



**Engineering & Construction
Services Division**

**Standard Specifications
for
Road Works**

Amendment to OPSS.MUNI 1350 (Nov 2014) – Material Specification for Concrete – Materials and Production

This specification shall be read in conjunction with OPSS.MUNI 1350 (Nov 2014). OPSS.MUNI 1350 (Nov 2014) shall form a normative part of this specification as a completed document. All requirements of OPSS.MUNI 1350 (Nov 2014) Appendix 1350-A shall apply in this specification.

TS 1350.01 SCOPE

Section 1350.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

This specification also covers the requirements for acceptance of concrete material for the construction of road base, curb and gutter, sidewalk, crosswalk, streetcar track and other concrete items.

TS 1350.02 REFERENCES

Section 1350.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

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

City of Toronto Standard Specifications

TS 3.40	Construction Specification for Concrete Road Base
TS 3.45	Construction Specification for the Repair of Concrete Pavement and Base
TS 3.50	Construction Specification for Concrete Curb and Concrete Curb and Gutter
TS 3.65	Construction Specification for Concrete Crosswalk
TS 3.70	Construction Specification for Concrete Sidewalk and Concrete Raised Median
TS 3.75	Construction Specification for Streetcar Track Pavement and Foundation Slab

Ontario Provincial Standard Specifications

OPSS.MUNI 904	Construction Specification for Structural Concrete
OPSS 1306	Material Specification for Burlap
OPSS 1315	Material Specification for White Pigmented Curing Compounds
OPSS.MUNI 1440	Material Specification for Steel Reinforcement for Concrete
OPSS 1860	Material Specification for Geotextiles

Canadian Standards Association

A3000	Cementitious Materials Compendium
A23.1	Concrete Materials and Methods of Concrete Construction
A23.2	Test Methods and Standard Practices for Concrete
A23.2-1C	Sampling Plastic Concrete
A23.2-4C	Air Content of Plastic Concrete by the Pressure Method

A23.2-5C	Slump of Concrete
A23.2-17C	Temperature of Freshly Mixed Hydraulic Cement Concrete

American Society of Testing and Materials

C 109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
C 171	Standard Specification for Sheet Materials for Curing Concrete
C 174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C457	Standard Test Method for Microscopical Determination of Parameters of the Air Void System in Hardened Concrete
C 666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction

Transportation Research Report

NCHRP	Concrete Sealers for Protection of Bridge Structures
Report 244	

TS 1350.03 DEFINITIONS

Section 1350.03 of OPSS.MUNI 1350 is amended by the addition of the following sentences:

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

Admixtures means a material other water, aggregate, cementing material, and fibre reinforcement used as an ingredient in concrete, mortar, or neat cement grout and added to the batch immediately before or during its mixing in order to purposely modify its usual characteristics and behavior.

Alkali-Aggregate Reactivity means a chemical reaction between the cementing material and certain minerals in the aggregates which cause expansive cracking in the hardened concrete.

Cold Weather means those conditions when the air temperature is at or below 5°C. It is also considered to exist when the air temperature is at or is likely to fall below 5°C within 96 hours after concrete placement. Temperature refers to shade temperature.

Crushed Material means aggregate particles having at least one well-defined face resulting from fracture. Particles with smooth faces and rounded edges or with only small chips removed are not considered crushed.

Epoxy means a multi-component resin grout.

Falsework means a temporary structure erected to support work in the process of construction, composed of shoring or vertical posting, formwork for beams and slabs, and lateral bracing.

Form A means a complete City of Toronto concrete mix design submission form for performance specification alternative. OPSS.MUNI 1350 (Nov 2014) OPSF 1350-1 is replaced by Form A.

Form B means a complete City of Toronto concrete mix design submission form to be submitted by the concrete supplier after executing a confidentiality agreement. OPSS.MUNI 1350 (Nov 2014) OPSF 1350-2 is replaced by Form B.

Formwork means a total system of support for freshly placed concrete including moulds or sheathing as well as all supporting membranes, hardware and bracing.

Grout means a mixture of cementing materials, with or without admixtures, and water. The consistency varies from stiff to fluid.

Mortar means a mixture of cementing materials, sand and water, with a butter-like consistency.

Non-Structural Concrete means concrete used for the construction of catch basins, maintenance holes, valve chambers, pipe support, road base, curb and gutter, crosswalk, sidewalk, streetcar track and all other concrete that does not classify as structural concrete.

Slurry means a pourable mixture of cementing materials, sand and water.

Superplastized (Flowing) Concrete means normal slump concrete to which a high-range water reducing admixture has been added to produce a high-slump flowing concrete.

Structural Concrete means any concrete used in the construction of bridges, culverts, tunnels, retaining walls, wharfs or guideways.

TS 1350.04 DESIGN AND SUBMISSION REQUIREMENTS

Subsection 1350.04.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

TS 1350.04.01 Design Requirements

Concrete mix design shall be one of the following alternatives chosen by the City:

- performance specification alternative; or
- prescriptive specification alternative.

The Contractor shall submit a mix design for each type of concrete specified in the Contract Documents. A complete mix design should consist of the following:

- 1) Either a completed City concrete mix design submission Form A; or
- 2) A completed City concrete mix design submission Form B; and
- 3) Supporting documentation including all material quality test data for the mix design and component materials required by the contract.

Concrete mix design submission Forms A or B shall identify all materials to be used in the concrete. No material shall be used in the concrete without the knowledge of the Contract Administrator.

Under the performance specification alternative, the Contractor shall provide a complete mix design submission on Form A to the Contract Administrator for each specific concrete mix.

At the sole discretion of the City, the City and the concrete supplier may enter to execute a confidentiality agreement to cover the protection of proprietary mix proportion information which is to be released as part of the mix design submission process on Form B.

TS 1350.04.02 Submission Requirements

Subsection 1350.04.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

A complete mix design submission shall be provided for concrete of each specified compressive strength according to CSA A23.1. A separate mix design submission is also required within each strength level for:

- Mixes where material proportions vary outside the tolerance identified below in this clause.
- Cast-in-place and slip-formed concrete.
- Mixes with different sources of materials.
- Mixes with different admixtures.
- Special purpose or unique mixes.

Submission of separate mix designs and separate supporting documentation is not required if concrete with the same mix design is to be supplied by multiple plants with the same sources of materials in the same proportions, however it must be supported in writing prior to use.

A new, complete mix design submission shall be provided prior to:

- Changing sources of materials used in the concrete.
- Substituting a material or product for another from the same source.
- Adding a material to the concrete that was not on the original mix design (except retarder).
- Adjusting the quantities of the stated materials in the concrete, outside of the following tolerances stated on Form B:
 - a) Cement: $\pm 5\%$ of quantity
 - b) Supplementary cementing materials: 95% to 100% of quantity
 - c) Admixtures: Dosage or range of dosage
 - d) Water: Range

Material quantities may be varied within the tolerances identified above, without submission of a new mix design.

Removal of a material from the mix requires submission of a new mix design, but does not require submission of supporting test data.

The submission process for new or modified mix designs is the same as for the original mix design.

TS 1350.04.02.01.01 *Performance Based Concrete Mix Data*

Clause 1350.04.02.01.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

Form A

Form A shall be completed by the concrete supplier based on the requirements of the Contract. The Contractor shall confirm with the concrete supplier and the Contract Administrator the performance characteristics of the concrete through the submission of Form A for each type of concrete as specified in the Contract Documents. The form shall be signed by the Contractor to certify that performance characteristics of the concrete have met their respective requirements under the contract.

The performance based mix design as detailed in Form A will be checked by the Contract Administrator to verify that the materials and sources are in compliance with the Contract Documents. Concrete placement cannot proceed until the Contract Administrator has verified that the form meets the project requirements. The form shall then form the basis of the detailed mix design.

The Contractor shall provide the following on submission of Form A:

- 1) Concrete exposure requirements shall be according to CSA A23.1, Table 2.
- 2) Primary concrete plant(s) supplying concrete.
- 3) Specified strength of concrete, for example 24-hour, 7-day, 28-day, or other specified ages.
- 4) Identification of all materials to be used in the concrete.
- 5) Concrete supplier and sources of all materials to be used.
- 6) Intended use and location of the concrete on the contract.
- 7) Target air content of the mix and slump range for quality control purposes.
- 8) Nominal maximum size of coarse aggregate and fine aggregate, and inventory numbers for the aggregates.
- 9) Declarations from the concrete supplier that the concrete they supply will meet all concrete requirements as specified in the Contract Documents.
- 10) The percentage of all supplementary cementing materials meet the contract requirements.
- 11) The dosage ranges of all chemical admixtures meet the requirements shown in subsection TS 1350.05.01, herein.

Form A shall be accompanied by all material quality test data of all materials used in the mix design, if requested.

Form B

Upon the execution of a confidentiality agreement between the City and the concrete supplier to cover the protection of proprietary mix proportion information which is to be released as part of the mix design submission process, the concrete supplier shall forward a completed Form B to the City.

The detailed mix design in Form B shall, in addition to material source information, contain the material quantities for cement, supplementary cementing materials, water and admixtures ranges, consistent with the specified Designated Sources for Materials List, and the requirements shown in TS 1350.05.01, herein.

The concrete supplier shall provide the following to the City on submission of Form B:

- 1) The information provided on Form A.
- 2) Quantity of cement and supplementary cementing materials to be used in the mix.
- 3) Dosage range of chemical admixtures to be used in the mix shall be according to subsection TS 1350.05.01, herein.
- 4) Quantity range of water to be used in the mix (total water).

Form B shall be signed by the concrete supplier to certify that performance characteristics of the concrete meet their respective requirements under the contract.

Form B shall be checked by the City to verify that the materials and sources are in compliance with the contract requirements. Concrete placement cannot proceed until the Contract Administrator has verified that the form meets the contract requirements.

TS 1350.05 MATERIALS

Section 1350.05 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

Concrete materials submission shall provide the following information:

- 1) The source of each material to be incorporated in the concrete and the name of the concrete supplier.
- 2) Certification that all materials to be incorporated into the concrete mix are compatible in the mix and meet or exceed the requirements given in subsection TS 1350.05.01, herein.
- 3) The proportions of materials for each class of concrete to be incorporated into the work as per the confidentiality agreement in a confidential manner by the City.
- 4) The results of slump, total air content and compressive strength testing at 7-day, 28-day, and other ages if required in the contract, for each class of concrete supplied.
- 5) If blended hydraulic cements or supplementary cementing materials are proposed, the Contract Administrator may request for documentation demonstrating satisfactory performance of similar concrete mixes incorporating the proposed cementing materials and proportions used in similar

applications such as bridge deck, sidewalk, and so on, and the current condition. The satisfactory performance may be shown through the documented visual assessment of at least five projects, each at least three years old, for each mix incorporating blended hydraulic cement or supplementary cementing materials.

- 6) If supplementary cementing materials are to be incorporated into the concrete mix, the Contract Administrator may request certification and documentation, stating that the quality and durability of the concrete with supplementary cementing materials will equal or exceed the quality and durability of the concrete without supplementary cementing materials. Specific documentation relating to de-icer chemical scaling resistance and rate of strength gain, if required, shall also be submitted.
- 7) At the request of the Contract Administrator, the results of testing of the quality of the air voids system of the hardened concrete mix(es) shall be incorporated into the Work, as determined by ASTM C 457, documenting conformance to CSA A23.1, clause 4.3.3.

TS 1350.05.01 Materials for Concrete

Subsection 1350.05.01 of OPSS.MUNI 1350 is amended by the addition of the following Table A:

Table A: Materials for concrete

Specification	TS 3.40 TS 3.45	TS 3.50 TS 3.70	TS 3.75
concrete for	road base	curb and gutter sidewalk and median	streetcar track
cement type	Portland and Portland limestone cement GU/GUL	Portland and Portland limestone cement GU/GUL	Portland and Portland limestone cement GU/GUL
min 28-day compressive strength	32 MPa	32 MPa	32 MPa
class of exposure	C-2	C-2	C-2
max size of aggregate	37.5 ^a or 19 mm	19 mm	19 mm
slump at plant	- - -	- - -	max 50 mm
slump at discharge no plasticizer	80 ± 30 mm	80 ± 30 mm	max 20 mm
slump at discharge with plasticizer	- - -	- - -	150 ± 30 mm
air content for max size of aggregate	5.5 ± 1.5% (37.5 mm) 6.5 ± 1.5% (19 mm)	6.5 ± 1.5%	6.5 ± 1.5%
water/cementing materials ratio	max 0.45	max 0.45	max 0.45
lot size	per day or as directed by the City	per day or as directed by the City	per day or as directed by the City

Note ^a: The 37.5 mm nominal aggregate may only be used for concrete slabs 250 mm thick or greater.

TS 1350.05.01.01 Cementing Materials

Clause 1350.05.01.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

All cement shall be general use Portland cement (GU) and Portland-limestone cement (GUL) according to CSA A3000 or high-early-strength Portland cement (HE) and Portland-limestone cement (HEL) meeting the requirements of CSA A3000.

High-early-strength Portland cement (HE) and Portland-limestone cement (HEL) may be used only with the prior approval of the Contract Administrator.

Portland cement (GU) and Portland-limestone cement (GUL) may not be used as a means of obtaining high early strength in the concrete unless prior approval has been obtained from the Contract Administrator.

Blended hydraulic cements shall be according to CSA A3000. Blended hydraulic cements may be used only with the prior approval of the Contract Administrator.

Supplementary cementing materials such as fly ash, silica fume and/or slag cement may be used by meeting the requirements of this specification.

Except when the cementing materials are supplied blended, the supplementary cementing material shall be weighed separately from the cement. In the concrete materials weighing process the cement shall be weighed prior to the supplementary cementing material. Supplementary cementing materials may be weighed on the same scale with the cement.

TS 1350.05.01.02 *Aggregates*

Clause 1350.05.01.02 of OPSS.MUNI 1350 is amended by the deletion of the following:

The maximum nominal size of the aggregate shall not exceed 19.0 mm.

TS 1350.05.02.04 *Air Content*

Clause 1350.05.02.04 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

Air content on the job site shall be controlled according to CSA A23.1, clause 5.2.5.3.4.

TS 1350.05.02.05 *Slump or Slump Flow*

Clause 1350.05.02.05 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

Under the performance specification alternative, addition of water on the job site according to CSA A23.1, clause 5.2.5.3.2 is at the discretion of the Contractor.

Under the prescriptive specification alternative, addition of water on the job site according to CSA A23.1, clause 5.2.5.3.2 is at the discretion of the City.

Section 1350.05 of OPSS.MUNI 1350 is amended by the addition of the following subsection:

TS 1350.05.03 *Other Materials*

TS 1350.05.03.01 *Steel Reinforcement for Concrete*

Steel reinforcement for concrete shall be according to OPSS 1440.

Submissions required by the Contract Administrator from the Contractor shall provide at least the following information:

- 1) The source of all reinforcing steel products and name of the reinforcing steel fabricator.

-
- 2) Three copies of the mill certificate and three copies of the stress-strain curves representative of each lot of material to be used for reinforcing steel.

TS 1350.05.03.02 *Curing Media*

Submissions required by the Contract Administrator from the Contractor shall provide at least the following information:

- 1) Curing plan requirements.
- 2) Allowable curing regimes according to CSA A23.1, Table 19.
- 3) Three copies of the manufacturer's product installation and certification data.

All exposed concrete surfaces shall have the curing process commence as soon as possible and not more than 30 minutes after surface finishing or within one hour of form removal. Acceptable methods of curing include one or more of the following:

- Burlap cloth shall be made from jute or kenaf, and shall be according to OPSS 1306.
- Geotextile fabric shall be a synthetic, permeable textile shall be according to OPSS 1860. A minimum thickness of 0.9 mm is required geotextile fabric and water.
- White opaque polyethylene film shall be according to ASTM C 171. A minimum thickness of 6 mils is required.
- White pigmented curing compound shall be according to ASTM C 309 and OPSS 1315.

