

Construction Specification for
Concrete Bus Pad

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TS 3.41.01 SCOPE

This specification covers the requirements for the construction of concrete bus pad.

TS 3.41.02 REFERENCES

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

City of Toronto Standard Specifications

TS 2.10	Construction Specification for General Excavation
TS 4.50	Construction Specification for Utility Adjustments
TS 310	Construction Specification for Hot Mixed, Hot Laid, Asphaltic Concrete Paving
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

City of Toronto Standard Drawings

T-216.02-3	Location and Detail of Joints for Rigid Pavements
T-216.02-4	Location and Detail of Joints for Composite Pavements
T-216.02-5	Utility Isolation in Composite Pavements

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Materials
OPSS 350	Construction Specification for Concrete Pavement and Concrete Base
OPSS 919	Construction Specification for Formwork and Falsework
OPSS 1212	Material Specification for Hot Poured Rubberized Asphalt Joint Sealing Compound
OPSS 1441	Material Specification for Load Transfer Assemblies
OPSS 1442	Material Specification for Epoxy Coated Reinforcing Steel Bars for Concrete

Ontario Provincial Standard Drawings

OPSD 501.010	Bus Bays
OPSD 552.050	Load Transfer Device Skewed Contraction Joint

Canadian Standards Association

A 23.1	Concrete Materials and Methods of Concrete Construction
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American Society of Testing and Materials

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

TS 3.41.03 DEFINITIONS

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

Concrete Pavement means a rigid pavement structure with an exposed concrete surface.

Concrete Base means a rigid pavement structure which is overlaid with asphaltic concrete on the same contract.

Geotextile means a permeable geosynthetic comprised solely of textiles.

Specified Thickness means the design thickness specified in the Contract Documents.

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

TS 3.41.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 3.41.04.01 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.

Where concrete bus pad is to be placed from October 1 to April 1, the Contractor must submit a detailed curing and protection plan. The plan shall describe the method by which in-place minimum concrete temperatures shall be maintained. No concrete shall be placed unless the plan is approved by the Contract Administrator.

TS 3.41.04.02 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 3.41.04.03 Dimensions

Concrete bus pads shall be constructed in accordance with T-501.01.

TS 3.41.05 MATERIALS

TS 3.41.05.01 Concrete

The materials for and the production of concrete bus pad 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% for 19 mm
7) Maximum water/cementing materials ratio	0.45

TS 3.41.05.02 Welded Steel Wire Fabric

All welded steel wire fabric detailed on the Contract Drawings or ordered by the City for incorporation in the concrete pavement shall be 152 mm x 152 mm – MW 18.7 x MW 18.7 welded steel wire fabric.

TS 3.41.05.03 Granular Base

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

TS 3.41.05.04 Tie Bars and Load Transfer Devices

Tie bars shall be according to OPSS 1442 and load transfer devices shall be according to OPSS 1441.

TS 3.41.05.05 Expansion Joint Material

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

TS 3.41.05.06 Joint Sealant

Joint sealant shall be hot-poured rubberized asphalt cement and shall be according to OPSS 1212.

TS 3.41.06 EQUIPMENT

TS 3.41.06.01 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 3.41.06.02 Finishing Tools

An aluminum or magnesium straight edge, 3 m wide, equipped with a handle to permit operation from the edge of the pavement and aluminum or magnesium floats, shall be used as necessary to finish the concrete road base.

TS 3.41.07 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 3.41.07.01 Excavation

All excavation shall be according to TS 2.10.

Excavation shall be to the lines and grades shown on the Contract Drawings or as directed by the Contract Administrator. Care shall be taken to prevent damage to appurtenances and utilities which may be in or under the proposed bus pad.

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.

Excavated material shall be disposed of off the site according to OPSS 180 and at the Contractor's expense.

TS 3.41.07.02 Subgrade Preparation

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

The subgrade shall be proof rolled, and any soft or yielding areas shall be subexcavated and replaced with approved material as provided for in the contract, or similar material as the surrounding subgrade, as approved by the City, at the optimum moisture density relationship according to TS 501.

If concrete is to be placed directly on the prepared subgrade, the subgrade shall be moistened prior to the placement of concrete, but there should be no standing water. At the time of placing concrete, the subgrade shall not be wet, soft or frozen.

