

**Construction Specification for
Concrete Curb and Concrete Curb and Gutter**

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TS 3.50.01 SCOPE

This specification covers the requirements for the construction of plain or reinforced cast-in-place concrete curb, concrete curb and gutter, mountable curb and gutter and dropped curb and gutter for entrances and disability access.

TS 3.50.02 REFERENCES

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

City of Toronto Standard Specifications

TS 4.50	Construction Specification for Utility Adjustments
TS 501	Amendment to OPSS.MUNI 501 – Construction Specification for Compacting
TS 1010	Amendment to OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
TS 1350	Amendment to OPSS.MUNI 1350 – Material Specification for Concrete – Material and Production

City of Toronto Standard Drawings

T-216.02-5	Utility Isolation in Composite Pavement
T-310.010-3	Concrete Sidewalk with Retaining Curb
T-310.010-4	Combined Concrete Curb and Sidewalk
T-310.010-7	Stamp for Concrete Work by Contractor
T-310.010-11	Stamp for Concrete Work by Utility or Agency
T-310.020-2	Sidewalk Paved with Unit Paver Band at Curb
T-600.11-1	Concrete Curb

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Materials
OPSS.MUNI 408	Construction Specification for Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers
OPSS.MUNI 919	Construction Specification for Formwork and Falsework
OPSS.MUNI 1440	Material Specification for Steel Reinforcement for Concrete

Canadian Standards Association

A 23.1	Concrete Materials and Methods of Concrete Construction
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TS 3.50.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Base Course means a layer of specified or selected materials of planned thickness constructed on the subgrade for drainage and to distribute pavement loads.

Contraction Joint means a cut or formed joint to regulate the location and degree of cracking in the plane of the curb or curb and gutter.

Expansion Joint means a physical separation between the concrete and appurtenances, or between parts of the curb or curb and gutter, which allows both horizontal and vertical movement.

Geotextile means a permeable geosynthetic comprised solely of textiles.

GU/GUL means general use or general use limestone hydraulic cement.

HE means high early strength hydraulic cement.

Slipform means the placing, consolidating and extruding of plastic concrete in a machine without the use of fixed side forms.

Subgrade means the soil prepared and compacted to support a structure or pavement.

TS 3.50.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 3.50.04.01 General

Any required submissions shall be in writing. All submissions shall be submitted to the Contract Administrator at least three weeks prior to the beginning of the work.

The requirements for submissions and design requirements shall be according to TS 1350.

TS 3.50.04.02 Materials

Prior to starting the work, the Contractor shall supply the Contract Administrator with material safety data sheets (MSDS) for all the materials to be incorporated in the work.

The Contractor shall be responsible for selecting the concrete materials and for the mix design for the concrete. The concrete mix proportions shall be according to CSA A23.1 and this specification.

The certificate of ready mix facilities and/or the certificate of mobile mix concrete production facilities along with the City of Toronto Form A or B (concrete mix details) shall be submitted as required by TS 1350.

Details of the method of curing and curing materials (including manufacturers' literature, where applicable) shall be submitted to the Contract Administrator.

One copy of the concrete delivery ticket shall be submitted to the Contract Administrator for each load of concrete delivered.

TS 3.50.05 MATERIALS

TS 3.50.05.01 Concrete

The materials for and the production of concrete curb and concrete curb and gutter shall meet the requirements of TS 1350 and the following:

1) Cement type	Normal Portland GU / Portland limestone GUL
2) Minimum 28 day compressive strength	32 MPa
3) Class of exposure	C-2
4) Maximum nominal size of coarse aggregate	19 mm
5) Slump at point of discharge	80 ± 30 mm
6) Air content	6.5 ± 1.5%
7) Maximum water/cementing materials ratio	0.45

For 7 day concrete:

- Minimum 7 day compressive strength: 32 MPa.

For 24-hour concrete:

- Minimum 24-hour compressive strength: 32 MPa.
- 24 hour concrete can only be manufactured using high early strength hydraulic cement (HE).

TS 3.50.05.02 Reinforcement

Reinforcement shall be according to OPSS.MUNI 1440.

All reinforcement detailed on the Contract Drawings for incorporation in the curb and concrete curb and gutter, shall be 15M bars.

TS 3.50.05.03 Granular Base and Curb Backfill

Granular base and curb backfill, if required, shall be Granular A and shall be according to TS 1010.