Each curing method may be used at ambient temperatures up to 28°C. At temperatures above 28°C, only the geotextile fabric and water procedure is recommended. At temperature below 5°C, curing compound is not recommended.

Concrete shall not be placed if rain is sufficiently intense to separate cement (paste) from the surface of the concrete mix or to hinder finishing operations. The surface of the concrete shall not be finished when water is present on the surface. Concrete already placed shall be protected against the effects of rain until the concrete has sufficiently hardened to resist damage.

The section of newly constructed concrete shall be closed to all vehicular traffic, including construction equipment, until such time as the concrete has attained at 20 MPa. Pedestrian traffic shall be kept off the newly constructed concrete for at least eight hours. The Contractor shall provide adequate measures to protect the newly constructed concrete section from damage by vehicular or pedestrian traffic.

TS 1350.05.03.03 *Joint Filler*

Expansion joint filler material shall be according to ASTM D 1751.

Submissions required from the Contractor shall provide at least the following information:

-
- 1) The source of the expansion filler material.
 - 2) Three copies of the manufacturer's product installation and certification data.

TS 1350.05.03.04 *Concrete Sealer*

The sealer shall be a two-coat colourless solution of methyl methacrylate copolymer resins, a penetrating agent and fast evaporating solvent with a minimum solids content of 20 per cent and containing no fillers. Application rates and solids content shall be according to certified test results on the NCHRP 244 test series to be submitted prior to construction for approval. Acceptable materials shall meet the following NCHRP 244 performance criteria:

- 1) Four Inch Cube Tests: 75 per cent effective in reducing water absorption when compared to an untreated control sample.
- 2) Southern Exposure Tests: 90 per cent effective in reducing chloride ion content when compared to an untreated control sample.

Submissions required from the Contractor shall provide at least the following information:

- 1) The source of the expansion concrete sealer.
- 2) Three copies of the manufacturer's product installation and certification data.
- 3) Certification that the sealer meets or exceeds the requirements of NCHRP 244.

TS 1350.07 PRODUCTION

TS 1350.07.02 Temperature Control

Subsection 1350.07.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

When the air temperature is below 5°C or likely to fall below this limit within 24 hours of placing, or when the air temperature is at or above 27°C or is likely to rise above this limit during concrete placing, the Contractor shall comply with the requirements of OPSS 904.

TS 1350.08 QUALITY ASSURANCE

TS 1350.08.02.01 *General*

Clause 1350.08.02.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

Concrete compressive strength and proper curing, as specified in this specification, shall be the criteria for acceptance of non-structural concrete.

As requested by the City, the Contractor shall submit to the owner prior to the start of the project verification that the foreman, lead hand or the supervisor of the concrete placing crew has ACI Flatwork Certification or equivalent.

TS 1350.08.02.01.02 *Quality Assurance Test Reporting*

Sub-clause 1350.08.02.01.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

The concrete mix shall be sampled according to CSA A23.2-1C; the slump of the concrete shall be tested in accordance with CSA A23.2-5C; the air content of the concrete shall be tested according to CSA A23.2-4C; and the temperature of the concrete shall be tested in accordance with CSA A23.2-17C.

Concrete test reports shall be distributed immediately to the Owner, Contractor and concrete supplier by electronic files when available.

TS 1350.08.02.04.01 *Compressive Strength*

Sub-clause 1350.08.02.04.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

The compressive strength requirements for standard-cured cylinders shall be according to CSA A23.1 clause 4.4.6.6.1.2. The strength determination of test result shall be according to CSA A23.1 clause 4.4.6.4.1.

Section 1350.08 of OPSS.MUNI 1350 is amended by the addition of the following subsections:

TS 1350.08.03 *Field Sampling and Testing of Concrete*

Concrete field sampling for cylinders and testing of air, slump and temperature of plastic concrete shall be obtained directly from the load of concrete and tested according to CSA A23.2.

TS 1350.08.03.01 *Frequency of Field Sampling and Testing*

The concrete supplied shall be sampled for acceptance tests according to Table B and Table C.

Table B: Frequency of field sampling and testing of concrete

Concrete for	Quantity m ³	28-day cylinder	Field testing
abutments, catch basins, maintenance holes, columns, culverts, slabs, footings, foundations, piers, walls, curb and gutter, sidewalk, and forms	< 100 100 - 500 > 500	3 sets /day 2 sets/100 m ³ 1set/100 m ³	Air, slump and temperature tests shall be carried out when cylinders are cast, or as directed by the City.
decks	< 100 100 - 500 > 500	3 sets /day 2 sets/100 m ³ 1set/100 m ³	
decks overlay	- - -	3 sets /day	
volume overlay	- - -	1 set /load	

The following lot sizes for small quantity work relating to catch basins, maintenance holes, slabs, foundations, curb and gutter, sidewalk and fixed forms:

Table C: Small quantity lots frequency of field sampling and testing of concrete

If quantity is . . .	Then sets per day required is . . .
less than 65 (m ³)	2
less than 30 (m ³)	1

OPSS.MUNI 1350 is amended by the addition of the following section:

TS 1350.10 ACCEPTANCE

TS 1350.10.01 Compressive Strength Acceptance

Concrete used in this Contract shall be according to TS 1350, except that the acceptance requirements shall apply to all types of concrete and not just for 28-day strengths. For example, if 7-day concrete is requested, the acceptance of the appropriate item or Extra Work shall be based on amending TS 1350 and all other relative specifications to replace all instances of 28-day with 7-day.

Acceptance of concrete strength for a lot shall be based on the compressive strength test results of a lot defined in subsection TS 1350.05.01 or as specified in the Contract Documents.

The Contract Administrator may determine the lot size after discussion with the Contractor before any concrete is placed, or according to the lot size as shown in subsection TS 1350.05.01, herein.

A concrete lot is deemed unacceptable if the concrete compressive strength does not meet all of the following:

-
- 1) The average of all groups of three consecutive compressive strength tests shall be equal to or greater than the specified strength.
 - 2) No individual strength test shall be more than 3.5 MPa below the specified strength.

The Contractor is required to remove and replace all unacceptable lots at no extra cost to the City. All replacement lots shall be accepted on the same basis as the original lot.

TS 1350.10.02 Small Lot Acceptance

A single cylinder test may be used to represent a sub lot under the following conditions:

- the second cylinder was damaged or determined to be unrepresentative;
- the second cylinder was broken early or later; either in error or at the discretion of the Contract Administrator; or
- the cylinder is used to determine compliance with TS 1350.11.10.

TS 1350.10.02.01 Track Allowance

For the purposed of acceptance, the concrete within the TTC track allowance shall be divided into lots of up to 100 linear metres or daily production, whichever is less.

TS 1350.10.03 High Early Strength

Concrete used in this Contract shall be according to TS 1350, except that the acceptance requirements shall apply to all types of concrete and not just for 28-day strengths. For example, if 7-day concrete is requested, the acceptance of the appropriate item or Extra Work shall be based on amending TS 1350 and all other relative specifications to replace all instances of 28-day with 7-day or 24 hour, respectively.

The number of cylinders cast for each set shall be revised as follows:

- 1) 7 day strength – minimum 4 cylinders cast
 - 1 break at 3 days
 - 2 breaks at 7 days
 - 2 breaks at 28 days
- 2) 24 hour strength – minimum 5 cylinders cast
 - 1 break at 10 hours
 - 1 break at 13 hours
 - 2 breaks at 24 hours
 - 2 breaks at 7 days

The timing for the second 24 hour break may be altered by the Contract Administrator depending on the results of the 10 hour or previous break(s). The Contract Administrator may request additional cylinders for critical work. The spare cylinders can be cast away if the previous results are favourable.

The concrete strength shall meet the requirements of TS 1350.10.01, herein, at the required strength interval, that is to say 7 day or 24 hour.

OPSS.MUNI 1350 is amended by the addition of the following section:

TS 1350.11 PAYMENT AND WARRANTY

TS 1350.11.01 Small Lot Price Adjustment

Price adjustments for 28-day concrete will be based on following:

Table D: Price adjustment for compressive strength 28-day concrete

Average tested compressive strength	Per cent payment of concrete
up to 3.5 MPa below specified compressive strength	$\frac{(Actual\ Strength)^{2.5}}{(Specified\ Strength)^{2.5}} \times 100$
greater than 3.5 MPa below specified compressive strength	remove and replace at no extra cost to the City

Price adjustments for high early strength concrete will be non-payment for any and all premium costs or based on the following, whichever is greater:

Table E: Price adjustment for high early strength concrete

Average tested high early compressive strength	Per cent payment of concrete
up to 3.5 MPa below specified high early strength	$\frac{(Actual\ Strength)^{2.5}}{(Specified\ Strength)^{2.5}} \times 100$
between 3.5 MPa and 7.0 MPa below specified high early strength	$\frac{(Actual\ Strength)^3}{(Specified\ Strength)^3} \times 100$
greater than 7.0 MPa below specified high early strength	remove and replace at no extra cost to the City

Concrete that is to be removed and replaced at no extra cost to the City may be deemed usable if all of the following conditions are met:

- High early strength concrete meets the specified compressive strength within the next time constraint, for example 24 hour within 7 days, and 7 day within 28 days;

-
- The contract schedule did not incur any delays;
 - The major interim schedules did not incur any delays, such as delays in opening the intersection to full operation;
 - The public did not incur any delays, for instance delayed access to private property; and
 - The concrete passes all other requirements.

In lieu of removing and replacing concrete that does not meet the compressive strength requirements, the Contract Administrator has the option to allow the usable concrete to be left in place. However, payment for the appropriate item or extra work related to the usable concrete shall be at 40 per cent of the bid cost for the entire contract item or no payment will be made for the concrete portion of the extra work performed, including all labour and Equipment that was used in the supply or placement of the concrete or both.

Attachments

The following two concrete mix design submissions form part of this specification:

- 1) Concrete Mix Design Submission Form A for Performance Specification Alternative
- 2) Concrete Mix Design Submission Form B for Prescriptive Specification Alternative



CONCRETE MIX DESIGN SUBMISSION (FORM A)

Project: _____ Date: _____
Contract No.: _____ Contractor: _____
Location: _____ Concrete Supplier: _____
Primary Plant Back-up Plant
Name & Address : _____ Name & Address: _____

SPECIFICATIONS	Mix Code			
	Application / Element / Location			
	Structural Requirements			
	- CSA Exposure Class			
	- Maximum W/CM Ratio			
	- Minimum Specified Strength, Mpa @ Days			
	- Nominal Maximum Aggregate Size, mm			
	- HVSCM Type 1 or 2			
	- Maximum Slag Replacement, %			
	- Maximum Fly Ash Replacement, %			
	- Plastic Air Content, %			
	- Slump Range, mm			
Durability Requirements				
- Exposure to Sulphate Attack				
- Alkali Aggregate Reactivity				
Architectural Requirements				
- Colour / Texture				
- Other				
CONTRACTOR REQUIREMENTS	Rate (m ³ /h)			
	Quantity (m ³)			
	Slump Range (mm)			
	Strength @ Age (MPa)			
	Other			
	Specialty Information			
	- Concrete Set (Delay, Normal, Accelerated)			
Method of Placement				
MATERIALS SECTION	Material	Quantity	Type / Name & Source	Inventory No.
	Cement (kg/m ³)	-----		-----
	SCM - Slag (kg/m ³)	-----		-----
	SCM - Fly Ash (kg/m ³)	-----		-----
	Water (l/m ³)	-----		-----
	Fine Aggregate	-----		
	Coarse Aggregate	-----		
	A.E.A. (mL/100 kg)	-----		-----
	W.R. (mL/100 kg)	-----		-----
	S.P. (mL/100 kg)	-----		-----

Contractor's Representative submitting Form A:

Print Name: _____ Signature: _____ Date: _____

Concrete Supplier's declaration to meet the above contract requirements:

Print Name: _____ Signature: _____ Date: _____

Form A Reviewed by Contract Administrator:

Print Name: _____ Signature: _____ Date: _____

Notes:

- 1) The "Concrete Supplier" provides to the contractor, a valid "Certificate of Concrete Production Facilities" as issued by the RMCAO (copy available upon request).
Check www.rmcao.org for an updated list of certified concrete plants
- 2) The "Concrete Supplier" certifies that all materials incorporated in the mix designs meet current CSA A23.1 requirements.
- 3) Concrete tests not done according to CSA Standards shall not be accepted for any basis of measurement.
- 4) The Owner shall be responsible for performance "off the chute" if the owner specifies any material proportion(s).



CONFIDENTIAL
CONCRETE MIX DESIGN SUBMISSION (FORM B)

Project: _____ Date: _____

Contract No.: _____ Contractor: _____

Location: _____ Concrete Supplier: _____

Primary Plant Name & Address: _____ Back-up Plant Name & Address: _____

	Mix Code			
	Application / Element / Location			
SPECIFICATIONS	Structural Requirements			
	- CSA Exposure Class			
	- Maximum W/C Ratio			
	- Minimum Specified Strength, Mpa @ Days			
	- Nominal Maximum Aggregate Size, mm			
	- HVSCM Type 1 or 2			
	- Maximum Slag Replacement, %			
	- Maximum Fly Ash Replacement, %			
	- Plastic Air Content, %			
	- Slump Range, mm			
	Durability Requirements			
	- Exposure to Sulphate Attack			
	- Alkali Aggregate Reactivity			
	Architectural Requirements			
	- Colour / Texture			
- Other				
CONTRACTOR REQUIREMENTS	Rate, m³/h			
	Quantity, m³			
	Slump Range, mm			
	Strength @ Age, MPa @ Days			
	Other			
	Specialty Information			
	- Concrete Set (Delay, Normal, Accelerated)			
	Method of Placement			
MATERIALS SECTION <small>(Material quantity information is confidential and is for internal use only)</small>	Material	Quantity	Type / Name & Source	Inventory No.
	Cement (kg/m ³)			-----
	SCM - Slag (kg/m ³)			-----
	SCM - Fly Ash (kg/m ³)			-----
	Water (l/m ³)			-----
	Fine Aggregate			
	Coarse Aggregate			
	A.E.A. (mL/100 kg)			-----
	W.R. (mL/100 kg)			-----
	S.P. (mL/100 kg)			-----

Form B submitted by: _____

Print Name: _____ Signature: _____ Date: _____

Form Reviewed by Contract Administrator:

Print Name: _____ Signature: _____ Date: _____

Notes:

- 1) The "Concrete Supplier" provides to the contractor, a valid "Certificate of Concrete Production Facilities" as issued by the RMCAO (copy available upon request). Check www.rmcao.org for an updated list of certified concrete plants.
- 2) The "Concrete Supplier" certifies that all materials incorporated in the mix designs meet current CSA A23.1 requirements.
- 3) Concrete tests not done according to CSA Standards shall not be accepted for any basis of measurement.
- 4) The Owner shall be responsible for performance "off the chute" if the owner specifies any material proportion(s).



MATERIAL SPECIFICATION FOR CONCRETE - MATERIALS AND PRODUCTION

TABLE OF CONTENTS

1350.01	SCOPE
1350.02	REFERENCES
1350.03	DEFINITIONS
1350.04	DESIGN AND SUBMISSION REQUIREMENTS
1350.05	MATERIALS
1350.06	EQUIPMENT
1350.07	PRODUCTION
1350.08	QUALITY ASSURANCE
1350.09	OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1350-A	Commentary
---------------	-------------------

1350.01 SCOPE

This specification covers the requirements for Materials; product supply pre-qualification; and mixing, transporting, and delivering concrete.

1350.01.01 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.

1350.01.02

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.

