Construction Specification for Concrete Crosswalk

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TS 3.65.01 SCOPE

This specification covers the requirements for the construction of concrete sidewalk.

TS 3.65.02 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 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

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Materials
OPSS 919	Construction Specification for Formwork and Falsework
OPSS 920	Construction Specification for Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops – Structures

Canadian Standards Association

A 23.1	Concrete Materials and Methods of Concrete Construction

American Society of Testing and Materials

C 174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores

TS 3.65.03 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 pavement.

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

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

TS 3.65.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 3.65.04.01 General

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

The requirements for submissions and design requirements are given in TS 1350.

TS 3.65.04.02 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 selected 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 3.65.05 MATERIALS

TS 3.65.05.01 Concrete

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

1)	Cement type	Normal Portland GU
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

TS 3.65.05.02 Granular Base and Backfill

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

TS 3.65.05.03 Expansion Joint Material

Expansion joint material shall be bituminous fibre board having a minimum thickness of 12 mm and shall be according to TS 1350.

TS 3.65.06 EQUIPMENT

TS 3.65.06.01 Forms

Forms shall be steel, wood or metal plate forms and shall be according to OPSS 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 3.65.06.02 Finishing Tools

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

TS 3.65.07 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 3.65.07.01 Excavation

The excavation shall be to the lines and grades shown on the Contract Drawings. Care shall be taken to prevent damage to utilities, and other appurtenances such as water services and gas valves which may be in or under the proposed crosswalk.

At the direction of the Contract Administrator, 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 and disposed of off the site according to OPSS 180 and at the Contractor's expense.

TS 3.65.07.02 Base

TS 3.65.07.02.01 *General*

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 saturated, soft or frozen.

In areas of underground utilities, polyethylene film (100 μm thick) shall be placed on the base.

TS 3.65.07.02.02 *Subgrade*

The subgrade shall be compacted to a minimum of 95% of maximum dry density according to TS 501.

TS 3.65.07.02.03 *Granular*

Granular base shall be placed to the required thickness, as specified in the Contract Documents, and compacted to 100% of maximum dry density according to TS 501.

TS 3.65.07.03 Form Placement

Forms shall be set true to the lines and grades as specified in the Contract Documents and in direct contact with the base. The cross fall shall match that of the new roadway.

Sufficient formwork shall be provided to prevent its removal from the completed work until the concrete has set at least four hours.

TS 3.65.07.04 Utility Adjustment

All utility adjustments shall be according to TS 4.50, except that no boxouts will be required. The top portion of the frame shall be encased with 12 mm expansion joint material, placed flush with the surface of the concrete and the frame and cover. The fibre shall be vertical and straight in alignment.

TS 3.65.07.05 Placing Concrete

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

The concrete shall be placed to a thickness equal to the depth of the concrete road base and the proposed asphaltic concrete, but shall not be less than 200 mm. The concrete shall be thoroughly consolidated by the use of 50 mm vibrators and other suitable tools to eliminate voids, honeycombing and entrapped air.

TS 3.65.07.06 Finishing Concrete

The concrete surface shall be finished while it is sufficiently plastic to achieve the desired grades, elevations and texture, with no water on the surface. The surface shall be uniform, dense and free from undulations and projections apart from those specified in the drawings.

The top surface shall be screeded to true grade and cross-section and finished with a magnesium or aluminum float. The final finish shall have a light broom texture in the direction of the flow of vehicular traffic.

The application of water, neat cement or sand to the surface shall not be permitted. Localized surface imperfections shall be dug out and repaired with fresh concrete before the concrete has set.

The concrete adjacent to all formwork and joints shall not be finished with a tool that leaves any marks or rounded edges.

The surface of the concrete crosswalk shall not have irregularities exceeding 6 mm when checked with a 3 m straight edge placed in any direction.

TS 3.65.07.07 Identification Stamp

The Contractor shall mark with an approved stamp at each end of the work, at each end of the crosswalk, and all others places directed by the Contract Administrator. The stamp shall be located on the centre of the bay parallel to a transverse joint and approximately 150 mm from the ends of the crosswalk.

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

TS 3.65.07.08 Joints

TS 3.65.07.08.01 *Contraction Joints*

Contraction joints shall be constructed by sawcutting to a depth of 50 mm. The contraction joints shall be evenly spaced at intervals not to exceed 0.8 m and shall be in the direction of the flow of vehicular traffic.

All sawcutting shall be completed within 24 hours of placing the first load of concrete.

TS 3.65.07.08.02 *Expansion Joints*

Expansion joints shall be placed along all outside edges of the crosswalk and along the centreline of the roadway in the direction of the flow of vehicular traffic.

Expansion joints shall be filled with 12 mm wide, bituminous fibre expansion joint material and the top surface of the bituminous fibre shall be flush with the concrete surface. The fibre shall be vertical and straight in alignment.

All edges adjacent to a layer of asphalt pavement shall have the asphalt edge routed and sealed with a bead of hot rubberized asphalt sealer, according to OPSS 920.

Full depth (isolation) joints shall be formed where the concrete abuts rigid structures, changes direction, or as shown on the contract drawings. If the face of the structure is rough or irregular, preventing a tight seal, the joint shall be placed 150 to 300 mm from the structure.

