CONSTRUCTION SPECIFICATION FOR PERMANENT CONCRETE BARRIERS

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740.01 SCOPE

This specification covers the requirements for the construction of permanent concrete barriers.

740.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

Use of this specification or any other specification shall be according to the Contract Documents.

740.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

740.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 301 Restoring Unpaved Roadway Surfaces
OPSS 310 Hot Mix Asphalt
OPSS 314 Untreated Subbase, Base, Surface, Shoulder, Selected Subgrade, and Stockpiling
OPSS 501 Compacting
OPSS 904 Concrete Structures
OPSS 919 Formwork and Falsework

Ontario Provincial Standard Specifications, Material

OPSS 1010 Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1150 Hot Mix Asphalt
OPSS 1305 Moisture Vapour Barriers
OPSS 1306 Burlap
OPSS 1308 Joint Filler in Concrete
OPSS 1315 White Pigmented Curing Compounds for Concrete
OPSS 1350 Concrete - Materials and Production
OPSS 1440 Steel Reinforcement for Concrete
OPSS 1442 Epoxy Coated Reinforcing Steel Bars for Concrete

Ontario Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 11 - Pavement, Hazard and Delineation Markings

CSA Standards

G40.20-13/G40.21-13 (R2018)	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
G164-18	Hot Dip Galvanizing of Irregularly Shaped Articles

740.03 DEFINITIONS

For the purpose of this specification, the following definition applies:

Asymmetric means the barrier placed where the pavement elevations on each side of the barrier differ.

740.04 DESIGN AND SUBMISSION REQUIREMENTS

740.04.01 Submission Requirements

A request shall be submitted to the Contract Administrator for permission to use a concrete barrier design other than as specified in the Contract Documents. The request shall be submitted at least 4 weeks prior to starting any work affected by the proposed change.

740.05 MATERIALS

740.05.01 Concrete

Concrete shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa, except that tall wall concrete barrier shall have a nominal minimum 28-Day compressive strength of 35 MPa. Coarse aggregate for the concrete shall have a nominal maximum size of 19.0 mm.

All coarse aggregate used for slip-formed tall wall concrete barrier shall have all faces crushed.

740.05.02 Curing

Membrane curing compound shall be according to OPSS 1315. Burlap shall be according to OPSS 1306 and moisture vapour barrier shall according to OPSS 1305.

740.05.03 Joint Filler

Joint filler for permanent concrete barrier shall be according to OPSS 1308.

740.05.04 Formwork

Formwork for permanent concrete barrier shall be according to OPSS 919.

740.05.05 Reinforcing Steel

Steel reinforcement shall be according to OPSS 1440.

Dowel bars shall be according to OPSS 1442.

740.05.06 Asphaltic Concrete

Asphaltic concrete shall be according to OPSS 1150.

740.05.07 Granular

Granular foundation material shall be according to OPSS 1010.

740.05.08 Interlocking Components

Hollow structural steel and wide flange steel sections used in permanent precast concrete barrier shall be according to CSA G40.21, grade 350W, and shall be hot dip galvanized after fabrication according to CSA G164.

740.05.09 Marking

The following information shall be permanently marked on the top or sides of the precast sections:

a) Name or trademark of the manufacturer.

b) Identification of plant if manufacturer has more than one plant.

c) The date of manufacture.

740.07 CONSTRUCTION

740.07.01 Concrete Barrier

Concrete barriers shall be installed at locations as specified in the Contract Documents.

Construction of concrete barrier shall be by the following methods:

a) Conventional wooden or steel formwork.

b) Slip-form.

c) Precast concrete barrier units.

Precast concrete barrier containing the I-Lock connection, may be used in permanent installations. The precast concrete barrier shall be secured in place as specified on the Contract Documents.

740.07.01.01 Foundation Preparation

Preparation of the granular foundation shall be according to OPSS 314 and OPSS 301, as appropriate. Immediately ahead of placing the concrete, the subgrade shall be wet down by means of a uniform spray of water sufficient to wet the subgrade thoroughly without leaving standing water.

Placement of asphaltic concrete pavement beneath and adjacent to the precast concrete barrier shall be according to OPSS 310.

740.07.01.02 Tolerances

Dimensions of the completed barrier shall not deviate by more than 10 mm from the dimensions as specified in the Contract Documents.