1350.02

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 904 Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General
OPSS 1002 Aggregates - Concrete
OPSS 1302 Water

CSA Standards

A23.1-09 Concrete Materials and Methods of Concrete Construction *
A23.2-3C Making and Curing Concrete Compression and Flexural Test Specimens *
A23.2-4C Air Content of Plastic Concrete by the Pressure Method *
A23.2-5C Slump and Slump Flow of Concrete *
A23.2-6C Density, Yield, and Cementing Materials Factor of Plastic Concrete *
A23.2-8C Flexural Strength of Concrete (Using a Simple Beam with Third-Point Loading) *
A23.2-9C Compressive Strength of Cylindrical Concrete Specimens *
A23.2-10C Accelerating the Curing of Concrete Cylinders and Determining Their Compressive Strength *
A23.2-13C Splitting Tensile Strength of Cylindrical Concrete Specimens *
A283-00 (R2004) Qualification Code for Concrete Testing Laboratories
A3000-08 Cementitious Materials Compendium

* [Part of A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]

ASTM International

C 157/C 157M-04	Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete
C 260-01	Standard Specification for Air-Entraining Admixtures for Concrete
C 457-06	Standard Test Method for Microscopical Determination of Air Void Content and Parameters of the Air Void System in Hardened Concrete
C 494/C 494M-05a	Standard Specification for Chemical Admixtures for Concrete
C 1017/C 1017M-03	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C 1202-05	Standard Test Method for Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration

Ready Mixed Concrete Association of Ontario Publications (RMCAO)

R1025	Certificate of Ready Mixed Concrete Production Facilities
R1026	Certificate of Mobile Mix Concrete Production Facilities

1350.03 DEFINITIONS

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

Agitator Truck means a vehicle in which freshly mixed concrete can be conveyed from the mixing site to the Work Area while being agitated. The containment vessel can either be stationary with an agitator or it can be mobile with a drum rotated continuously so as to agitate the concrete.

Cementing Material means hydraulic cement with or without a supplementary cementing material.

Confidentiality and Indemnity Agreement means a legal agreement between an Owner and the concrete supplier as obtained from the Municipal Engineers Association (MEA) or the Ready Mixed Concrete Association of Ontario (RMCAO).

Curing means the maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediately following placing and finishing so that the desired concrete properties may develop.

High Volume Supplementary Cementing Materials (HVSCM) Concrete means concrete that contains a level of supplementary cementing materials above that typically used in construction.

Hot Weather means those conditions when the air temperature is at or above 28 °C. It is also considered to exist when the air temperature is likely to rise above 28 °C within 24 hours. Temperature refers to shade temperature.

Inspector means a representative of the Owner to which the concrete is being supplied.

Mobile Mix Concrete means concrete that is completely batched and mixed by a mobile mixer truck at the site.

Performance Criteria means requirements to be met as specified in the Contract Documents and as shown in form OPSF 1350-1 or OPSF 1350-2.

Portland Cement means the product obtained by pulverizing clinker consisting essentially of hydraulic calcium silicates to which calcium sulphate, limestone, water, and processing additions may be added at the option of the cement manufacturer.

Pre-Qualification Performance Criteria means requirements to be met as specified in the Contract Documents and as shown in form OPSF 1350-1 or OPSF 1350-2 and have been demonstrated through trial batches or concrete test data from a similar class of concrete as specified in the Trial Batch clause.

Ready Mixed Concrete means concrete that is completely batched at the plant and completely mixed at the plant or while in transit.

Self-Consolidating Concrete (SCC) means a highly flowable, yet stable concrete that can spread readily into place, fill the formwork, and, if applicable, encapsulate the reinforcement without any mechanical consolidation and without undergoing any significant separation of material constituents.

Stationary Mixer means a non-mobile mixer installed at a plant for the purpose of mixing concrete.

Supplementary Cementing Material (SCM) means material that, when used in conjunction with hydraulic cement, contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity or both.

Truck Mixer means a concrete mixer mounted on a truck or other vehicle used for the complete mixing of concrete materials after they have been batched at the plant.

Water-to-Cementing Materials Ratio (W/CM) means the ratio by mass of the amount of water to the total amount of cementing material in a freshly mixed batch of concrete or mortar, stated as a decimal. The amount of water does not include that absorbed by the aggregate.

1350.04 DESIGN AND SUBMISSION REQUIREMENTS

1350.04.01 Design Requirements

1350.04.01.01 Mix Design Alterations

The Contractor may make minor alternations to the stated mix proportions in order to maintain compliance with the overall performance requirements as specified in the Contract Documents. Such deviations shall be according to CSA A23.1.

A minimum of 24 hours notice of deviations in the mix design that alter the sources of supply or the fundamental characteristics of the mix shall be given to the Owner by the Contractor. Resubmission of form OPSF 1350-1 and, if applicable, form OPSF 1350-2, shall be made for such deviations.

1350.04.02 Submission Requirements

Submissions for the performance or prescriptive specification alternative requirements shall be made based on the specification alternative as specified in the Contract Documents.

1350.04.02.01 Performance Specification Alternative

In the case of the performance specification alternative, the Contractor shall be solely responsible for the design of the concrete and to ensure that the requirements of CSA A23.1 and this specification have been met.

At least 14 Days prior to placing any concrete, the Contractor, in concert with the concrete supplier, shall:

- a) Establish the concrete mix properties to meet performance criteria for plastic and hardened concrete, after considering the Contractor's criteria for construction and placement and the Owner's performance criteria.

- b) Submit documentation demonstrating the Owner's pre-qualification performance criteria can be met.
- c) Prepare, submit, and implement a quality control plan to ensure that the Owner's performance criteria can be met. When specified in the Contract Documents, submit documentation demonstrating that the Owner's performance requirements have been met.
- d) Ensure that the concrete supplier submits the following to the Contractor to forward to the Owner.
 - i. Certification that the plant, equipment, and all materials to be used in the concrete comply with the requirements of this specification.
 - ii. Certification that the mix design satisfies the requirements of this specification.
 - iii. Certification that the production and delivery of concrete will meet the requirements of this specification.
 - iv. Certification that the concrete complies with the specified performance criteria.
- e) Provide documentation verifying that the concrete supplier's plant and equipment meet the plant certification requirements of the RMCAO Approved Quality Program.

1350.04.02.01.01 Performance Based Concrete Mix Data

At least 2 weeks prior to the delivery of concrete, the Contractor shall submit to the Owner the attached form OPSF 1350-1 detailing the material and sources of materials to be used for each class of concrete. The form shall be completed for all concrete supplied to the project.

The quantity of chemical admixtures shall be at least the minimum dose specified in the Contract Documents. The Contractor may deviate from the specified minimum dose due to weather conditions and changes in materials. However, written notification of this change shall be provided to the Contract Administrator at least 24 hours prior to the delivery of the concrete by the Contractor.

1350.04.02.01.02 Mix Design Confidentiality and Indemnity Agreement

The Contractor shall ensure that the concrete supplier submits a confidential concrete mix design for the Contract to the Owner on the attached form OPSF 1350-2, when requested by the Contract Administrator, and only after a confidentiality agreement has been signed between the Owner and the concrete supplier.

At least 2 weeks prior to the placing of any concrete, the Owner and the concrete supplier shall execute a confidentiality agreement to cover the protection of proprietary mix proportion information that is to be released as part of form OPSF 1350-2.

1350.04.02.02 Prescriptive Specification Alternative

In the case of the prescriptive specification alternative, the Owner shall be solely responsible for the concrete mix design and to ensure that the requirements of CSA A23.1 and this specification have been met.

The Contractor, in concert with the concrete supplier, shall:

- a) Plan the construction methods based on the Owner's mix proportions and parameters.
- b) Obtain approval from the Owner for any deviations from the specified mix design or parameters.
- c) Identify to the Owner any anticipated problems or deficiencies with the mix parameters related to construction.

- d) Provide verification that the plant, equipment, and materials to be used in the concrete comply with the requirements of this standard.
- e) Demonstrate that the concrete complies with the prescriptive criteria as supplied by the Owner.

1350.04.02.03 Ready Mixed Concrete Operation or Mobile Mix Concrete Operation

At least 1 week prior to the delivery of concrete to the Work Area, the Contractor shall submit to the Owner a current valid Certificate of Ready Mixed Concrete Production Facilities or a current valid Certificate of Mobile Mix Concrete Production Facilities for the plant being used to produce ready mixed concrete, issued under the Approved Quality Program as outlined in the publications, Certificate of Ready Mixed Concrete Production Facilities and Certificate of Mobile Mix Concrete Production Facilities.

1350.04.02.04 Concrete Delivery Ticket

The concrete supplier shall provide 2 copies of the delivery ticket to the Contractor immediately following unloading at the Work Area. The Contractor shall provide one copy of each delivery ticket to the Owner within 1 Business Day of completion of the placement. The concrete delivery ticket shall include:

- a) Name and location of plant.
- b) Date and serial number of the ticket.
- c) Name of Contractor.
- d) Specific designation of the job by name and location.
- e) Specified class or designation of the concrete.
- f) Volume of concrete.
- g) Truck number and cumulative total or load number.
- h) Time stamped when mixing of cement and aggregates commences.
- i) Ordered slump or slump flow.
- j) Time that the discharge of load was completed.
- k) Amount of water added after batching, authorization, and units used.
- l) Amount and type of admixtures added after batching.

1350.05 MATERIALS

1350.05.01 Materials for Concrete

1350.05.01.01 Cementing Materials

Cementing materials shall be according to CAN/CSA A3000.

Portland cement shall be used; however, a portion of it may be replaced by SCM. The SCM shall be ground granulated blast furnace slag, fly ash, or silica fume or any combination of two or all of the materials.

The mass of Portland cement and all SCMs contained in a concrete mix shall be specified on form OPSF 1350-2, if applicable. Furthermore, the Contractor shall disclose on form OPSF 1350-1 and, if applicable, form OPSF 1350-2, when the mix design is classified as a HVSCM as specified in CSA A23.1.

HVSCM 1 concrete shall only be used with prior written approval of the Owner.

Neither slag nor fly ash shall be used for lean concrete base, unless trial mix tests are performed and the results show that the performance requirements of the Owner have been met.

1350.05.01.02 Aggregates

Aggregates shall be according to OPSS 1001 and OPSS 1002.

The maximum nominal size of the aggregate shall not exceed 19.0 mm.

1350.05.01.03 Water

Water for concrete shall be according to OPSS 1302 and CSA A23.1, clause 4.2.2.

1350.05.01.04 Air Entraining and Chemical Admixtures

Air entraining chemical admixtures shall be according to the ASTM C 260.

Chemical admixtures shall be according to ASTM C 494M or when flowing concrete is specified, it shall be according to ASTM C 1017M.

The Contractor shall ensure that the chemical admixtures to be used are compatible with each other and that the performance of the concrete will not be negatively affected.

The Contractor shall use only chemical admixtures specified in the Contract Documents. Specialty chemical admixtures may be used when approved by the Owner.

1350.05.02 Performance Requirements for Concrete

1350.05.02.01 General

In instances where there are conflicts between this specification and other standards, the most stringent performance requirements shall apply.

1350.05.02.02 Exposure Classes of Concrete

Concrete having various exposure classifications shall meet the most stringent requirements of CSA A23.1, Tables 1, 2, and 3.

Classification A exposures do not apply to this specification.

1350.05.02.03 Compressive Strength

The concrete compressive strength shall be according to CSA A23.1, Tables 1, 2, and 3, and as specified in the Contract Documents.

1350.05.02.04 Air Content

The total air content of the concrete, measured with an air meter immediately prior to placing, shall be as shown in CSA A23.1, Table 4. Nominal maximum sizes of coarse aggregate shall be according to CSA A23.1, Table 4 (i.e., 10 mm, 14-20 mm, and 28-40 mm shall be 9.5 mm, 13.2-19.0 mm, and 28-40 mm, respectively).

Air content in hardened concrete shall meet the requirements of CSA A23.1, clauses 4.3.3.2 and 4.3.3.3, and the requirements as shown in Table 3 of this specification.

1350.05.02.05 Slump or Slump Flow

Slump or slump flow shall be consistent with the placement and consolidation methods, equipment, and site conditions.

Slump requirements shall be identified and reviewed by the Contractor and concrete supplier prior to construction. The tolerances for concrete slump acceptance and rejection in the Work Area shall be as follows:

- a) Slumps less than 80 mm - the maximum allowable variation shall be ± 20 mm.
- b) Slumps between 80 to 180 mm - the maximum allowable variation shall be ± 30 mm.
- c) Slumps greater than 180 mm - the maximum allowable variation shall be ± 40 mm.
- d) For SCC, the maximum allowable variation shall be ± 70 mm from the slump specified in the mix design.

Slump or slump flow shall be measured according to CSA A23.2-5C. Maximum slump for non-self-consolidating concrete shall be 240 mm, provided no segregation of the concrete occurs.

1350.05.02.06 Within Batch Uniformity of Concrete

If, in the opinion of the Contract Administrator, there is evidence of non-uniformity of the mixed concrete from a particular mixer, tests shall be carried out by the Contractor on 3 samples of concrete obtained from widely separate portions of the batch while the mixer is being completely emptied at normal operating rate to evaluate the mixing equipment.

Samples shall not be taken prior to 10% or after 90% of the batch has been discharged.

The minimum size of sample shall be 30 litres.

Between samples, the mixer shall not be allowed to turn in the mixing direction. Water shall not be added to the batch at any time after sampling has started.

The following criteria and that of CSA A23.1, Table 13, shall be used to judge whether or not the equipment under test is producing uniform concrete:

- a) Where the result of each test is equal to or less than the acceptance limit, the concrete shall be considered uniform.
- b) Where the result of any single test is greater than the rejection limit, the concrete shall be considered non-uniform.
- c) If a test result falls between acceptance limit and rejection limit, additional tests shall be made on the next consecutive batch or load delivered by that unit.

If, after testing one additional batch or load, the test falls outside the acceptance limit, the equipment shall be rejected.

1350.06 EQUIPMENT

1350.06.01 Batching Plant

The batching plant and equipment shall be according to the certification requirements of the RMCAO.

The batching plant shall have direct communication with the placement operation.

1350.06.02 Mixing Equipment

All mixers shall be according to the certification requirements of RMCAO and shall be capable of discharging the concrete so that the uniformity requirements of CSA A23.1, Table 13, are met.

1350.06.03 Non-Agitating Delivery Equipment

The concrete containment area of non-agitating delivery equipment shall be a smooth watertight steel container equipped with gates that will permit control of the concrete discharge.

1350.07 PRODUCTION

1350.07.01 General

A manufacturer producing ready mixed concrete shall possess a current valid Certificate of Ready Mixed Concrete Production Facilities or a current valid Certificate of Mobile Mix Concrete Production Facilities for the plant being used to produce ready mixed concrete, issued under the Approved Quality Program as outlined in the publications, Certificate of Ready Mixed Concrete Production Facilities and Certificate of Mobile Mix Concrete Production Facilities.

The entire contents of the truck mixer shall be discharged prior to recharging. When any ingredient is added after initial batching, the volume of material in the drum shall not exceed the mixing capacity of the drum.

Proper facilities shall be provided to enable inspection of the quality of the materials used in the production of the concrete. The inspector shall be provided with all reasonable facilities for securing samples to determine whether the concrete and its materials are being supplied according to this specification. Owners wishing to obtain samples of the various raw materials from the concrete supplier shall provide advance notice to the concrete supplier and comply with all concrete supplier health and safety policies.

Where test results fail to meet the minimum requirements of this specification and the Owner and the concrete supplier have already executed a confidentiality agreement, the Contractor shall ensure that the batch records retained by the concrete supplier under the Approved Quality Program shall be made available to the Owner within 5 Business Days of a written request. The Owner shall treat these records in the same manner as form OPSF 1350-2 and they shall remain the confidential information of the concrete supplier.

1350.07.02 Temperature Control

The concrete temperature at the time of discharge from the truck shall be between 10 and 28 °C.

1350.07.03**Records and Reporting**

In addition to the batch records required to conform to the Approved Quality Program, the Contractor shall record the following information on the concrete delivery tickets, when applicable:

- a) The method used to control the temperature of the concrete during hot weather conditions.
- b) The method used to extend the discharge time of the concrete beyond 1.5 hours after introduction of the mix water during hot weather conditions.
- c) The type and quantity of any materials added to the concrete after leaving the batch plant, and the time that each material was added.