TS 3.65.07.08.03 *Construction Joints*

The crosswalk shall be constructed at least up to the centre expansion joint, as a single pour. In the event of an unavoidable stoppage of concrete placement extending more than 30 minutes, a keyed construction joint shall be placed. Where possible, the construction joint shall coincide with the planned location of a construction joint. If the stoppage occurs at a planned expansion joint, no keyed construction joint is required.

TS 3.65.07.09 Concrete Curing

Concrete curing shall be according to TS 1350.

TS 3.65.07.09.01 *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 TS 1350.

TS 3.65.07.09.02 *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 TS 1350.

TS 3.65.07.09.03 *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 TS 1350.

TS 3.65.07.09.04 *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 3.65.07.10 Concrete Protection

Concrete protection shall be according to TS 1350.

TS 3.65.08 QUALITY ASSURANCE

Quality assurance shall be according to TS 1350.

TS 3.65.08.01 Concrete Thickness

The thickness of the concrete structure shall be determined by field measurement or in accordance with a thickness measurement method specified in Contract.

The Contract Administrator reserves the right to verify the thickness of the concrete structure for structural integrity check and payment purpose using a non-destructive testing method or by coring.

When a measurement of concrete thickness is carried out by coring, the measurement shall be based on either a 100 mm or 150 mm diameter core. The diameter of the core shall be at least three times the size of the maximum coarse aggregate according to CSA A23.1.

No core shall be taken within 250 mm from the joints or edges. The length of each core shall be determined according to ASTM C 174. Core samples that are broken or obviously damaged shall not be used for concrete thickness determination. The damaged cores shall be replaced by acceptable cores taken from the same sublot(s). Core samples taken for concrete thickness determination shall not be used for compressive strength test.

Regardless of the method used, concrete thickness shall be determined on a lot basis. Each lot shall have four sublots of equal size, where each sublot is represented by a thickness measurement. The Contract Administrator will determine the size of the lot(s) and sublots for the purpose of concrete thickness acceptance and payment.

The concrete thickness for a crosswalk in a lot shall be the average concrete thickness of the lot (Tx). The average concrete thickness for a lot shall be calculated from the following formula:

$$Tx = \frac{T1 + T2 + T3 + T4}{4}$$

Where: Tx is the average concrete thickness for a lot, rounded off to the nearest mm.
T1, T2, T3 and T4 are the concrete thickness for sublots 1, 2, 3 and 4.

For the purpose of the calculation, any individual sublot measurement that is more than 5 per cent above the specified thickness shall be assumed to be equal to the specified thickness plus 5 per cent.

A lot will be accepted, on a thickness basis, if the average concrete thickness of the lot equals or exceeds 100 per cent of the specified thickness. Payment for the lot will be determined according to TS 3.65.10.01, herein.

At the sole discretion of the Contract Administrator, a lot may be accepted and allowed to remain in place, if the average concrete thickness of the lot is between 95 and 100 per cent of the specified thickness. The lot accepted based on the above conditions will not be eligible for full payment. Payment for the lot will be determined according to TS 3.65.10.01, herein. Adjustment of the Contract Price for the lot shall be based on Table 1.

If the concrete thickness of an individual sublot is less than 95 per cent of the specified thickness, the Contractor shall remove and replace the sublot at their expense even if the average concrete thickness of a lot is more than 95 per cent of the specified thickness.

All replacement lots shall be accepted on the same basis as the original lot.

TS 3.65.09 MEASUREMENT FOR PAYMENT

TS 3.65.09.01 Concrete Crosswalk

Measurement of concrete crosswalk shall be by surface area placed in square metres (m^2), without any deduction for maintenance holes and appurtenances.

TS 3.65.10 BASIS OF PAYMENT

TS 3.65.10.01 Concrete Crosswalk – Item

Payment at the Contract Price for the above tender item shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include, compacting the subgrade, the supplying, placing and compacting of the granular base, constructing and sawcutting joints and the curing and protection of the concrete, traffic control and steel plates.

All costs associated with poured rubberized asphalt joints shall be deemed to be part of the unit price for concrete crosswalk.

All costs associated with adjusting appurtenances shall be deemed to be part of the unit price for concrete crosswalk.

All costs associated with the excavation and the compaction of the subgrade shall be deemed to be part of the unit price for concrete crosswalk.

All costs associated with the supplying, placing and compacting of the granular base shall be deemed to be part of the unit price for concrete crosswalk.

At the discretion of the Contract Administrator, payment for the item may be adjusted according to TS 3.65.08.01, herein and Table 1.

The cost of thickness testing shall be borne by the City unless the results indicate a thickness deficiency of 5 per cent or more, in which case the Contractor shall bear all costs of testing.

Table 1: Payment adjustment

Thickness Tx	Per cent payment
100 per cent of specified thickness or above	100
100 per cent of specified thickness to 95 per cent of specified thickness	$\frac{(Actual\,Thickness)^2}{(Specified\,Thickness)^2} \times 100$
less than 95 per cent of specified thickness	remove and replace at the Contractor's expense