TS 3.41.07.03 Granular Base Placement

Granular base shall be placed to the required thickness and compaction. 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.

The minimum thickness of the granular base shall be 150 mm. The base of the new granular shall be at or below the base of the existing granular to ensure positive drainage from the base of the existing subbase granular.

TS 3.41.07.04 Box-outs

Box-outs shall be constructed in the concrete around each appurtenance according to the following requirements and as shown on standard drawings T-216.02-3 and T-216.02-5:

- 1) 25 mm x 50 mm chamfered keyways shall be constructed in the concrete at the edges of the box-outs.
- 2) The edges of the box-out shall be located a minimum of 300 mm from the outside edge of the structure requiring adjustment.
- 3) The perimeter of the box-out shall consist of curves of a radius not less than one metre. Angular corners shall not be permitted.
- 4) A gap of 12 mm wide x 50 mm deep, along the inside edge of the box-out joint, shall be left at the surface of the concrete to allow for the application of hot-poured asphalt joint sealer as per this specification.

TS 3.41.07.05 Utility Adjustment

All utility adjustments shall be according to TS 4.50.

TS 3.41.07.06 Reinforcement, Tie Bars and Load Transfer Devices

Tie bars, as required, shall be inserted at mid depth of the slab, where indicated on the Contract Drawings, in such a manner that no voids are created around the tie bar, and no distortion of the bus pad surface occurs.

Dowels and load transfer devices shall be placed in assemblies at transverse joint locations in advance of the concreting operation. Dowel assemblies shall be fixed to the subgrade or subbase in such a manner that they remain stable and undisturbed during concrete placement.

Dowel bars shall be evenly spaced and placed parallel to the pavement centreline, the pavement surface and to each other. Dowels shall not deviate more than 3 mm from the pavement alignment.

Welded steel wire fabric, as required, shall be placed and adequately supported at the mid-slab depth at the locations shown on the Contract Drawings. Placing the welded steel wire fabric during the concrete placement is permitted provided the final location of the fabric is as required. A minimum cover of 100 mm shall be maintained at all outside edges of the concrete base and at the expansion joints.

TS 3.41.07.07 Placing Concrete

Concrete shall be placed and consolidated according to CSA A23.1 and the requirements of this specification. The concrete delivering and spreading operations shall be coordinated as to provide a uniform rate of progress of the paving equipment.

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.

All concrete bus pad work shall be completed on the same day; no open excavations shall be allowed after working hours.

The thickness of the bus pad shall be as specified in the Contract Documents. If the thickness is not provided the minimum thickness of the concrete bus pad shall be 340 mm.

TS 3.41.07.08 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 finishing shall be performed in a manner that does not draw water to the surface. The surface of the bus pad shall have no irregularities exceeding 6 mm when tested with a 3 m straightedge in any direction.

After all finishing operations are completed on concrete pavements and before initial curing and protection of the concrete, the plastic surface of the concrete shall receive an initial and final texturing. Initial texturing shall be finished transversely with a steel wire broom to produce a uniform textured surface.

Final texturing shall be achieved using equipment manufactured to produce transverse grooves 3 mm $\pm$ 1 mm wide with a groove depth of 4 mm $\pm$ 1 mm. These grooves should be uniformly spaced 25 mm apart.

Grooving shall extend to within 75 mm $\pm$ 15 mm of the pavement edge. Grooving for small or irregular areas may be done by hand methods. The surface shall be free in all cases from displaced aggregate particles and local projections.

TS 3.41.07.09 Joints

Contraction, expansion and construction joints shall be formed in the concrete pavement as shown on drawing T-216.02-3. All joints in the concrete, where possible, shall align with the joints in the curb and gutter or adjacent structure. Where joints intersect with roadway appurtenances, they shall deviate in alignment to be directed through the centre of the appurtenance, as shown on drawing T- 216.02-5.

Joints shall not pass closer than one metre from the edge of a concrete box-out.

TS 3.41.07.09.01 Contraction Joints

Contraction joints shall be placed at a minimum 7:1 skew as shown on drawing T-216.02-3. Contraction joints shall also be placed longitudinally (parallel to the centreline) at the centreline and at each edge of the driving lanes. The contraction joints shall be formed such that they are 12 mm wide x 50 mm deep. The maximum distance between contraction joints shall be 5 m between longitudinal joints and 6 m between transverse joints.