1350.07.04**Concrete Strengths 35 MPa or Greater****1350.07.04.01****Trial Batch**

The mix properties for concrete with strengths of 35 MPa or greater shall be confirmed by the performance of a trial batch. The trial batch shall confirm all the performance properties identified for a particular class of concrete in CSA A23.1, Table 2, through the following tests:

- a) Slump.
- b) Plastic air content.
- c) Compressive strength.
- d) Hardened Air Void System (AVS).

The testing of the field trial batch of concrete shall be the responsibility of the Contractor.

At least 30 Days prior to placing concrete with strengths of 35 MPa or greater, the Contractor shall mix a full size trial batch of concrete in the proportions stated in the mix design.

When the concrete is mixed within a truck mixer, the volume of the trial batch shall be the same as the volume of concrete normally mixed in the truck.

When the source of concrete is a ready mixed concrete plant, the trial batch of concrete shall originate from the primary plant to be used for the supply of the concrete and be delivered to the Work Area.

When the approved ready mixed concrete operation is currently supplying or has supplied a similar class of concrete within the last 6 months, permission may be given by the Owner to use concrete test data from that operation without the need for full size field trial batch, providing:

- a) There is no change in the source of any material.
- b) The performance characteristics of the aggregates have not changed significantly.
- c) The concrete mix designated and previously used meets the specified performance requirements.
- d) Documentation of this prior approval is submitted to the Owner.

1350.07.04.02**Early Compressive Strength Determination of Mix Design**

When approved by the Owner, accelerated compressive strengths shown in Table 1 may be used to predict the 28-Day compressive strength of the proposed concrete mix.

The cylinders shall be tested according to CSA A23.2-10C using the autogenous curing test procedure.

1350.07.05 Ready Mixed Concrete

1350.07.05.01 Delivery of Ready Mixed Concrete

1350.07.05.01.01 General

The concrete shall be delivered to the Work Area without segregation in a thoroughly mixed and uniform mass and be discharged with the uniformity required in CSA A23.1, Table 13.

1350.07.05.01.02 Delivery by Non-Agitating Equipment

Concrete that is completely mixed in a stationary mixer may be transported in non-agitating equipment.

Covers shall be used to provide protection to the concrete during inclement weather.

Discharge of concrete shall be completed within 30 minutes of the introduction of the mixing water to the cement and aggregates.

1350.07.05.01.03 Delivery by Agitator or Mixer Trucks

After completion of mixing, concrete shall be transported to the Work Area by means of agitator trucks or truck mixers. The equipment shall be operated at the agitation speed of rotation designated by the manufacturers of the truck.

Discharge of the concrete shall be completed within 90 minutes after the introduction of mixing water to the cement and aggregates. This time may be extended using a set retarder, provided the Owner approves such use.

1350.07.05.01.03.01 Site Addition of Materials

When a truck mixer is used at agitating capacity, no adjustment shall be made to the load of concrete.

In the case of the performance specification alternative, only the concrete supplier, in concert with the Contractor, shall undertake the site addition of materials to the mixer.

When the measured slump or slump flow of the concrete is less than that specified in the mix design, water may be added by the concrete supplier, in concert with the Contractor, to bring the concrete up to the designated slump or slump flow, provided the following criteria are met:

- a) The specified water-to-cementing materials ratio is not exceeded.
- b) No more than 60 minutes has elapsed from the time of batching.
- c) Addition of water is only at the start of discharge (i.e., not more than 10% of the concrete has been discharged).
- d) Not more than the lesser of 16 L/m³ or 10% of the mixing water shall be added.

Air entraining admixture may be added to the load of concrete by the concrete supplier, in concert with the Contractor, prior to discharge, to increase the air content to that specified in the mix design. The use of detraining admixtures to lower the air content of concrete is prohibited.

When any material is added to the concrete, the concrete supplier shall thoroughly mix the load of concrete to meet the uniformity requirements of CSA A23.1, Table 13.

1350.08 QUALITY ASSURANCE

1350.08.01 General

The Owner shall be allowed access to all sampling locations and reserves the right to request a quality assurance (QA) sample at any time from the Contractor. The Contract Administrator may elect to carry out testing of the QA sample to ensure that material used in the Work is according to the requirements of this specification. Testing shall be carried out at a laboratory designated by the Owner. The Owner shall be responsible for all costs associated with QA testing.

Samples of aggregates, cementing materials, water, chemical admixtures, and air entraining admixtures representative of the materials to be used in the work shall be provided, when requested by the Owner.

1350.08.02 Sampling and Testing

1350.08.02.01 General

1350.08.02.01.01 Quality Assurance Testing Staff and Laboratory Requirements

Field sampling and testing of concrete shall be performed by a person holding either of the following certifications:

- a) CSA Certified Concrete Testing Technician, Concrete Testing and Sampling Certificate, or
- b) ACI Concrete Field Testing Technician - Grade 1.

This person shall have a valid original card issued by the certifying agency in his or her possession at all times.

Laboratory tests shall be completed by a laboratory certified according to CSA A283 for the category appropriate to the test required by CSA.

1350.08.02.01.02 Quality Assurance Test Reporting

Concrete test reports shall be immediately distributed electronically to the Owner, Contractor, and concrete supplier using CMATS™. The test results shall include the following information for each individual mix design:

- a) Project identification.
- b) A graphical representation of the specified and actual compressive strength data.
- c) The average strength value for each age that the concrete is tested.
- d) Average slump value for the mix design.
- e) Average plastic air content for the mix design.

Testing shall be completed as shown in Table 2.

1350.08.02.02 Air Content in Hardened Concrete

The air void system in the hardened concrete may be performed on cast cylinder specimens. The air void system shall be tested according to ASTM C 457.

1350.08.02.03 Testing for Uniformity of Mixed Concrete

When required by the Owner, tests to determine the within-batch uniformity of mixed concrete shall be according to the Within Batch Uniformity of Concrete clause, except the acceptance and rejection limits for uniformity shall be according to CSA A23.1, Table 13.

1350.08.02.04 Strength Tests and Requirements

1350.08.02.04.01 Compressive Strength

For the purpose of concrete acceptance on the basis of concrete strength, cylinders shall be made and cured according to CSA A23.2-3C, under standard moisture and temperature conditions, and tested according to CSA A23.2-9C.

A compressive strength test result is the average strength of two standard 100 x 200 mm or 150 x 300 mm concrete cylinders that are representative of concrete taken from one batch of concrete.

To conform to the specified nominal minimum 28-Day compressive strength requirements:

- a) The average of all groups of 3 consecutive strength tests shall be equal to or greater than the specified strength.
- b) No individual strength test shall be more than 3.5 MPa below the specified strength.

1350.08.02.04.02 Flexural Strength

Concrete for pavement and base shall meet the requirements for compressive strength and also flexural strength as stated here. The minimum flexural strength shall be 3.8 MPa at 10 Days.

A flexural strength test is the average of 2 breaks on a standard beam test specimen that is representative of concrete taken from one batch of concrete.

Flexural strength test beams shall be made and cured according to CSA A23.2-3C, depending on the particular circumstances. The method of testing shall be according to CSA A23.2-8C.

Alternatively, a splitting tensile test may be carried out instead of the flexural strength test. One splitting tensile test shall be considered to be the average of 2 standard cylinders that are representative of concrete taken from one batch of concrete. The splitting tensile test cylinders shall be according to CSA A23.2-3C. The method of testing shall be according to CSA A23.2-13C. The minimum splitting tensile strength shall be 2.8 MPa at 10 Days.

To conform to the specified nominal minimum 10-Day strength requirements, the average of all sets of 3 consecutive strength tests shall be equal to or greater than the specified strength.

TABLE 1
2-Day Accelerated Compressive Strengths

Minimum 28-Day Compressive Strengths MPa	Corresponding 2-Day Accelerated Compressive Strengths MPa
20	8.4
25	12.9
30	17.4
35	21.9
40	26.4

TABLE 2
Quality Assurance Tests

Required Test	Test Method
Slump and Slump Flow of Concrete	CSA A23.2-5C
Air Content	CSA A23.2-4C
Compressive Strength	CSA A23.2-3C and CSA A23.2-9C
Accelerating the Cure of Concrete Cylinders and Determining Their Compressive Strength (Accelerated Cured)	CSA A23.2-10C
Yield	CSA A23.2-6C
Chloride Ion Penetrability Test	ASTM C 1202
Linear Shrinkage Test	ASTM C 157M (Note 1)
Note: 1. Drying shall commence after 7 Days of wet curing.	

TABLE 3
Hardened Concrete Air Void System Requirements

Class of Exposure	Total Air Content %	Spacing Factor mm
C-XL, C1, C2, and F1	3.0 minimum	0.230 maximum mean 0.260 maximum individual
Concrete with water/cementing ratios of 0.36 or less	3.0 minimum	0.250 maximum mean 0.300 maximum individual

Concrete Mix Design Submission

Contract _____	Date Submitted _____
Location _____	Submitted To _____
Contractor _____	Contact _____
Batch Plants: Primary _____	Secondary _____
Concrete Supplier: Name _____	
Address _____	
City/Province _____	
Telephone _____	Fax _____ Email _____

SPECIFICATION	MIX CODE					
	Application / Element / Location					
	Structural Requirements					
	- CSA Exposure Class					
	- Maximum W/CM					
	- Minimum Specified Strength, MPa @ Days					
	- Nominal Maximum Aggregate Size, mm					
	- HVSCM Type 1 or 2					
	- Plastic Air Content, %					
	Durability Requirements					
	- Exposure to Sulphate Attack					
	- Alkali Aggregate Reactivity					
	Architectural Requirements					
	- Colour / Texture					
	- Other					
CONTRACTOR REQUIREMENTS	Rate, m³/h					
	Quantity, m³					
	Slump Range, mm					
	Strength @ Age, MPa @ Days					
	Other					
	Specialty Information					
	- Concrete Set, Delay, Normal, Accelerated					
	Method of Placement					
MATERIALS SECTION	Material	Source				
	Cement					
	SCM - Slag					
	SCM - _____					
	Water					
	Fine Agg.					
	Coarse Agg.					
	A.E.A.					
	W.R.					
	S.P.					

Form Submitted By:

Print Name: _____ Signature: _____ Date: _____

Contractor's Representative Receiving Form:

Print Name: _____ Signature: _____ Date: _____

CONFIDENTIAL - Concrete Mix Design Submission

Contract _____ Date Submitted _____

Location _____ Submitted To _____

Contractor _____ Contact _____

Batch Plants: Primary _____ Secondary _____

Concrete Supplier: Name _____

Address _____

City/Province _____

Telephone _____ Fax _____ Email _____

	MIX CODE						
	Application / Element / Location						
SPECIFICATION	Structural Requirements						
	- CSA Exposure Class						
	- Maximum W/CM						
	- Minimum Specified Strength, MPa @ Days						
	- Nominal Maximum Aggregate Size, mm						
	- HVSCM Type 1 or 2						
	- Plastic Air Content, %						
	Durability Requirements						
	- Exposure to Sulphate Attack						
	- Alkali Aggregate Reactivity						
SPECIFICATION	Architectural Requirements						
	- Colour / Texture						
	- Other						
CONTRACTOR REQUIREMENTS	Rate, m³/h						
	Quantity, m³						
	Slump Range, mm						
	Strength @ Age, MPa @ Days						
	Other						
	Specialty Information						
	- Concrete Set, Delay, Normal, Accelerated						
MATERIALS SECTION	Method of Placement						
	Material	Source	Unit	Quantity			
	Cement		kg/m ³				
	SCM - Slag		kg/m ³				
	SCM - _____		kg/m ³				
	Water		L/m ³				
	Fine Agg.						
	Coarse Agg.						
	A.E.A.		mL/100 kg				
	W.R.		mL/100 kg				
S.P.		mL/100 kg					

Form Submitted By:

Print Name: _____ **Signature:** _____ **Date:** _____

Municipal Representative Receiving Form:

Print Name: _____ **Signature:** _____ **Date:** _____

Appendix 1350-A, November 2014 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

This specification is intended for use by municipalities requiring ready mixed concrete.

The designer should specify the following in the Contract Documents:

- The Owner's choice of concrete specification alternatives, either Performance Specifications or Prescriptive Specifications. (1350.04.02)
- Minimum dose of chemical admixtures. (1350.04.02.01.01)
- Chemical admixtures. (1350.05.01.04)

The designer should determine if a quality control program is to be prepared and implemented. If so, the requirement for it should be specified in the Contract Documents. (1350.04.02.01)

The designer may consider the following and specify this requirement for air content in hardened concrete in the Contract Documents:

When the approved ready mixed concrete operation is currently supplying or has supplied a similar class of concrete within the last 6 months, permission may be given to waive this testing requirement, providing that:

- a) There is no change in the source of any material.
- b) The concrete mix designated and used previously meets the specified performance requirements.
- c) Documentation of this prior approval is submitted to the Owner.

CSA A23.1, Table 5, lists the alternative methods for specifying concrete. The designer should review this table when determining which concrete specification alternative is to be used in the Contract. CSA A23.1, Annex J, discusses the selection of alternatives for specifying concrete requirements. These alternatives include:

Performance - When the Owner requires the concrete supplier to assume the responsibility for performance of the concrete as delivered and the Contractor to assume responsibility for the concrete in place.

For this alternative, the Owner should specify the following in the Contract Documents:

- a) Required structural criteria including strength at age.
- b) Required durability criteria including class of exposure.
- c) Additional criteria for durability, volume stability, architectural requirements, sustainability, and any additional Owner performance, pre-qualification or verification criteria.

Appendix 1350-A

- d) Quality management requirements.
- e) Certification of the concrete supplier through the Approved Quality Program.
- f) Any other properties that may be required to meet the Owner's performance requirements.

Prescriptive - When the Owner assumes responsibility for the performance of the concrete.

For this alternative, the Owner should specify the following in the Contract Documents:

- a) Mix proportions, including the quantities of any or all materials (admixtures, aggregates, cementing materials, and water) by mass per cubic metre of concrete;
- b) The range of air content;
- c) The slump range;
- d) Use of a concrete quality plan, if required;
- e) Other requirements.

CSA A23.1, Annex K, discusses concrete made with a high volume of supplementary concreting materials (HVSCM).

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 Standards Drawings

No information provided here.