TS 3.50.05.04 Expansion Joint Material

Expansion joint material shall be bituminous fibre board having a minimum thickness of 12 mm.

TS 3.50.06 EQUIPMENT

TS 3.50.06.01 Forms

Forms shall be steel, wood or metal plate forms and shall be according to OPSS.MUNI 919. They shall be of sufficient cross section and strength, and so secured as to resist the pressure of the concrete when placed, and the impact and vibration of any construction equipment they support, without springing or settlement.

Forms shall be pinned or staked in place with not less than three pins for each 3 m length, and with a pin at each side of each form butt joint. The top surface of the formwork shall comply with the specified tolerances. The inside face of the form shall be vertical. The form shall deviate from grade by no more than 3 mm in 3 m, and in alignment by no more than 6 mm in 3 m.

Forms shall be cleaned and coated with form oil before each use.

TS 3.50.06.02 Slipform Equipment

Guidelines shall be provided at a constant height above, and at a constant horizontal distance from the edge of the proposed curb and concrete curb and gutter. The guidelines may be either wire or heavy-duty string.

The paver shall have automatic horizontal and vertical controls to be used in conjunction with at least one guideline. The equipment shall be equipped with internal vibrators of sufficient number, size and frequency to provide uniform consolidation to the entire cross section. The vibrators shall not operate while the equipment is stopped.

TS 3.50.06.03 Finishing Tools

An aluminum or magnesium float shall be used to float the concrete curb and concrete curb and gutter and a small radius edger shall be used to tool the edges.

TS 3.50.07 CONSTRUCTION

Prior to starting the work, the Contractor shall submit the verification that either the foreman/lead hand or the supervisor of the placing crew has ACI Flatwork Certification.

TS 3.50.07.01 Excavation

Excavation shall be to the lines and grades as shown on the Contract Drawing. Care shall be taken to prevent damage to appurtenances and utilities which may be in or under the proposed curb and concrete curb and gutter.

The Contractor shall make good all damage caused during the course of the work and return the work to its initial condition at no extra cost to the City.

Excavated material shall be removed from the site according to OPSS 180.

TS 3.50.07.02 Subgrade Preparation

The subgrade shall be compacted to a minimum of 95% of the maximum dry density as determined by TS 501.

TS 3.50.07.03 Granular Base Placement

Granular base shall be placed to the required lines and depth as shown on the Contract Drawings. The moisture content and compaction of the granular base shall be uniform and shall be according to TS 1010.

The granular base shall be moistened prior to the placement of concrete, but without any standing water. At the time of placing concrete, the base shall not be wet, soft or frozen.

TS 3.50.07.04 Utility Adjustment

All utility adjustments shall be according to TS 4.50 and OPSS.MUNI 408.

TS 3.50.07.05 Utility Isolation

Utility isolations shall be constructed in the concrete curb and concrete curb and gutter by sawcutting the curb or curb and gutter, to depth of 50 mm, at a distance of 300 to 400 mm from the outside edge of the frame.

TS 3.50.07.06 Reinforcement

The required reinforcement shall be placed and adequately supported at the locations as shown on the Contract Drawings.

Two - 15M longitudinal reinforcing bars, 2 m long shall be placed at each catch basin, one bar 100 mm below the top and one bar 100 mm above the bottom of the curb, centred on the catch basin.

Two - 15M reinforcing bars shall be placed at the mid-slab depth in the gutter longitudinally across the full width of industrial and commercial driveways. Short bars shall be overlapped by a minimum of 300 mm.

TS 3.50.07.07 Placing Concrete

Concrete shall be placed and consolidated to meet the requirements of CSA A23.1 and the requirements of this specification. The concrete delivering and spreading operations shall be coordinated to provide a uniform rate of progress of the placing operation.

The concrete shall be placed to the specified thickness, line and grade. The concrete shall be consolidated by 50 mm vibrators and other suitable tools to eliminate voids, honeycombing and entrapped air, especially against the formwork. For concrete placed using slipform equipment, the internal vibrators shall provide the necessary consolidation and no additional vibration will be required.

TS 3.50.07.07.01 Concrete Curb

All concrete curb shall be poured monolithic with the adjacent concrete sidewalk, paver base or other concrete structure and shall be according to T-310.010-4 or T-310.020-2. If the Contract does not specify a concrete structure adjacent to the back of the curb, the curb shall be poured integral with the concrete pavement or road base. The Contractor shall not construct stand-alone concrete curb.

