwise, concrete surfaces shall be repaired in accordance with the repair product manufacturer's specifications.

Class 2 – Class 2 Finish is to be produced on all formed surfaces exposed to view from a moderate distance, such as surfaces of abutments and piers, and to any surfaces for which a Class 2 finish is specified or required by the Drawings or the Special Provisions. A Class 2 finish shall provide surfaces of uniform colour and texture as viewed from a distance of 25 m.

- In order to produce a Class 2 finish, formwork shall be mortar tight and shall render a true surface. Fins 3 mm wide (maximum) shall be allowed at the panel joints; however, sheathing joints must be mortar tight.

- Irregularities of 3 mm in height with areas of 50 mm x 75 mm shall be allowed to a maximum of four such areas per 3 m² of formwork. Patches of dissimilar material will not be permitted. Horizontal and vertical joints shall be aligned. All ties, bolts, nails and other metal specifically required for construction purposes shall be removed or cut back to a depth of 50 mm from the surfaces of the concrete and the resulting holes filled.
- No dry ties shall be permitted; form tie rods shall remain embedded and terminate not less than 50 mm from the formed face of the concrete. Removable embedded fasteners on the ends of the rods shall be such as to leave holes of a regular shape for reaming and filling.
- Honeycombs, voids, or bugholes over 10 mm diameter shall be filled. All fins and projections shall be removed with a hand stone or power grinder. The use of a power grinder shall be kept to a minimum and confined to the areas required. When a rubbed finish is not called for, patches shall be textured with a mortar float or lightly brushed after trowelling smooth.
- Where more than 50 voids or bugholes over 5 mm diameter occur per square metre, or if the surfaces are not acceptably uniform in colour or texture, the entire area affected shall be given a rubbed finish, repaired in accordance with the repair product manufacturer's specifications.

7. PRECAST LIFTING ANCHORS

All precast components must have embedded lifting anchors. The exact type, location and installation requirements of the lifting anchors must be shown on the detailed design drawings. The lifting procedures assumed by the detailed design engineer must also be shown and described on the detailed design drawings. Unless otherwise specified or approved by the ministry, components must be assumed to be lifted by one (or, where practical, two) excavators, as per typical ministry bridge installation methods.

8. CONCRETE COVER FOR PRECAST BRIDGE COMPONENTS

Table 5 - Specified Concrete Cover and Tolerances for Precast Concrete Bridge Components

Precast Concrete Bridge Component ¹	Design Concrete Cover Requirements ² (mm)	Tolerances for Placement of Reinforcement in Forms	
		Allowable Tolerance for Reduction to the Required Cover ³ (mm)	Allowable Tolerance for Increase to the Required Cover ⁴ (mm)
Precast Deck Panels			
Top of deck panel	50	- 8	+ 8
Underside of deck panel ⁵	25	- 6	+ 8
Vertical face of exposed deck panel edge	50	- 8	+ 8
Blockouts and Grouted Deck Joints			

Face of blockouts for shear studs, dowels, anchor bolts ⁶	25	- 6	+ 8
Vertical face of transverse grouted deck joint	25	- 6	+ 8
Precast Concrete Slab Girders			
Top of slab girder	50	- 8	+ 8
Underside of slab girder	30	- 7	+ 8
Vertical face of exposed slab girder	50	- 8	+ 8
Ballast Walls and Footings			
Both faces of ballast walls	35	- 8	+ 8
Footings, all faces	35	- 8	+ 8

Footnotes:

1 The cover for precast concrete is reduced from the cover used in cast-in-place concrete because of greater dimensional control of formed concrete, tighter tolerances on placement of reinforcing, and better quality of concrete in plant controlled conditions (Ref. Table 1 of CSA A23.4). Construction tolerances for cast-in-place concrete are provided in CSA A23.1/2.

2 Concrete cover is the distance from the concrete surface to the nearest deformation (or surface for smooth bars or wires) of the reinforcement. Concrete cover includes tie wire for reinforcement because tie wire (when exposed) could corrode and potentially crack concrete.

3 Allowable tolerance for reduction to the required cover shown in the above table is determined based on the lesser of 8 mm or ¼ required concrete cover, based on Clauses 14.4.1 (a) and 14.4.2 of CSA A23.4. Allowable tolerances in the table above were rounded down to nearest whole mm.

4 Allowable tolerance for increase to the required cover shown in the above table is 8mm based on Clause 14.4.1 (a) of CSA A23.4.

5 Concrete cover requirements do not apply at drip groove locations on the underside of deck panels.

6 Rectangular blockouts for precast concrete deck panels (made with removable forms and as shown on ministry standard drawing series STD-EC-030) are subject to the required concrete cover on all faces of the blockout and the allowable tolerances as specified above. However, where corrugated steel pipe (CSP) 'stay-in-place forms' are used to build blockouts for shear studs, dowels, anchor bolt, etc., and where it is unavoidable, reinforcement may be placed in direct point contact with the CSP 'stay-in place-forms' provided the final resulting blockouts will be filled in the final construction stage.

Section B – Precast Concrete Roadside Barriers and Unreinforced Interlocking Blocks

1. PRECAST CONCRETE UNREINFORCED INTERLOCKING BLOCKS

Precast concrete unreinforced interlocking blocks shall meet the following specifications:

- Concrete must have a 28 day strength of 20 MPa minimum unless otherwise specified.
- Blocks shall be cast monolithically (i.e., no cold joints allowed).
- The finish shall meet Class 1 (unless noted otherwise by the ministry) requirements as described in Section A above.
- Standard full block size must be 1500x750x750 mm.
- Dimensional tolerance must be ± 20 mm for length, width and height and the blocks shall be reasonably square, with the diagonals within a tolerance of ± 15 mm of each other.
- Top and bottom surfaces must be flat to a tolerance of ± 3 mm under a 600 mm straight edge.
- Concrete shall be air entrained 4-7% to protect the surface from freeze thaw degradation.
- Each block must contain a satisfactory embedded lifting device.
- Interlock pattern and geometry must be approved by the ministry.
- Edges shall be chamfered.

2. PRECAST CONCRETE ROADSIDE BARRIERS

Concrete roadside barriers shall meet the standards (including drawings) established by the BC Ministry of Transportation and Infrastructure (MoTI) in Section 941 of the BC MoTI “Standard Specifications for Highway Construction”, available at:

https://www2.gov.bc.ca/assets/gov/driving-and-transportation/transportation-infrastructure/engineering-standards-and-guidelines/highway-specifications/volume_2_ss2020.pdf

3. PRECAST CONCRETE FABRICATOR QUALIFICATIONS

Table 6 - Acceptable Fabricator Qualification Requirements for Precast Barriers and Blocks

Example Component	Fabricator Qualification Requirements
Interlocking Concrete Blocks (typ. 1500x750x750 mm)	Fabricator certified to category B or D (see Tables 1 & 2) OR Fabricators shall have their operations and products inspected and approved by a Ministry Engineer.
Concrete Roadside Barriers/ Bridge Approach Barriers	Fabricator certified to category B or D (see Tables 1 & 2) OR Fabricator shall provide proof (if requested by the ministry) of recent satisfactory fabrication of barriers in accordance with BC MoTI “Standard Specifications for Highway Construction” Section 941.