**Construction Specification for
Maintenance of Traffic****Table of Contents**

TS 1.00.01	SCOPE	3
TS 1.00.02	REFERENCES	3
TS 1.00.03	DEFINITIONS	4
TS 1.00.04	DESIGN AND SUBMISSION REQUIREMENTS.....	4
TS 1.00.04.01	Hot Mix Asphalt.....	4
TS 1.00.04.02	Night Time Lighting Plan	4
TS 1.00.05	MATERIALS.....	4
TS 1.00.05.01	Superpave 9.5 Asphalt.....	4
TS 1.00.05.02	Superpave 19.0 Asphalt.....	4
TS 1.00.05.03	Crushed Aggregate	4
TS 1.00.05.04	Site Fence.....	5
TS 1.00.05.05	Crowd Control Barrier	5
TS 1.00.05.06	Temporary Barrier.....	5
TS 1.00.06	EQUIPMENT – Not Used	5
TS 1.00.07	CONSTRUCTION	5
TS 1.00.07.01	General.....	5
TS 1.00.07.02	Site Meetings	6
TS 1.00.07.03	Temporary Traffic Lanes	7
TS 1.00.07.04	Bus Stops	7
TS 1.00.07.05	Side Streets	7
TS 1.00.07.06	Private Driveways	7
TS 1.00.07.07	Temporary Sidewalks.....	8
TS 1.00.07.08	Bicycle Facilities.....	8
TS 1.00.07.09	Site Fence.....	8
TS 1.00.07.10	Crowd Control Barriers.....	9
TS 1.00.07.11	Temporary Barrier	9
TS 1.00.07.12	Traffic Control	10
TS 1.00.07.12.01	Traffic Control Plan	10
TS 1.00.07.12.02	Traffic Protection Plan.....	10
TS 1.00.07.12.03	Police Officer for Traffic Control	10
TS 1.00.07.12.04	Mass Transit	16
TS 1.00.07.13	Maintenance of Temporary Work	16
TS 1.00.07.14	Maintenance of Temporary Accesses	17

TS 1.00.07.15	Night Time Lighting.....	17
TS 1.00.08	QUALITY ASSURANCE	17
TS 1.00.09	MEASUREMENT FOR PAYMENT.....	17
TS 1.00.09.01	Granular A for Maintenance of Traffic.....	17
TS 1.00.09.02	Site Fence	18
TS 1.00.09.03	Relocate Site Fence	18
TS 1.00.09.04	Crowd Control Barrier.....	18
TS 1.00.09.05	Relocate Crowd Control Barrier.....	18
TS 1.00.09.06	Temporary Precast Concrete Barrier	18
TS 1.00.09.07	Relocate Temporary Precast Concrete Barrier	18
TS 1.00.09.08	Traffic Control.....	18
TS 1.00.10	BASIS OF PAYMENT	18
TS 1.00.10.01	General	18
TS 1.00.10.02	Granular A for Maintenance of Traffic – Item	19
TS 1.00.10.03	Site Fence – Item	19
TS 1.00.10.04	Relocate Site Fence – Item	19
TS 1.00.10.05	Crowd Control Barrier – Item	19
TS 1.00.10.06	Relocate Crowd Control Barrier – Item	19
TS 1.00.10.07	Temporary Precast Concrete Barrier – Item	19
TS 1.00.10.08	Relocate Temporary Precast Concrete Barrier – Item	19
TS 1.00.10.09	Traffic Control – Item	20

TS 1.00.01**SCOPE**

This specification covers the requirements for the construction and maintenance of the following:

- 1) Temporary traffic lanes.
- 2) Temporary access to private driveways and side streets.
- 3) Temporary pedestrian facilities (sidewalks) for the convenience of the public.
- 4) Temporary bicycle facilities.
- 5) Site fence, crowd control barrier or other barrier as specified in the Contract Documents to separate work areas from those used by the public.
- 6) Traffic control persons, police officers, signs, barricades, delineators, lights and other traffic control devices in conformance with the Ontario Traffic Manual, Book 7 – Temporary Conditions and *Occupational Health and Safety Act*.

TS 1.00.02**REFERENCES**

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

City of Toronto Standard Specifications

TS 310	Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving
TS 501	Amendment to OPSS.MUNI 501 – Construction Specification for Compacting
TS 1101	Amendment to OPSS.MUNI 1101 – Material Specification for Performance Graded Asphalt
TS 1151	Material Specification for Superpave, Stone Mastic and Warm Mix Asphalt
TS 1010	Amendment to OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material

City of Toronto Standard Drawings

T-216.02-12	Crowd Control Barrier
-------------	-----------------------

Ontario Provincial Standard Specifications

OPSS 740	Construction Specifications for Concrete Barriers
OPSS 1352	Material Specification for Precast Concrete Barriers

Ontario Ministry of Transportation

Ontario Traffic Manual Book 7 Temporary Conditions

American Traffic Safety Services Association

Nighttime Lighting Guidelines for Work Zones – A guide for developing a lighting plan for night time work zones (Appendix F)

Illuminating Engineering Society

The Lighting Handbook

Infrastructure Health & Safety Association

Best Practices for Traffic Control During Nighttime Operations (Appendix G)

TS 1.00.03 DEFINITIONS

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

Crushed Aggregate means pieces of aggregate having at least one well-defined face resulting from fracture. Particles with smooth faces and rounded edges, or with only small chips removed, are not considered crushed.

Superpave means an acronym for Superior Performing Asphalt Pavements. It is an alternative system to the Marshall method for specifying material components and asphalt mix design method using the Superpave gyratory compactor.

Transportation Services means City's Transportation Services division.

TS 1.00.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 1.00.04.01 Hot Mix Asphalt

All submission and design requirements for hot mix asphalt shall be as specified in TS 1151, except that trial batches will not be required.

TS 1.00.04.02 Night Time Lighting Plan

Submit a night time lighting plan showing additional lighting equipment and spacing to provide lighting levels required for the determined work activities according to Nighttime Lighting Guidelines for Work Zones. Plans are to be pre-approved by the Contract Administrator and a copy stored in the field office.

TS 1.00.05 MATERIALS

TS 1.00.05.01 Superpave 9.5 Asphalt

All Superpave 9.5 asphalt shall meet the materials specifications of TS 1151 and construction specification of TS 310. The grade of asphalt shall be PG 58-28 according to TS 1101.

TS 1.00.05.02 Superpave 19.0 Asphalt

All Superpave 19.0 asphalt shall meet the materials specifications of TS 1151 and construction specifications of TS 310. The grade of asphalt shall be PG 58-28 according to TS 1101.

TS 1.00.05.03 Crushed Aggregate

All crushed aggregate shall be Granular A and shall be according to TS 1010.

TS 1.00.05.04 Site Fence

All site fences shall consist of steel 'T' posts, top wire and plastic fencing.

Steel 'T' posts shall be 50 x 50 x 2400 mm metal stakes primed with one brush coat of black zinc rich paint according to SSPC Paint 20.

The fencing shall be constructed of heavy duty, high visibility, orange plastic and shall be a minimum of 1.2 m high.

The top wire shall be stranded wire with a minimum diameter of 4.1 mm or 8 gauge.

TS 1.00.05.05 Crowd Control Barrier

Crowd control barriers shall be according to T-216.02-12, and the barriers should be similar in shape and size to those supplied by Mark-All Services Incorporated for their Type 'B' Crowd Control Barrier with smooth rounded corners (551 Piercey Road, Bolton, Ontario, L7E 5B5, 905-951-2700), or approved equivalent.

The crowd control barrier shall be painted in yellow and have a solid piece of reflective tape placed along the top rail. The reflective tape shall be a minimum 600 mm in length and shall be centred on the top rail.

TS 1.00.05.06 Temporary Barrier

All temporary barriers shall be of the type listed below:

- 1) Precast concrete barrier, with an I-Lock connection, meeting the requirements of OPSS 1352.
- 2) Triton barrier as manufactured by Energy Absorption Systems Inc. (One East Wacker Drive, Chicago, Illinois, 60601, 312-467-6750). The local supplier of Triton Barrier is Lecol Co. Ltd. (689 Warden Avenue, Units 15 & 16, Scarborough, Ontario, M1L 4R6, 416-694-4420) or approved equivalent.

TS 1.00.06 EQUIPMENT – Not Used

TS 1.00.07 CONSTRUCTION

TS 1.00.07.01 General

The Contractor shall at all times carry on the work in a manner that will create the least interference with the traffic consistent with the faithful performance of the work. The Contractor shall not close the road or provide any detour except with the written approval of the Contract Administrator in conjunction with the representative from Transportation Services. The Contractor shall at its own expense provide for the safe passage and control of traffic by supplying, placing, maintaining, changing, and removing such barricades, signs, lights, and Traffic Control Persons (TCPs) as are required for the proper notification and protection of the public approaching or passing through any part of the Working Area and all devices so used shall be according to the Ontario Traffic Manual, Book 7 – Temporary Conditions and all aspects of the Work shall be according to the *Occupational Health and Safety Act*.

Where, with the approval of the Contract Administrator, the road is closed and traffic is diverted entirely off the road to any other public roads, the Contractor shall, at its own expense, supply and erect barricades, lights and such other protection as may reasonably be required by the Contract Administrator at all points where traffic might enter on that portion of the road so closed to traffic. The Contractor, when required by the Contract Administrator, shall supply traffic control personnel, to protect the barricades and direct traffic at each end of the portion or portions of the roadway closed to the traffic.

If, at any time, the Contractor fails to provide for the safe passage and control of traffic on any existing road or detour as prescribed in this specification, and if the Contractor fails to correct forthwith such as unsatisfactory condition upon being so directed in writing, the Contract Administrator may immediately correct the unsatisfactory condition and take such other action as they deems necessary for the safe passage and control of traffic. The City may deduct from any monies due or to become due to the Contractor, on any account, any cost or expense incurred by the City.

Failure to act on the part of the Contract Administrator under this subsection shall not relieve the Contractor from its responsibilities under this Contract.

The Contractor shall co-ordinate the removal and reinstallation of any existing parking meters, traffic control signs or signals, and other roadside furniture with Transportation Services.

The Contractor shall restore all parking meters, traffic control signs or signals, and other roadside furniture damaged by construction to the satisfaction of the Contractor Administrator and Transportation Services. All restoration is to be done at the expense of the Contractor.

Wherever roadway plates are required, they must be saw cut in, flush with the road surface, ramped with Superpave 9.5, Traffic Category B hot mix asphalt and skid resistant. All concrete, asphalt and contaminated aggregate, used for temporary construction and in traffic maintenance, shall be excavated and disposed of off the site. All material deemed reusable, by the Contract Administrator, shall be graded into and compacted to form part of the roadway subbase or other temporary work. No additional payment will be made for the re-handling, reuse or disposal of this material.

All temporary construction and temporary traffic maintenance shall be carried out to the satisfaction of the Contract Administrator and in accordance with the temporary traffic management plan conforming to the requirements of Ontario Traffic Manual. The Contract Administrator will give written notification of any deficiencies, and the Contractor shall initiate repairs within 24-hours.

The City reserves the right to contract with others to complete any repairs that have not been initiated within 24-hours of written notification. All repair costs, including all overhead and office costs incurred in the remedial actions will be deducted from the final payment to the Contractor.

TS 1.00.07.02 Site Meetings

Regular site meetings will be held every week or every two weeks, or as required by the Contract Administrator, to discuss traffic management and progress of work. Attendance will be required by at least one representative from the Contractor.

The Contractor shall be responsible for the following:

- 1) Coordinating and organizing attendance of subcontractors responsible for any work to be discussed as part of the agenda.
- 2) Informing the Contract Administrator, in advance of the meeting, of all items to be added to the agenda.
- 3) Ensuring that the Contractor representatives in attendance have the required authority to commit the Contractor to actions agreed upon.

TS 1.00.07.03 Temporary Traffic Lanes

At least two paved lanes of a minimum width of 3.05 m each including placing temporary pavement markings shall be kept open to traffic at all times during construction. Where additional width is available, it shall be used to provide wider curb lanes. Any portions of such lanes which, in the opinion of the Contract Administrator, are required outside the edge of the existing pavement shall consist of 75 mm of Superpave 19.0, Traffic Category B hot mix asphalt over a 225 mm thickness of Granular A, compacted to meet the requirements of TS 501.

Prior to the placing of the stone and asphalt layers, selected excavated material from either roadway or sewer excavations shall be used to fill ditches or other low areas and shall be compacted to 100% of maximum dry density.

Wherever possible, all temporary walkways, sidewalk, bus stops, pedestrian, wheel chair, bicycle and vehicular accessibility ramps shall be maintained at all times, including the provision of suitable, clean areas for bus stops.

TS 1.00.07.04 Bus Stops

At temporary bus stops, a flat and adequately drained platform consisting of Superpave 9.5, Traffic Category B asphalt to 75 mm compacted thickness shall be placed on top of a 100 mm compacted thickness of Granular A base for pedestrian use. In addition, a safe walkway must be maintained between the temporary bus stop and any adjacent sidewalk.

TS 1.00.07.05 Side Streets

The Contractor shall maintain two-way traffic on side streets wherever possible. If necessary and subject to the approval of the City, traffic on side streets may be reduced to one lane for a limited period of time. If the side street is to be reduced to one lane, a qualified Traffic Control Person (TCP) must be present on site from the time of lane reduction until the side street is open to two-way traffic.

TS 1.00.07.06 Private Driveways

The Contractor shall maintain access to driveways wherever possible. Driveways greater than 6 m in width shall have access maintained at all times. Construction shall be scheduled to allow temporary access to either half of the driveway. Such temporary access shall consist of a layer of well compacted Granular A placed to a minimum thickness of 150 mm and a minimum width of 3 m, or as specified in the Contract Documents.

TS 1.00.07.07 Temporary Sidewalks

The Contractor shall provide and maintain safe and convenient facilities for pedestrian traffic through the areas under construction. These facilities shall provide for a dry, hard and even surface at all time. Such temporary sidewalks shall have a minimum width of 2.1 m, and consist of a layer of well compacted Granular A placed to a minimum thickness of 100 mm, and a layer of well compacted smooth Superpave 9.5, Traffic Category B asphalt surface placed on top to a minimum compacted thickness of 75 mm. A minimum vertical clearance of 2.5 m shall be provided.

Wheelchair access shall be maintained at all times.

All pedestrian traffic shall be separated from the construction area by means of a temporary site fence or pedestrian control barrier. If the erection of a temporary site fence or pedestrian control barrier is not feasible, the Contractor shall seek approval from the City to use traffic control barrels (TC 54).

The Contractor shall provide sufficient signs to direct pedestrians around all sidewalk detours.

TS 1.00.07.08 Bicycle Facilities

The Contractor shall provide and maintain safe and convenient facilities for bicycle traffic through the area under construction. Where a bicycle lane or bicycle path exists within the work area, temporary facilities shall be provided. Such temporary bicycle facilities shall consist of a layer of well compacted, Granular A placed to a minimum thickness of 100 mm, a layer of well compacted smooth Superpave 9.5, Traffic Category B asphalt surface placed on top to a minimum thickness of 75 mm, and a minimum width of 1.5 m for one way traffic and a minimum width of 2.5 m for two way traffic. A minimum vertical clearance of 2.5 m shall be provided.

Cyclists shall be directed to follow a detour, or use pedestrian facilities after dismounting, as required. All information with regard to the use of bicycle facilities shall be supplied and maintained by the Contractor.

TS 1.00.07.09 Site Fence

The Contractor shall supply and maintain a continuous site fence to separate the travelled portion of the road or pedestrian area from the area under construction if the requirement for site fence is specified in Contract Documents.

Fence posts shall be spaced at a maximum of 3 m apart. Sleeves shall be placed in the concrete base on the first half of the pavement to be constructed, so that the posts are clear of the excavation for the second half. The site fence shall be removed following the completion of the road base and the sleeves shall be filled with concrete of the same type as used for the construction of the concrete road base. The construction area shall then be isolated from the public sections by the use of approved delineators, as specified in the Ontario Traffic Manual, Book 7 – Temporary Conditions.

The Contractor may, subject to the approval of the City, substitute approved delineators as specified in the Ontario Traffic Manual, Book 7 – Temporary Conditions for the site fence.

The top wire shall be threaded through the top portion of the fence, every three or fewer holes and drawn taut by machine. The top wire shall not be tightened by hand. The top wire shall be securely fastened to each post using standard tie wire. Every 100 mm or at every corner or break in the fence, the top wire of the fence shall be fastened to the bottom of the next post at every 100 mm intervals, or at every break in the fence to provide stability.

TS 1.00.07.10 Crowd Control Barriers

Crowd control barriers shall be placed between the construction areas and the pedestrian traffic. The triangular base shall be facing the construction area to minimize any obstructions to the pedestrian traffic.

Adjacent sections shall be connected at all times and pulled taut to form a continuous unbroken chain. Sections at the ends of each chain shall be secured to a section of site fence or a solid structure, such as a pole or sign. Crowd control barriers shall prevent pedestrian traffic from gaining access to the construction area.

Construction areas shall be completely isolated from pedestrian traffic at all times.

For contracts with multiple staging, the Contractor may be required to relocate the barrier sections from one stage to the next. The Contractor may also be required to relocate sections of the crowd control barrier on a daily basis to facilitate construction access or to temporarily increase the work area. The cost of relocation of crowd control barrier between stages throughout the contract is included as part of the item for staging requirements unless a separate pay item is provided in the Contract Documents for the relocation of crowd control barrier.