Where the concrete curb is not placed adjacent to concrete structure, the Contractor shall construct the step along the back of the curb as shown on T-600.11-1 for future installations. The curb height shall be 130 mm for local streets and 150 mm for major arterial streets. The curb height may vary between 100 and 170 mm to provide adequate drainage or to match existing grades.

TS 3.50.07.08 Finishing Concrete

The concrete surface shall be finished while it is still sufficiently plastic to achieve the desired grades, elevation and texture. The surface of the concrete shall not be finished when standing water is present on the surface. The surface shall be uniform, dense and free from undulations and projections.

The top surface shall be screeded to true grade and cross section and finished with a magnesium or aluminum float is recommended.

The surface of the curb and concrete curb and gutter shall have no irregularities exceeding 6 mm in 3 m when tested with a straightedge in any direction. The edge of the curb and concrete curb and gutter shall be edged with a small radius edger.

The final finish for curb and concrete curb and gutter shall have a light brush texture.

TS 3.50.07.09 Identification Stamp

The Contractor shall mark with an approved stamp according to T-310.010-7 at each end of the work, at each tenth bay or no less than 20 m interval and all other places directed by the Contract Administrator. The stamp shall be located on the top of the curb. A stamp is not required for monolithic curb.

The stamp shall identify the Contractor's name and the year of construction.

The utility or agency shall mark with an approved stamp according to T-310.010-11 at each end of the work, at each tenth bay or no less than 20 m interval and all other places directed by the Contract Administrator. The stamp shall be located on the top of the curb. A stamp is not required for monolithic curb.

The stamp shall identify the utility or agency's name and the year of construction.

TS 3.50.07.10 Joints

Contraction, expansion and construction joints shall be formed or sawcut in the curb and concrete curb and gutter as required. The joints shall coincide with joints in the concrete road base and sidewalks.

TS 3.50.07.10.01 *Contraction Joints*

Contraction joints shall be constructed by forming or sawcutting to a depth of one quarter of the thickness of the concrete curb and concrete curb and gutter. The maximum distance between contraction joints shall be 6 metres. Joints shall coincide with and be of similar construction to joints in the adjacent sidewalk and road base.

TS 3.50.07.10.02 *Expansion Joints*

Expansion joints shall be constructed using 12 mm wide bituminous fibre to the full thickness of the curb and concrete curb and gutter.

Full depth (isolation) joints shall be formed around appurtenances extending into and through the curb and concrete curb and gutter. The isolation joints shall be placed perpendicular to the curb between 300 and 400 mm from the outside edge of the frame.

The top surface of the bituminous fibre shall be flush with the concrete surface. The fibre shall be vertical and straight in alignment.

TS 3.50.07.10.03 *Construction Joints*

At the end of each day's work, or in the event of an unavoidable stoppage of concrete placement extending more than 30 minutes, a construction joint shall be formed. Where possible, the construction joint shall coincide with the planned location of a contraction joint.

TS 3.50.07.11 *Concrete Curing*

Concrete curing shall be according to TS 1350.

TS 3.50.07.11.01 *Curing with Burlap and Water*

Burlap mats shall be pre-soaked by immersion in water for at least 6 hours immediately prior to placing. The mats shall cover the entire width and edges of the exposed concrete. The mats shall overlap 300 mm and shall be held down to prevent displacement. The mats shall be maintained in place and kept saturated for a minimum period of 7 Days. The Contractor may constantly water the mats or cover them with opaque polyethylene film, or a combination of both, in order to keep the mats saturated.

Alternatively, this method shall be used for a minimum period of 3 days following which the surface shall be cured with curing compound according to clause 1350.05.03.02 of TS 1350.

TS 3.50.07.11.02 *Curing with Geotextile Fabric and Water*

Geotextile fabric shall be pre-soaked by immersion in water for at least 6 hours immediately prior to placing. Two layers of fabric shall be applied to the surface of the concrete and shall cover the entire width and edges of the exposed concrete. Strips shall overlap 100 mm and shall be held down to prevent displacement. The fabric shall be maintained in place and kept saturated for a minimum period of 7 Days. The Contractor may constantly water the mats or cover them with opaque polyethylene film, or a combination of both, in order to keep the mats saturated.