Transverse contraction joints in the concrete bus pad shall align with the joints in the adjacent concrete structure such as composite pavement or curb and gutter. Load transfer devices should be installed as per OPSD 552.050.

Where contraction joints intersect with roadway appurtenances, they shall deviate in alignment to be directed through the centre of the appurtenance, as shown on drawing T-216.02-5.

TS 3.41.07.09.02 Expansion Joints

Expansion joints shall be constructed to the full thickness of the concrete pavement as shown on drawing T-216.02-3. The top surface of the bituminous fibre shall be 50 mm from the surface of the concrete pavement. The fibre shall be vertical and straight in alignment. A gap of 12 mm wide x 50 mm deep shall be left at the surface of the concrete pavement to allow for the application of hot-poured asphalt joint sealer.

TS 3.41.07.09.03 Construction Joints

In the event of an unavoidable stoppage of concrete placement extending more than 30 minutes, a keyed construction joint shall be placed as shown on drawing T-216.02-3. Where possible, the construction joint shall coincide with the planned location of a contraction joint. A gap of 12 mm wide x 50 mm deep shall be left at the surface of the concrete pavement to allow for the application of hot-poured asphalt joint sealer.

Where a keyed construction joint is not possible, tie bars shall be used. Tie bars shall be inserted so that voids are not created around the bar. Tie bars shall not be placed within 600 mm of a transverse joint.

TS 3.41.07.09.04 Asphalt to Concrete Joints

Where a concrete road base

is installed adjacent to asphalt without a concrete base, a gap of 12 mm wide x 50 mm deep, shall be left at the surface of the concrete base transition to allow for the application of hot-poured asphalt joint sealer as per this specification. Hot-poured asphalt joint sealer shall be placed in the joint between the concrete pavement and the asphalt.

TS 3.41.07.09.05 Joint Sealant

All joints shall be sealed with hot-poured rubberized asphalt cement.

The sealant compound shall be melted slowly with constant agitation until it is in a lump-free, free-flowing state, within the temperature range recommended by the manufacturer for application. Heating above the manufacturer's recommended range for application is not permitted.

Immediately prior to pouring the sealant compound, the joint shall be cleaned and dried using a hot compressed air lance.

The sealant compound shall be placed within two minutes of the hot lance treatment by a manual pouring cone, or hose and wand, fitted with a proper size tip, from a low pressure pump connected to the heating kettle.

The tip of the cone or wand shall be placed to the bottom of the joint to ensure uniform application. The joint shall be filled such that the top of the sealant is 2 to 4 mm below the surface of the concrete bus pad. If after the initial placement, the material subsides below the required level, then additional material shall be applied.

Sealant compound damaged by traffic or the Contractor's operation shall be replaced at no extra cost to the City.

TS 3.41.07.10 Concrete Curing

Concrete curing media shall be according to TS 1350.

TS 3.41.07.10.01 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 3.41.07.10.02 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 3.41.07.10.03 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 3.41.07.10.04 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 3.41.08 QUALITY ASSURANCE

Quality assurance shall be according to TS 1350.

TS 3.41.08.01 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.

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- 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.
 - The final concrete texture does not meet the specifications noted in subsection TS 3.40.07.08.

TS 3.41.08.02 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 Documents.

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 subplot(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 subplot 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 bus pad in a lot shall be the average concrete thickness of the lot (T_x). The average concrete thickness for a lot shall be calculated from the following formula:

$$T_x = \frac{T_1 + T_2 + T_3 + T_4}{4}$$

Where: T_x is the average concrete thickness for a lot, rounded off to the nearest mm.
 T_1 , T_2 , T_3 and T_4 are the concrete thickness for sublots 1, 2, 3 and 4.

For the purpose of the calculation, any individual subplot 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 3.40.10.01.

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 3.40.10.01. Adjustment of the Contract Price for the lot shall be based on Table 1.

If the concrete thickness of an individual subplot is less than 95 per cent of the specified thickness, the Contractor shall remove and replace the subplot 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 3.41.09 MEASUREMENT FOR PAYMENT

TS 3.41.09.01 Concrete Bus Pad

Measurement of concrete bus pad shall be by surface area placed in square metres (m²).

TS 3.41.10 BASIS OF PAYMENT

TS 3.41.10.01 Concrete Bus Pad – 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 including the supplying and placing of joint sealant.