TS 1.00.07.11 Temporary Barrier

Temporary barriers shall be placed between the construction areas and the vehicular traffic, as specified on the Contract Drawings. Triton barriers require a “clear zone”, as specified by the manufacturer, between the construction area and the vehicular traffic.

Preparation of the base, if necessary, shall be according to OPSS 740, except that the slope of the foundation for the Triton Barrier shall not exceed 5 per cent when measured perpendicular to the barrier.

Supplying, placing, relocation and removal of the temporary concrete barriers shall be according to OPSS 740.

End treatments for temporary concrete barrier shall be as specified in the Contract Documents.

The supply, placing, relocation and removal of the Triton Barrier shall be according to the manufacturer's Triton Barrier Application Manual.

TS 1.00.07.12 Traffic Control

TS 1.00.07.12.01 *Traffic Control Plan*

The Contractor shall at its own expense, develop Traffic Control Plans as stipulated in the Ontario Traffic Manual, Book 7 – Temporary Conditions. The Traffic Control Plan will include detours, staging sequences, vehicle access and egress from worksite, temporary barriers, and removal of old pavement markings for complex projects. For minor projects, the Contractor may select the appropriate typical layouts from the Ontario Traffic Manual Book 7.

On extended hour or night work contracts the Traffic Control Plan shall include any additional delineation, spacing, barriers, arrow boards as required by Ontario Traffic Manual Book 7.

The Contract Administrator or the Transportation Services representative or both, shall review the Traffic Control Plan. Any changes to the Traffic Control Plan shall be agreed upon by the Contract Administrator or the Transportation Services representative or both.

TS 1.00.07.12.02 *Traffic Protection Plan*

The Contractor shall at its own expense, develop Traffic Protection Plans for the protection of workers in the work zone, as required under the *Occupational Health and Safety Act* and *Regulations for Construction Projects* Ontario Regulation 213/91 and 145/00. The Traffic Protection Plan shall conform to the requirements of all pertinent acts and regulations. The Contractor shall submit the Traffic Protection Plan to the City for record before the construction begins. All traffic protection measures shall be carried out to the satisfaction of the Contract Administrator and in accordance with the Traffic Protection Plan submitted.

TS 1.00.07.12.03 *Police Officer for Traffic Control*

TS 1.00.07.12.03.01 *General*

All costs associated with the requirements for a police officer for traffic control throughout the Contract for any reason shall be borne by the Contractor.

In addition to complying with the Ontario Traffic Manual, Book 7 – Temporary Conditions, the Contractor is required to provide a police officer for traffic control on site in accordance with Table 1 – *Deployment of Traffic Control in Road Construction Activities*, as amended from time to time in TS 1.00.07.11.03.02.

The Ministry of Labour is the governing agency responsible for the safety of workers and the public. The Toronto Police Service, as part of their responsibility as the employer, is required to provide the training for, the equipping of, and ensuring the use by members of personal protective equipment.

TS 1.00.07.12.03.02 Traffic Control Requirements

The following criteria outline the requirements for police officers as stated in the Memorandum of Understanding: Guidelines for Road Occupancy Traffic Control.

Table 1: Deployment of traffic control in road construction activities

Conditions under which traffic control may be required	Normal regulatory posted speed 60 km/h or lower, one lane or reduced to one lane	Normal regulatory posted speed 70 km/h to 90 km/h, one lane or reduced to one lane	Any speed, more than one lane in each direction
to protect workers on public way	Traffic Control Persons (TCP) can be used	TCP can be used	Police presence is required
to protect construction vehicles crossing roadway	TCP can be used	TCP can direct construction traffic only, not public traffic	Police presence is required
to protect construction vehicles entering a roadway	TCP can be used	TCP can direct construction traffic only, not public traffic	Police presence is required
electrical contractor work on traffic control signals	Police presence is required if there is an absence of traffic control device display and/or if the vehicle/pedestrian indication(s) are to display conflicting movement. If not, follow Ontario Traffic Manual Book 7 – Section 5.4: Use of Paid Duty Police Officers (January 2014). If the TCP conditions are not met, then police presence is required.		
construction, surface maintenance, utilities, Toronto Water	Follow Ontario Traffic Manual Book 7 – Table 6 – Deployment of Traffic Control Persons (TCP). If the TCP conditions are not met, then police presence is required.		

Note 1: Table 1 is a modified version of OTM Book 7 – Table 6: Deployment of Traffic Control Persons (TCP) that takes into consideration City of Toronto Operational Guidelines.

Note 2: See Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, Regulations 213/91 as amended by Regulations 631/94 and 145/00.

Note 3: If conditions under Ontario Traffic Manual Book 7 – Section 5.4 Use of Paid Duty Officers (January 2014) are satisfied, the TCP(s) must be positioned in a manner which will not conflict with the traffic control device operation. If this is not possible, police presence is required.

Note 4: For City of Toronto employees, contractors, and sub-contractors, traffic control work is performed in compliance with the provisions of: The City's Traffic Control policy and its guidelines; the Regulations for Construction Projects (sections 67-69, 104-106, and 186-187); the Ontario Traffic Manual for Temporary Conditions (OTM Book 7 and Field Edition); and the Handbook for Construction Traffic Control Persons.

Note 5: In reviewing traffic control measures related to road construction activities, Transportation Services, Toronto Police Services and the applicant must ensure that the safety of all road users is preserved.

The above guidelines does not preclude the need for a site meeting to discuss traffic safety related issues, hours of work and so forth with the Transportation Services and Toronto Police Service representative and other agencies.

TS 1.00.07.12.03.03 Road Emergency Service

In the event of road emergency services that have to be performed by City staff, City contractors or other utilities, and which the assistance from Toronto Police Service is required for traffic control, on-duty officers should be requested through a phone call to the Toronto Police Service Communication Centre at 416-808-2222.

Road emergency service is deemed to be any unscheduled maintenance where:

- Public safety or health is threatened
- Immediate action is required
- The public is without essential service.

Examples of road emergencies include sewer or watermain breaks, electrical failure and leaking of gas from the distribution system.

At any road emergency work site, a representative of the affected work (utility) must respond to the site as soon as possible to assess the situation, determine the necessary repairs and establish time frames required to complete the repairs. Police officers will document any instance where a representative of the affected work fails to attend the location within 1.5 hours of the call being received by the Toronto Police Service and forward this information to the Unit Commander of Traffic Services.

Where a road emergency has occurred which, through its circumstances and conditions requires that the ensuing traffic control be provided by a police officer, this traffic control shall be provided by an on-duty officer until the emergency has passed.

If the emergency resolution will be lengthy and on-duty officers are required for other service duties, then staff of Transportation Services, Toronto Police and the associated contractor will collectively determine which subsequent traffic control can be provided by means other than an on-duty police officer.

All Other Emergencies:

In the event of any other type of emergency which presents an immediate danger to the health or safety of any person, including the failure of buildings or parts of buildings, due to events such as fires, explosions, circumstances resulting in the collapse of buildings or otherwise, and which results in the need for traffic control, the required traffic control shall be provided by on-duty police officers for the duration of the emergency.

Where the City division(s) having jurisdiction over and managing the emergency determine(s) that the emergency has passed in that the immediate danger to the health or safety of persons is removed and that restoration of the site can be initiated, said division(s) in conjunction with Toronto Police Service shall determine if continued traffic control is required, and if so, whether the continued traffic control should reasonably be provided by on-duty police officers or transferred to paid duty officers.

TS 1.00.07.12.03.04 *Scheduled Maintenance and Construction Work*

Traffic control for all scheduled or regular maintenance activities shall be determined by Transportation Services staff, in consultation with Toronto Police Services and the applicant and the nature of the traffic control will be specified in the appropriate road occupancy permit.

The Contractor is responsible for providing traffic control at a permitted road occupancy, as required in the conditions specified in the activity permit.

A Transportation Services representative, in consultation with the Toronto Police Construction Liaison Officer, will determine the nature of traffic control and if there is a need for police officers for all other activities on City roads.

Where the permitted road occupancy creates a disruption to the rules of the road, appropriate traffic control should be established to ensure that the safety of all road users is maintained for the extent of the road occupancy, based on the criteria in Table 1.

The Contractor shall at its own expense, provide, place in service, maintain and remove all of the traffic control devices and Traffic Control Persons as required by the Ontario Traffic Manual, Book 7 – Temporary Conditions, and according to the *Occupational Health and Safety Act* and *Regulations for Construction Projects* Ontario Regulation 145/00 and shall conform to the Traffic Control Plan. The Contractor shall ensure that sufficient traffic control devices and Traffic Control Persons are always readily available to meet all the traffic control requirements on site. No claims will be considered for Contractor's loss due to the unavailability of Traffic Control Persons and any traffic control devices.

Traffic Control Persons should be considered to control locations with a single lane of one-way traffic flow. A Traffic Control Person can also control pedestrian movements off the travelled portion of the roadway. A Traffic Control Person can also control pedestrian movements at a signalized intersection if the signal indications are clearly visible and the Traffic Control Person is not required to stop traffic. If more than one lane or direction of traffic flow is to be controlled or stopped, then a police officer will be required according to the Ontario Traffic Manual, Book 7 – Temporary Conditions.

In addition, the Contractor shall, at its own expense, provide, place in service and maintain and remove special construction signs, where appropriate, to advise of rough surface, raised maintenance covers, timber decking, steel plates, narrow lanes and detours for motor vehicles, bicycles, and pedestrians on all approaches to and within the areas under construction.

A static barrier, for example, crowd control barrier may be acceptable to close crosswalks at a signalized intersection depending on the pedestrian and vehicle volumes. Yellow 'Caution Tape' is not recognized as an acceptable barrier.

The maintenance of all signs, barricades and other traffic control devices is a 24 hours a day 7 days a week obligation. The Contractor must provide a contact person that will be available at all times, throughout the duration of the project.

The Contract Administrator will issue a verbal or a written warning or both to the Contractor when the Contractor is found failing to protect the site according to Ontario Traffic Manual, Book 7 – Temporary Conditions. Upon receipt of the warning, the Contractor shall rectify all traffic control deficiencies to the satisfaction of the Contract Administrator without delay.

All scheduled maintenance and construction requests will be staffed with appropriate traffic control requirements. All paid duties required under this specification shall be arranged through the Central Paid Duty Office. The Contractor is responsible for providing police officers, as required, on all City projects and capital projects.

Police officer shall ensure the Contractor produces a valid permit, issued by the City, for the required work and that the Contractor works within the parameters outlined in the permit prior to any work being commenced.

A filled out Paid Duty Request Form shall be faxed, along with a valid road cut permit issued by the City, to the Central Paid Duty Office 416-808-5042. Calls for further assistance can be directed to the Central Paid Duty Office 416-808-7880. In certain circumstances, a request for Paid Duty Police Officer can be made in person at any Division.

If Paid Duty Officers are determined to be the required traffic control, these officers shall be arranged through the Central Paid Duty Office by faxing your request to 416-808-5042. If further assistance is required, the Central Paid Duty Office at 416-808-7880 should be contacted.

A Paid Duty Request Form can be obtained from any police station or the Toronto Police Central Paid Duty Office at 416-808-7880. The form and the current hourly rates of police officer for traffic control pay, which are provided in the terms of agreement at the back of the form, are updated once every January of the year. To download the Paid Duty Request Form, visit www.torontopolice.on.ca/paidduty/.

TS 1.00.07.12.03.05 *Determining the Actual Need for Police Officer for Traffic Control*

The need for police officers for construction and maintenance (utility cut permit related) work on City roads generally follows the criteria in TS 1.00.07.11.03.02, herein, and has to be determined on a case-by-case basis. The Transportation Services representative shall determine the actual need for police officer according to site conditions and in consultation with the Contract Administrator, the Contractor and the Toronto Police Traffic Services Construction Liaison Officer 416-808-1952.

The actual need for police officer for traffic control shall be determined at the pre-construction meeting and site meetings. Transportation Services representatives and the Toronto Police Traffic Service Construction Liaison Officer shall be invited to the pre-construction and site meetings. It is at their discretion to decide if they will attend the meeting.

City Contract Administrators and inspectors shall monitor the use of police officers for traffic control at the site and intervene whenever the presence of police officer for traffic control is deemed necessary or not warranted based on the conditions specified in this specification.

TS 1.00.07.12.03.06 *Transportation Services Representatives*

The Contractor is required to contact the respective work zone traffic coordinator in your work area to determine the need for a police officer for traffic control and on any other aspect of the road emergency that requires immediate action.

TS 1.00.07.12.03.07 *Disputing the Need for a Police Officer on Site*

Should a dispute arise between police officers on patrol with regards to the need for traffic control at a construction site, a Traffic Services Construction Liaison Officer and a representative of Transportation Services, shall consult to determine if additional traffic control measures are required at the site. No claims for delay, resulting from these matters, will be considered by the City.

TS 1.00.07.12.03.08 *Work Instructions to Police Officer*

In addition to the brief description of police officer for traffic control duties provided by a Contractor in a Paid Duty Request Form, the Contractor shall provide the police officer for traffic control with detailed written work instructions. The instructions shall be related to the specific site and handed to the police officer for traffic control at the time of his/her arrival to the site.

TS 1.00.07.12.03.09 *Change and Cancellation*

The Contractor shall notify the Central Paid Duty Office immediately about any change, cancellation, or a need for additional police officer for traffic control. Any changes or cancellations shall be made according to the Terms of Agreement.

Toronto Police Service requires a minimum cancellation time of 12 hours prior to the scheduled start time. Failure to give sufficient notification will result in Contractor paying a minimum payment of three hours per police officer, along with all associated fees and taxes.

A police officer's maximum working period is 12 hours in a 24 hour period. The Contractor shall make bookings of additional police officer for traffic control in a timely manner, when necessary.

TS 1.00.07.12.03.10 *Reimbursing Police Officer for Traffic Control*

The Contractor shall be responsible to pay the Toronto Police Service for services provided by the police officer for traffic control according to the Terms of Agreement, based upon the hourly wage rate in effect at the time.

The Contractor shall record police officer's names, badge numbers and hours of work and provide the Contract Administrators and City inspectors with a summary sheet outlining the events of police officer arrangement and copies of corresponding invoices.

TS 1.00.07.12.03.11 *Relocating Legally Parked Vehicles and Parking Enforcement*

The procedure to relocate legally parked vehicles due to construction activities shall be discussed at the pre-construction meeting. The Contractor shall follow the Toronto Police Service procedure entitled *Procedure for Construction Companies Relocating Legally Parked Vehicles* to relocate legally parked vehicles in the construction zone.

Legally parked vehicles may be relocated to accommodate construction using one of the six Toronto Police Service contract towing companies provided in the Toronto Police Service procedure. The Contractor shall assume the towing costs.

The relocation will only be carried out in the presence of either a parking enforcement officer or the police officer working with the Contractor that day. The police officer must be present to record the vehicle's information. The vehicles relocated from one legal parking location will be relocated to another legal location nearby.

Parking enforcement can be requested by calling either Parking Enforcement East in the east end of the city at 416-808-6600 or Parking Enforcement West in the west end of the city at 416-808-1600.

TS 1.00.07.12.04 *Mass Transit*

The Contractor shall coordinate all staging with any transit commission, for example TTC and GO, school or tour group that may have a bus stop or travel within the construction limits. Special attention shall be given to loading and unloading areas for disabled persons and school buses.

The Contractor shall provide access to all existing bus stops. The relocation and reinstatement of the bus stops shall be performed by the Contractor, under the direction of the transit authority or the City.

All costs associated with relocating and providing temporary bus stops shall be borne by the Contractor, except for any temporary ramps or accesses which will be paid for under the appropriate items.

There will be no additional payment for any delays caused by the Contractor having to stage his work around the transit commissions.

TS 1.00.07.13 *Maintenance of Temporary Work*

Until the final course of asphalt and the permanent pavement markings have been placed, the travelled portion of the road shall be considered as temporary traffic lanes.