The horizontal alignment shall not deviate more than 10 mm from the required lines as specified in the Contract Documents.

When a 3 m long straight edge is placed on the top and faces of the concrete barrier surface, the surface of the concrete shall not vary more than 6 mm from the edge of the straight edge.

When the slip-formed concrete barrier does not conform to the tolerances, the concrete barrier may be corrected to the required tolerances using a magnesium float, while the concrete is still plastic, providing the surface and/or the barrier is not damaged during such adjustments.

740.07.01.03 Surface Finish

The surface of the concrete barrier placed with conventional forms shall have a surface finish according to OPSS 904.

Slip-formed barrier surface shall not be brushed. Offsets and fins shall be removed immediately by light trowelling. Surface blemishes 10 mm or less in diameter shall be left untouched. If surface blemishes larger than 10 mm diameter occur, adjustments in the operation shall be made to correct the condition. If the adjustments do not correct the condition within 10 m, the operation shall be halted until the condition is corrected either by adjustments to the operation or to the concrete mix.

The use of water on the completed barrier to correct imperfections shall not be permitted.

740.07.01.04 Curing

Curing shall be according to OPSS 904 with the exception that white pigmented curing compound is permitted with slip-formed concrete.

Curing for formed surfaces shall be according to OPSS 904.

When joints are made after the application of curing compound, the exposed face of the barrier in the vicinity of the joint shall be retreated with curing compound.

When white pigmented membrane is used as curing compound on slip-formed barrier, it shall also be used on adjacent preformed barrier sections for colour uniformity.

740.07.01.05 Concrete Subject to Cold Weather

Concrete shall not be placed by slip-forming when the ambient air temperature is below 0 °C.

When the concrete is placed at temperatures of 5 °C or less, the concrete in the barrier wall shall be maintained at a minimum temperature of 5 °C for 3 Days. The compressive strength cylinders shall be cast and cured with the barrier wall. The 3-Day compressive strength cylinders shall be at least 80% of the minimum specified 28-Day compressive strength of the wall. If these conditions cannot be met, then the concrete shall be protected according to OPSS 904, for footings and slabs on the ground.

740.07.01.06 Expansion Joints

Expansion joints 12 mm minimum in width shall be installed where concrete barrier abuts a structure, adjacent to piers, over existing deck expansion joints, and at the locations as specified in the Contract Documents. The expansion joint shall be filled with Type A expansion joint filler.

If forming the joint is performed before the concrete has hardened, the adjacent portions of the barrier shall be supported firmly to ensure the design shape of the barrier wall is constructed as specified in the Contract Documents.

740.07.01.07 Construction Joints

Construction joints shall be vertical and square with a rough joint face. Joints shall be created by sawcutting the hardened concrete to a depth of 45 mm ± 5 mm around the outside of the barrier and removing the remaining loose and excess concrete.

Curing compound shall be applied to the joint face.

Transition sections between barrier and treatments for high mast lighting poles, overhead sign structures, and bridge piers in median shall be one-piece construction of the same class of concrete as the barrier. No portion of the transition shall be slip-formed.

Dowels shall only be used at transitions.

Continuity between transition sections and barrier wall sections shall be accomplished by using three size 25M by 1.0 m long, epoxy coated smooth reinforcing bars placed horizontally in the wall. The three bars shall be embedded 500 mm into the squared end of the constructed wall and shall be located on the barrier centre line, commencing 150 mm from the top of the barrier and equally spaced vertically at 150 mm intervals. Construction joints at transition sections for tall wall concrete barrier shall consist of five horizontal epoxy coated smooth reinforcing bars installed.

Prior to constructing the addition, the exposed horizontal bars and the squared end of the barrier wall shall be greased to inhibit bonding.

Transitions for high mast lighting poles and overhead sign structures shall be one-piece construction of the same class of concrete as the barrier wall.

740.07.01.08 Treatment at Bridge Piers

Granular A material with asphalt surface shall be used to fill the area between concrete barriers where separation occurs at bridge piers or at other locations where separation of the barriers is required.

Compaction of granular shall be according to OPSS 501. The asphalt surface shall be according to OPSS 310.