Alternatively, this method shall be used for a minimum period of 3 days following which the surface shall be cured with curing compound according to clause 1350.05.03.02 of TS 1350.

TS 3.50.07.11.03 *Curing with Polyethylene Film*

White, opaque polyethylene film (100 µm thick) shall be placed such that air flow between it and the concrete surface is prevented. The film shall be held down at the edges and laps, and shall be overlapped a minimum of 150 mm, to prevent displacement. The film shall be kept in place for a minimum period of 7 Days.

Alternatively, this method shall be used for a minimum period of 3 days following which the surface shall be cured with curing compound according to clause 1350.05.03.02 of TS 1350.

TS 3.50.07.11.04 *Curing with Membrane Compound*

Immediately prior to application, the curing compound shall be agitated by mechanical means to provide a homogeneous mixture. Curing compound shall be spray applied in two coats to the concrete surface, with the second coat applied at right angle to the first coat, such that the membrane formed is uniform in thickness and colour and is free of breaks and pinholes. The surface shall be maintained in this condition for a minimum period of 7 Days. The rate of application shall not be less than that specified by the manufacturer of the compound.

TS 3.50.07.12 *Concrete Curb and Curb and Gutter Protection*

Concrete curb and concrete curb and gutter protection shall be according to TS 1350.

TS 3.50.07.13 *Backfill*

Granular backfill shall be placed to the required lines and depth as shown on the Contract Drawings. The moisture content and compaction of the granular backfill shall be uniform and shall be according to TS 1010.

TS 3.50.08 *QUALITY ASSURANCE*

Quality assurance shall meet the requirements of TS 1350.

TS 3.50.08.01 *Visibly Defective or Damaged Concrete*

Concrete that is visibly defective or damaged is not acceptable and shall be removed and replaced at no extra cost to the City.

Concrete is visibly defective or damaged when:

- The concrete is honeycombed.
- The concrete contains embedded debris.
- The concrete has been damaged by freezing.
- The concrete temperature at the time of placement exceeded the requirements of this specification.
- The concrete surface has been damaged by rain.
- The concrete contains footprints or other undesirable impressions.
- The concrete has been subjected to traffic before the concrete attained 20 MPa.
- The concrete has cracked or separated.
- The concrete surface has spalled as defined in the *General Conditions of Contract* that the Contract Administrator will be the sole judge to the determination.
- Expansion and isolation joints are not vertical.
- The concrete sections have heaved or sunk, from their original position.

TS 3.50.09 MEASUREMENT FOR PAYMENT

**TS 3.50.09.01 Concrete Curb Integral to Road Base
Concrete Curb Monolithic with Concrete Structure
Concrete Curb and Gutter**

Measurement for the above item(s) shall be by the length in linear metres (m) along the front face of the curb. No deduction will be made for utility frames and covers.

TS 3.50.09.02 Supplemental Cost for 7 Day Concrete

Measurement of 7 day concrete shall be by surface area placed in square metres (m²). Concrete delivery tickets shall not be used for measurement purposes.

TS 3.50.09.03 Supplemental Cost for 24-hour Concrete

Measurement of 24-hour concrete shall be by surface area placed in square metres (m²). Concrete delivery tickets shall not be used for measurement purposes.

TS 3.50.10 BASIS OF PAYMENT

**TS 3.50.10.01 Concrete Curb Integral to Road Base – Item
Concrete Curb Monolithic with Concrete Structure – Item
Concrete Curb and Gutter – Item**

Payment at the Contract Price for the above tender item(s) shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include the supplying, placing and removal of the formwork; supplying, placing and finishing of the concrete; the supplying and placing of steel reinforcement and the supplying, placing and compacting of backfill material.

The granular material immediately beneath the concrete curb or curb and gutter or both, and immediately above the sub drain 300 x 300 mm granular envelope, as well as any granular material placed beyond the limits of the curb or curb and gutter or both for constructability of the road is deemed to be included in the Contract Price for concrete curb or concrete curb and gutter.

TS 3.50.10.02 Supplemental Cost for 7 Day Concrete – Item

The supplemental cost for 7 day concrete shall be the premium cost in addition to the cost for standard 28 day concrete.

TS 3.50.10.03 Supplemental Cost for 24-hour Concrete – Item

The supplemental cost for 24-hour concrete shall be the premium cost in addition to the cost for 7 day concrete.