Temporary traffic lanes shall be maintained so that there are no irregularities exceeding 40 mm. All crosswalks shall be ramped using temporary Superpave 9.5, Traffic Category B asphalt to provide smooth transitions between the base asphalt and the top surface of the crosswalk. Utility frames and covers, valve boxes and so on shall be ramped with hot mix asphalt or covered over with a steel plate or maintained flush with the surface of the asphalt. After final adjustment to finish grade, the appurtenances shall be ramped as described above. Prior to the placement of the final course of hot mix asphalt, the ramps must be removed without disturbing the base to allow the final course asphalt to be placed to its full depth.

The cost of any necessary patching of temporary traffic lanes or regarding of temporary access to driveways and side streets or regarding of temporary sidewalks or bicycle facilities shall be paid for at the Contract Price for stone and asphalt under the general heading "Maintenance of Traffic". If no such items exist, no separate payment will be made and all costs associated with this temporary work shall be factored into other related pay items.

Should the Contractor fail to correct any unsatisfactory condition upon notification from the City staff to do so, the City may proceed to maintain the project and deduct the entire cost of such maintenance from monies due to the Contractor.

TS 1.00.07.14 Maintenance of Temporary Accesses

The Contractor shall provide safe, convenient and free of obstacles temporary vehicular, wheel chair and pedestrian access to driveways, sidewalks, storefronts, bicycle facilities, bus stops, bus shelters and other public amenities in and around the area of construction at all time during construction.

The Contractor shall at all times, keep all temporary traffic lanes, sidewalks, foot paths, pedestrian ramps, entrances and exits to buildings and facilities free from accumulation of dust, waste materials and rubbish due to its employees or the work.

The Contractor shall keep all temporary access ways free from accumulation of free standing pools of water or oily surface, snow or ice formations, and to warn users of the access ways to beware of slippery conditions. The Contractor shall apply salt and sand to the access ways when there is an accumulation of snow and ice on the ground.

Cleaning up, to the satisfaction of the Contract Administrator shall be a mandatory condition to the final acceptance of the Work.

Should the Contractor fail to maintain or, in the opinion of the Contract Administrator, not expedient to maintain the temporary accesses to the satisfaction of the City, the City may, notwithstanding section GC 4.06, GC 4.07 and GC 4.08 of the City of Toronto General Conditions of Contract, take the appropriate action to remove the obstacles and deduct the total costs of such action from the monies due to the Contractor.

TS 1.00.07.15 Night Time Lighting

The minimum lighting level necessary for housekeeping, access and egress is 55 lux. For more complex areas, additional lighting may be required according to The Lighting Handbook, Night Time Lighting Guidelines for Work Zones and Best Practices for Traffic Control During Night Time Operations.

Spot or task lighting can be used to supplement general lighting requirements when necessary, but may not replace the general duty to provide lighting in all areas

The Contractor shall have a light meter on site and provide the test reading results to the Contract Administrator or inspector showing compliance with the lighting requirements.

TS 1.00.08 QUALITY ASSURANCE

City staff shall conduct inspections, as required, and the Contractor shall be notified of any deficiency in writing. Repairs shall be carried out according to TS 1.00.07, herein.

TS 1.00.09 MEASUREMENT FOR PAYMENT

TS 1.00.09.01 Granular A for Maintenance of Traffic
Superpave 9.5 Asphalt for Maintenance of Traffic
Superpave 19.0 Asphalt for Maintenance of Traffic

Measurement for the above item(s) shall be by mass in tonne (t).

TS 1.00.09.02 Site Fence

Measurement of site fence shall be by length in metres (m) of site fence required to be in place at any one time during the life of the Contract.

TS 1.00.09.03 Relocate Site Fence

Measurement of relocate site fence shall be by length in metres (m).

TS 1.00.09.04 Crowd Control Barrier

Measurement of crowd control barrier shall be by length in metres (m) for the maximum number of barrier sections required to be in place at any one time during the life of the Contract.

TS 1.00.09.05 Relocate Crowd Control Barrier

Measurement of relocate crowd control barrier shall be by length in metres (m).

**TS 1.00.09.06 Temporary Precast Concrete Barrier
Temporary Triton Barrier**

Measurement for the above item(s) shall be by length in metres (m) of the maximum length of barrier required to be in place at any one time during the life of the Contract.

**TS 1.00.09.07 Relocate Temporary Precast Concrete Barrier
Relocate Temporary Triton Barrier**

Measurement for the above item(s) shall be by length in metres (m).

TS 1.00.09.08 Traffic Control

Measurement for the above item shall be by lump sum. Contractors shall determine the lump sum amount and submit the amount in their bids.

TS 1.00.10 BASIS OF PAYMENT

TS 1.00.10.01 General

The following items may or may not appear in the Contract Documents. If these items do not appear, then the cost of temporary work required under this specification should be factored into other pay items by the Contractor.

No separate payment shall be made for the provision of temporary drainage works. Payment for this work shall be deemed to be included in the unit prices bid for the other items.

No additional payment will be made for any re-handling required incorporating any reusable material into the final or temporary works.

No additional payment will be made for the replacement of any item that has become damaged as a result of the Contractor's actions or by any other means.

TS 1.00.10.02 Granular A for Maintenance of Traffic – Item
Superpave 9.5 for Maintenance of Traffic – Item
Superpave 19.0 for Maintenance of Traffic – 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 supply, placing and compacting of granular materials and hot mix asphalt to construct road detours and temporary ramps, the removal, placing and compacting of all reusable materials and any excavation required for the construction of all detours.

The removal of all temporary asphalt and contaminated aggregate, by whatever means, shall be paid for under the item "General Excavation".

TS 1.00.10.03 Site Fence – 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 the supply, erection, maintenance, relocation and removal of all site fence and the preparations to the concrete road base, if required.

TS 1.00.10.04 Relocate Site Fence – 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 the relocation of all site fences.

TS 1.00.10.05 Crowd Control Barrier – 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 the supply, erection, maintenance, and removal of all crowd control barriers.

TS 1.00.10.06 Relocate Crowd Control Barrier – 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 the relocation of all crowd control barriers.

TS 1.00.10.07 Temporary Precast Concrete Barrier – Item
Temporary Triton Barrier – 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, maintenance, relocation and removal of all temporary concrete barriers, including tapered end treatments. All other end treatments will be paid for under the appropriate item(s).

TS 1.00.10.08 Relocate Temporary Precast Concrete Barrier – Item
Relocate Temporary Triton Barrier – 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 relocation of all temporary concrete barriers, including tapered end treatments. All other end treatments will be paid for under the appropriate item(s).

TS 1.00.10.09 Traffic Control – 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 the production of Traffic Control Plan, Traffic Protection Plan, Night Time Lighting Plan all costs associated with the supply of police officers, traffic control persons, the supply, placing, maintenance, relocation and removal of all signs, barricades and other traffic control devices that are not covered in other pay items of the contract.

The Contractor shall provide support documents to the Contract Administrator on the use of police officers and the supply of various traffic control measures related to the contract, including, but not limited to, the invoices charged to the Contractor by the Toronto Police Service. The City will only pay the invoices and other traffic control related charges that are proved to be actually provided in the contract. Payment shall be evenly distributed over the duration of the contract.

**Construction Specification for
Field Office**

Table of Contents

TS 1.10.01	SCOPE	2
TS 1.10.02	REFERENCES	2
TS 1.10.03	DEFINITIONS – Not Used.....	2
TS 1.10.04	DESIGN AND SUBMISSION REQUIREMENTS.....	2
TS 1.10.05	MATERIALS – Not Used	2
TS 1.10.06	EQUIPMENT	2
TS 1.10.06.01	Separate Telephone Line.....	3
TS 1.10.06.02	Parking	4
TS 1.10.07	CONSTRUCTION – Not Used.....	4
TS 1.10.08	QUALITY ASSURANCE – Not Used	4
TS 1.10.09	MEASUREMENT FOR PAYMENT	4
TS 1.10.09.01	Field Office.....	4
TS 1.10.10	BASIS OF PAYMENT.....	4
TS 1.10.10.01	Field Office – Item.....	4

TS 1.10.01 SCOPE

This specification covers the requirements for the supply, maintenance, relocation, and removal of the field office, parking, hydro hook-up and consumption, air conditioning, heating, taxes, insurance and permits.

TS 1.10.02 REFERENCES

Ontario Ministry of Transportation

Ontario Traffic Manual Book 7 Temporary Conditions

TS 1.10.03 DEFINITIONS – Not Used**TS 1.10.04 DESIGN AND SUBMISSION REQUIREMENTS**

For all products to be used at the site by the Contractor during the Contract, a list of the materials with reference to the Material Safety Data Sheet (MSDS) shall be placed at a conspicuous location at field office, all documents shall be accompanied with the most recent detailed product specification sheet, and be available at all times to persons affected by the materials.

TS 1.10.05 MATERIALS – Not Used**TS 1.10.06 EQUIPMENT**

The field office shall be constructed and equipped according to occupational health and safety requirements and shall include the following

- a) a supply of fresh cold drinking water
- b) a sanitary system including a toilet adequate for the sole use of City staff
- c) a working fire extinguisher mounted next to all entrances
- d) a supply of working smoke alarm and a working carbon monoxide detector
- e) a properly equipped and maintained first aid kit
- f) a properly equipped and maintained portable eye-wash kit
- g) adequate lighting
- h) adequate heating and air-conditioning to maintain the trailer at 20°C
- i) a printer equipped with adequate supply of consumables such as 8½ inch x 11 inch and 8½ inch x 14 inch paper, ink cartridges and toner cartridges
- j) one copy of the Occupational Health and Safety Act
- k) one copy of the applicable traffic control plan according to Ontario Traffic Manual Book 7
- l) one copy of the Notice of Project from the Ministry of Labour and
- m) one copy of all appropriate Form 1000 for all subcontractors and City staff and their subcontractors.

The field office shall be of a standard equal to that is usual in the trade for such construction. The field office shall be a smoke free environment according to City bylaws.

The field office shall be installed at a place that will not obstruct the free and safe movement of vehicles and pedestrian traffic. The Contractor shall ensure that the field office is provided with safe, easy and adequate means for entering and exiting the field office for all users. The location of the field office shall be approved by the Contract Administrator.

The field office shall have a minimum interior area of 25 square metres. The field office shall be equipped with three glass windows fitted with security bars and acceptable window blinds, exterior door(s) with dead bolt lock system(s), including padlock(s) with three sets of keys for each lock system(s). The field office shall be for the sole use of the Contract Administrator.

The field office shall be supplied with electric outlets, a lockable filing cabinet with two or more drawers, an office desk with a working adjustable ergonomic office chair, waste basket, a 1200 mm x 2400 mm size table with four chairs, a water cooler with an adequate supply of drinking water and disposable cups. The Contractor is responsible for connecting, maintaining and disconnecting all electrical, heating and plumbing utilities and any approvals or permits required at their expenses. No Smoking signs shall be posted at all common areas.

A fully self-contained heated washroom unit shall be provided alongside with the field office for the sole use of the Contract Administrator. The washroom unit will contain a chemical flush toilet, urinal, hot water sink, at least lukewarm and cold running water, heated with exhaust fan, interior lighting, and lockable.

A power requirement of 110V 15AMP is required to connect to the unit.

Janitorial services must be provided at once a week, and the toilet should be properly maintained in a clean condition acceptable to the Contract Administrator. Toilet tissue and a hand disinfectant solution shall be supplied regularly.

The Contractor shall service, maintain and carry insurance on the field office and its contents. The Contractor shall provide evidence of the insurance to the Contract Administrator before work commences. The field office shall be provided 7 Days prior to the commencement of work, and shall remain up to 30 Days after the completion of Contract. The field office shall be removed from the site within 3 Working Days of being notified by the Contract Administrator. Work shall not be permitted to start, other than utility locates and the placement of advance warning signs, until the field office is properly supplied and installed.

Under no circumstances shall the field office be used for the storage of tools or materials or for the Contractor's use.

The field office shall be cleaned and garbage shall be disposed of weekly to the satisfaction of the Contract Administrator.

TS 1.10.06.01 Separate Telephone Line

Installation and services costs of telephone lines with a phone, fax/copier on a separate line is not required.

TS 1.10.06.02 Parking

Provide two legal parking spaces 2.4 m x 4.8 m in size adjacent to the field office or provide parking spaces at an adjacent parking facility for two vehicles for the Contract Administrator. The parking spaces shall be provided 7 Days prior to the commencement of work and shall remain up to 30 Days after the completion of Contract.

TS 1.10.07 CONSTRUCTION – Not Used

TS 1.10.08 QUALITY ASSURANCE – Not Used

TS 1.10.09 MEASUREMENT FOR PAYMENT

TS 1.10.09.01 Field Office

For measurement purposes, a count shall be made of the number of field offices and paid by the following schedule

- a) 50% Supply and Installation
- b) 10% Removal
- c) 40% Pro-rated over the length of the project.

TS 1.10.10 BASIS OF PAYMENT

TS 1.10.10.01 Field Office – 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.

In the event there is a delay in the installation of the field office and all of its components even after all City requirements for its setup are completed, the total payment shall be pro-rated according to subsection TS 1.10.09.01, herein.

If for any reason the field office is removed without the Contract Administrator's approval, deduction (pro rated) shall be applied according to subsection TS 1.10.09.01, herein.

**Construction Specification for
Garbage Collection**

Table of Contents

TS 1.20.01	SCOPE	2
TS 1.20.02	REFERENCES – Not Used	2
TS 1.20.03	DEFINITIONS	2
TS 1.20.04	DESIGN AND SUBMISSION REQUIREMENTS – Not Used	2
TS 1.20.05	MATERIALS	2
TS 1.20.06	EQUIPMENT	2
TS 1.20.07	CONSTRUCTION	2
TS 1.20.08	QUALITY ASSURANCE – Not Used	3
TS 1.20.09	MEASUREMENT FOR PAYMENT	3
TS 1.20.09.01	Garbage Collection	3
TS 1.20.10	BASIS OF PAYMENT	3
TS 1.20.10.01	Garbage Collection – Item	3

TS 1.20.01 SCOPE

This specification covers the requirements for the collection of all garbage bins, recycling bins and green bins within the contract limits.

TS 1.20.02 REFERENCES – Not Used

TS 1.20.03 DEFINITIONS

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

Recycling Bin means the container used for the collection of glass bottles and jars, metal food and beverage cans, plastic bottles and jugs, and aluminum foil and paper materials. Also referred to as blue bin.

Green Bin means collects organic waste such as fruit and vegetables scarps, paper towel, coffee grinds and so on and turns it into compost.

Paper Materials means any writing and computer paper, envelopes (all colours), junk mail, paper egg cartons, cardboard rolls from toilet paper, paper bags, paper gift wrap and greeting cards, boxboard (shoe and office supply boxes), newspaper, magazines and telephone books and corrugated cardboard.

Hazardous Waste means all waste marked corrosive, flammable, explosive or poisonous.

Construction/Renovation Waste means any material typically used for the construction or renovation of a building, such as wood lath, particle board, drywall and so on.

TS 1.20.04 DESIGN AND SUBMISSION REQUIREMENTS – Not Used

TS 1.20.05 MATERIALS

The work shall include replacement of garbage bags where used in municipal containers, whenever the containers are emptied.

Hazardous and construction/renovation waste shall not be collected.

TS 1.20.06 EQUIPMENT

Garbage, blue and green bins shall be collected by using pedestrian operated carts or buggies along the sidewalk only unless no sidewalk exists on the street. Under no circumstances shall the Contractor collect the bins by vehicle or vehicles operating from the travel portion of the lanes in any location where sidewalks are available.

TS 1.20.07 CONSTRUCTION

Garbage, recycling and green bins from private residences, apartments, stores and businesses, which is ordinarily left at the curbside, and the contents of all municipal garbage containers, within the contract limits shall be collected and stockpiled at pre-determined locations on adjacent side streets or at the edge of the contract limits.

The locations shall be selected as to minimize the disruption to the regular flow of traffic. The piles shall be spread out so that the garbage truck is not stopped at any one location for any extended period of time.