740.07.01.09 Isolation and Contraction Joints

All joints shall be formed in the plastic concrete immediately following the slip-form equipment. Joints shall be formed using a grooving tool with a minimum 40 mm deep bit and shall be continuous along the front and back vertical face, excluding the top of the barrier. Tooling marks or other surface defects adjacent to the newly formed joint shall be trowelled smooth. A proposal may be submitted to sawcut the contraction joints in lieu of scoring, which may be permitted subject to a demonstration of the proposed technique and prior approval by the Contract Administrator.

Isolation joints shall be placed on each side of the outside perimeter of all sub-surface structural elements such as storm-water and maintenance access structures to accommodate vertical differential movement.

Contraction joints shall be equally spaced along the barrier wall at 4 m intervals. This interval may be locally modified to a length between 3 to 5 m to avoid being within 3 m of any other joint.

The construction joint at the end of the day shall coincide with a contraction or isolation joint.

Cracks outside the joints are unacceptable. The section containing the cracks shall be removed and replaced. The limits of removal shall extend to the nearest joint on each side of the crack.

740.07.02 Reflectors

Reflectors placed on permanent concrete barrier shall be according to the OTM Book 11.

740.07.03 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

740.08 QUALITY ASSURANCE

740.08.01 Acceptance Criteria for Precast Concrete Barrier

Final inspection of the precast units will not be made until they have been installed.

All concrete barrier units shall meet the following criteria:

a) There shall be no exposed coarse aggregate, such as honeycombing. The top and bottom surface of the precast unit are excluded from this condition.

b) Cracks shall not extend through the precast unit.

740.09 MEASUREMENT FOR PAYMENT

740.09.01 Actual Measurement

740.09.01.01 Concrete Barrier
Tall Wall Barrier
Asymmetric Concrete Barrier
Asymmetric Tall Wall Barrier

Measurement shall be made in metres along the centreline of the barrier, from end to end of installation, and shall include the length required for lighting pole footings and overhead sign structure footings.

Where two concrete barriers are constructed back to back, Type A-2, TW-2, and M-2; they shall be treated as a single installation and the length will be measured only once for payment purposes.

740.09.01.02 Granular

Measurement shall be according to OPSS 314.

740.09.01.03 Asphaltic Concrete

Measurement shall be according to OPSS 310.

740.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

740.10 BASIS OF PAYMENT

740.10.01 Concrete Barrier - Item
Tall Wall Barrier - Item
Asymmetric Concrete Barrier - Item
Asymmetric Tall Wall Barrier - Item

Payment at the Contract price for the above items shall be full compensation for all labour, Equipment, and Material required to construct the barriers, including any concrete backfill between Type A-2, TW-2, or M-2 concrete barriers at the location of bridge piers or transitions.

Costs associated with any required removals and replacements of defective workmanship or materials shall be the Contractor's responsibility at no cost to the Owner.

740.10.02 Granular

Granular material used as backfill between concrete barriers shall be paid for at the Contract price for the appropriate granular items.

740.10.03 Asphaltic Concrete

Asphaltic concrete laid as a foundation or used as asphalt surface at bridge piers shall be paid for at the Contract price for the appropriate hot mix item.

Appendix 740-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Location of concrete barriers. (740.07.01)

- Horizontal alignment. (740.07.01.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 911.130	Guide Rail System, Concrete Barrier, Cast-In-Place, Type A, Installation
OPSD 911.131	Guide Rail System, Concrete Barrier, Cast-In-Place, Type C, Installation
OPSD 911.132	Guide Rail System, Concrete Barrier, Cast-In-Place, Tall Wall, Installation
OPSD 911.134	Guide Rail System, Concrete Barrier, Installation - Median Concrete Barrier to Structure
OPSD 911.135	Guide Rail System, Concrete Roadside Barrier, Cast-In-Place or Slipformed, Installation
OPSD 911.136	Guide Rail System, Concrete Barrier, Cast-In-Place, Type M, Installation
OPSD 911.143	Guide Rail System, Concrete Barrier, Precast I-Lock Connection, Type TW, Installation - Permanent
OPSD 911.380	Guide Rail System, Concrete Barrier, Permanent Transition, Installation at Piers and Poles
OPSD 911.381	Guide Rail System, Concrete Barrier, Permanent Transition Installation, Roadside Concrete Barrier to Structure
OPSD 911.382	Guide Rail System, Concrete Barrier, Dowel Connection Detail
OPSD 911.383	Guide Rail System, Concrete Barrier, Permanent Transition Installation at Lighting Pole and Sign Support Footings