The garbage, recyclables and green bin collection and relocation to stockpiles shall be undertaken at a regularly scheduled time, approved by the Contract Administrator six days a week. All regular pickups must be maintained, whether the Contractor is working that day or not.

The Contractor shall be responsible for returning individual garbage, recycling and green bins to the correct curbside location from where they were collected.

TS 1.20.08 QUALITY ASSURANCE – Not Used

TS 1.20.09 MEASUREMENT FOR PAYMENT

TS 1.20.09.01 Garbage Collection

Measurement shall be by lump sum and shall be pro-rated for each month of the Contract.

TS 1.20.10 BASIS OF PAYMENT

TS 1.20.10.01 Garbage Collection – Item

Payment at the Contract Price for the above tender item shall include full compensation for all labour, Equipment and Material to do the work. The cost of all labour and equipment required to provide garbage, recycling and green bin collection on non-working days shall be included in the Contract Price for this item.

**Construction Specification for
Steel Plates Used in Connection with Roadway Utility Excavations**

Table of Contents

TS 1.30.01	SCOPE	2
TS 1.30.02	REFERENCES	2
TS 1.30.03	DEFINITIONS – Not Used.....	2
TS 1.30.04	DESIGN AND SUBMISSION REQUIREMENTS.....	2
TS 1.30.05	MATERIALS.....	2
TS 1.30.05.01	Steel Plate Requirements	2
TS 1.30.06	EQUIPMENT – Not Used	3
TS 1.30.07	CONSTRUCTION	3
TS 1.30.07.01	Installation.....	3
TS 1.30.07.02	Safety	4
TS 1.30.07.03	Signage.....	5
TS 1.30.07.04	Seasonal Requirements.....	5
TS 1.30.08	QUALITY ASSURANCE – Not Used	5
TS 1.30.09	MEASUREMENT FOR PAYMENT – Not Used.....	5
TS 1.30.10	BASIS OF PAYMENT.....	5

TS 1.30.01 SCOPE

This specification covers the requirements for the placement and removal of steel plates over open excavations within the public right-of-way.

TS 1.30.02 REFERENCES

City of Toronto Standard Drawings

T-216.02-18 Steel Plate Ahead

Ontario Ministry of Transportation

Ontario Traffic Manual Book 7 Temporary Conditions

Canadian Standards Association

G40.21

38W/260W Standard Specification for Carbon Structural Steel

Canadian Highway Bridge Design Code (CHBDC)

CL-625 ONT Loading Conditions (17,845 kg for one axle or 28,552 kg for tandem axle at 1.2 m axle spacing)

TS 1.30.03 DEFINITIONS – Not Used

TS 1.30.04 DESIGN AND SUBMISSION REQUIREMENTS

For trenches and installations with spans greater than 1.20 m, a structural design shall be prepared by a professional engineer licensed in the province of Ontario. Design of plate thickness shall be according to the maximum allowable span of the steel plate over the trench in the roadway, and the maximum dead and live loads that steel plate can undertake from the roadway. Indicate the required minimum plate overlap in the design report.

TS 1.30.05 MATERIALS

Where road plates are used to facilitate vehicle crossings, the Contractor must have a satisfactory supply of road plates at the job site before commencing work.

TS 1.30.05.01 Steel Plate Requirements

Steel plates shall be able to withstand CL-625-ONT traffic loading without any lateral movement.

Steel plates shall be fabricated to meet G40.21 38W/260W steel requirements.

When two or more of plates are in place more than three consecutive days without the need to accomplish work or inspections, the plates shall be tack welded together at each corner to reduce or eliminate vertical movement. Alternative methods to accomplish this, such as metal connectors, will be considered for approval on case by case basis.

Steel plates shall be installed to resist bending, vibrations and loud rattling under traffic loads and shall be anchored securely to prevent movement. If these conditions are not met, the Contractor shall be required to backfill and pave the excavation daily, or use alternative methods such as “Plate Locks” which are designed to secure the plates with minimum noise and vibration.

All steel plates within the right-of-way, whether used in or out of the traveled way, shall be without deformation. The plate surface must not deviate more than 6.35 mm when measured with a 3.0 m straight edge along the length of the plate.

In the event of improper installation of the steel plates that presents a nuisance or a public safety problem, the Contractor shall respond to all excavation restoration requests by the City immediately upon notification. Non-responses will result in the required restoration work being done by the City, with all expenses to be paid by the Contractor.

Steel plates must extend a minimum of 300 mm beyond the edges of the excavation and be countersunk so that the surface of the plates is flush with the adjacent pavement.

Before steel plates are installed, the excavation shall be adequately shored to support the bridging and traffic loads.

Where deformations in the existing pavement do not allow the plate surface to match the adjacent pavement, temporary paving with a cold asphalt mix should be used to feather the edges of the plate to form a wedged taper to cover the edges of the steel plate.

Wedges or other non-asphaltic devices shall be used for leveling as required to eliminate rocking of the plates. Compacted temporary asphalt shall be used to fill all gaps between the plates and existing pavement surfaces.

Steel road plates shall have a welded-open diamond mesh for traction and painted traffic yellow for high visibility. Steel road plates shall have a minimum thickness of 13 mm when used on sidewalks and a minimum thickness of 25 mm when used on roadways.

Other equivalent road plates with a skid resistant surface in a highly visible colour may be used with the approval of the Contract Administrator.

TS 1.30.06 EQUIPMENT – Not Used

TS 1.30.07 CONSTRUCTION

TS 1.30.07.01 Installation

The steel plate installation shall be recessed by milling into the existing asphalt to set flush with the surface of the existing asphalt. The pavement shall be cut and cold planed to a depth equal to the thickness of the plate and to a width and length equal to the dimensions of the plate. Full depth cutting of the asphalt section of excavation is not permitted. Wedges or other non-asphaltic devices shall be used for leveling as required to eliminate rocking of the plates. Compacted temporary asphalt (cold mix) shall be used to fill the gap between the edge of the plate and the adjacent existing asphalt pavement.

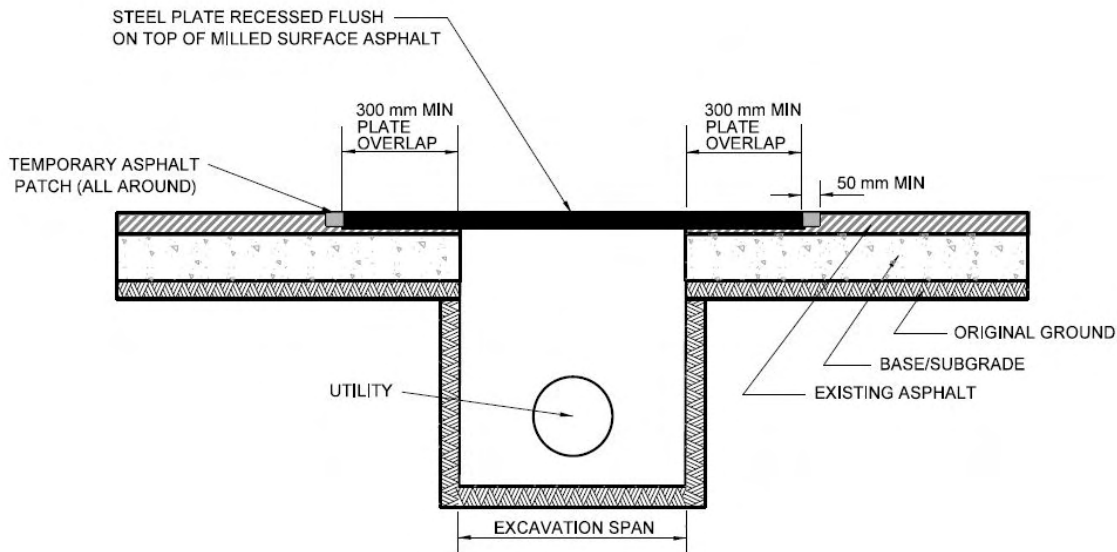


Figure 1 – Installation Detail

TS 1.30.07.02 Safety

Provisions should be made for the safety and protection of vehicular and pedestrian traffic during the construction period as follows:

- The Contractor shall be responsible for the furnishing, erection and maintenance of all required traffic control devices. All signs and devices shall be according to the requirements of the current edition of the Ontario Traffic Manual Book 7 Temporary Conditions
- When in the opinion of the Contract Administrator, City inspector or Work Zone Traffic Coordinator, the work constitutes a hazard to traffic in any area of the work, the Contractor may be required to suspend operations during certain hours and to remove any equipment from the area of work
- The roadway surface shall be kept clean of debris at all times and should be thoroughly cleaned at the completion of the work.
- The Contractor shall be responsible to replace all pavement markings in kind which have been disturbed as a result of the excavation.
- Routine inspection and maintenance depending on the duration of the installed steel plate be performed every Day during when in use.

TS 1.30.07.03 Signage

In addition to any traffic control devices required by the Work Zone Traffic Coordinator, warning signs advising motorists that they should expect to encounter steel plates, shall be placed at approximately 30 m in advance of the steel plate location. Steel plate ahead sign shall be according to T-216.02-18.

Plates left overnight may require, at the discretion of the Work Zone Traffic Coordinator, that the sign be supplemented with a Type "A" Low-Intensity-flashing warning light mounted on the sign support.

TS 1.30.07.04 Seasonal Requirements

Where possible, limit the use of plates during winter, given the possibility of ploughing operations.

TS 1.30.08 QUALITY ASSURANCE – Not Used

TS 1.30.09 MEASUREMENT FOR PAYMENT – Not Used

TS 1.30.10 BASIS OF PAYMENT

All costs associated with this Work shall be considered incidental to all related items of Work. No separate payment shall be made.

**Construction Specification for
General Excavation****Table of Contents**

TS 2.10.01	SCOPE	2
TS 2.10.02	REFERENCES	2
TS 2.10.03	DEFINITIONS	2
TS 2.10.04	DESIGN AND SUBMISSION REQUIREMENTS.....	2
TS 2.10.05	MATERIALS – Not Used	3
TS 2.10.06	EQUIPMENT – Not Used	3
TS 2.10.07	CONSTRUCTION	3
TS 2.10.07.01	General.....	3
TS 2.10.07.02	Existing Underground Utilities	3
TS 2.10.07.03	Shoring, Sheet piling and Bracing.....	4
TS 2.10.07.04	Excavation Method	4
TS 2.10.07.05	Excavating and Subgrade Preparation	4
TS 2.10.07.06	Drainage and Dewatering	5
TS 2.10.07.07	Constructing Ditches and Channels	5
TS 2.10.07.08	Unauthorized Excavation	6
TS 2.10.07.09	Backfilling of Over-excavated Areas and Voids.....	6
TS 2.10.07.10	Disposing of Stones, Broken Rock and Boulders	6
TS 2.10.07.11	Removal of Maintenance Items.....	6
TS 2.10.07.12	Disposing of Surplus and Unsuitable Material	6
TS 2.10.08	QUALITY ASSURANCE.....	7
TS 2.10.09	MEASUREMENT FOR PAYMENT	8
TS 2.10.09.01	General Excavation.....	8
TS 2.10.09.02	Strip Topsoil and Other Material from Ditches and Other Low Areas...	8
TS 2.10.09.03	Place and Compact Approved Material Ditches and Other Low Areas	8
TS 2.10.10	BASIS OF PAYMENT.....	8
TS 2.10.10.01	General Excavation – Item.....	8
TS 2.10.10.02	Strip Topsoil and Other Organic Material from Ditches and Other Low Areas – Item	9
TS 2.10.10.03	Place and Compact Approved Material in Ditches and Other Low Areas – Item	9

TS 2.10.01 SCOPE

This specification covers the requirements for general excavation, reuse and disposal of all materials necessary for construction of the earth subgrade to the specified profile and cross-section and for the rehabilitation of roadways, sidewalks, relocation, maintenance and installation of buried utilities, drainage or other reasons as specified in the Contract Documents.

The work shall also include the sloping and shaping necessary to prepare, alter, complete the construction of embankments, shoulders, ditches, boulevards, roadway and driveway intersections to the required alignment, grade and cross-sections shown as on the Contract Plans.

TS 2.10.02 REFERENCES

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

City of Toronto Standard Specifications

TS 13.10	Construction Specification for Unshrinkable Fill
TS 206	Amendment to OPSS 206 – Construction Specification for Grading
TS 405	Amendment to OPSS 405 – Construction Specification for Pipe Subdrain
TS 501	Amendment to OPSS.MUNI 501 – Construction Specification for Compacting

City of Toronto Standard Drawing

T-216.02-9	Cross-Section Limits for General Excavation (Payment Purposes Only)
------------	---

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Materials
OPSS.MUNI 212	Construction Specification for Borrow
OPSS.MUNI 510	Construction Specification for Removals

TS 2.10.03 DEFINITIONS

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

Excavation means the removal of all material encountered including rock, rubbish, earth, concrete, asphalt and concrete pavement structure, frozen earth and pipes.

Excess Excavation means all excavation beyond that specified, performed without written order of Contract Administrator.

Earthen Materials shall include unsuitable materials, clays, silts, sands, gravels, pavements, concrete, boulders, rock, and stone.

TS 2.10.04 DESIGN AND SUBMISSION REQUIREMENTS

The Contractor shall provide an environmental assessment report, from a qualified laboratory, attesting to the non-contaminated nature of any imported borrow to be incorporated into the work.

TS 2.10.05 MATERIALS – Not Used

TS 2.10.06 EQUIPMENT – Not Used

TS 2.10.07 CONSTRUCTION

TS 2.10.07.01 General

Excavation consists of the following:

- a) Roadway excavation includes the removal of earthen materials from within the roadway to construct the subgrade, including the removal of unsatisfactory material, to the grade and cross-section as shown on the plans. Excavation shall include for all facilities within the street right-of-way, including the street, sidewalk, curb and gutter, medians, driveways, alleys, easements, landscaping or other surface improvement work. All excavation zones shall be proof rolled, compacted, inspected and approved by the Contract Administrator prior to the placement of any subsequent materials.
- b) Any excavation required to remove temporary ramps, accesses, platforms and footpaths constructed under the maintenance items, which cannot be incorporated into permanent or other temporary construction.
- c) Salvaging, stockpiling and reuse of materials.
- d) Placing and compacting suitable excavated material as fill.
- e) Disposing of surplus and unsuitable materials.
- f) Localized or extended excavation of soft spots and other undesirable material.
- g) Excavation for utility service installation, repair or relocation.

Removal of excavated materials shall be according to OPSS.MUNI 510 or as specified in the Contract Documents. Excavation shall be to the lines and grades shown on the Contract Drawings. Care shall be taken to prevent damage to appurtenances and utilities which may be within the area of excavation.

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.

TS 2.10.07.02 Existing Underground Utilities

The Contractor shall be responsible for arranging underground locates of all utility assets prior to excavating. The Contractor shall not commence excavation in a location prior to a utility members marking the location of their utilities or indicating that none exist within the excavation limits outlined by the Contractor. Where necessary, the Contractor shall employ the services of a private utility locator to ensure that all utilities are located in a timely manner.

It is the Contractor's responsibility to verify the location and elevation of all existing utilities within the limits of the Work. The Contractor shall observe the locations of the stake outs, prior to commencing the Work, and in the event there is a discrepancy between the locations of the stake outs and the locations shown on the Contract Documents, that may affect the Work, the Contractor shall immediately notify the Contract Administrator and the affected utility companies, in order to resolve the conflict.

All existing buried utilities located within the excavation zone and any other facilities adjacent to the excavation shall be carefully supported and protected from damage as a result of the Contractor's operations. The Contractor shall be responsible for repairing any damaged underground utilities, as a result of the Contractor's actions during the course of the work, and shall do so at no extra cost to the City.

All costs associated with this work shall be considered incidental to all related items of work in the Contract. No separate payment will be made for costs incurred in obtaining utility locates.

TS 2.10.07.03 Shoring, Sheeting and Bracing

The Contractor shall furnish and install the required shoring, sheeting, and bracing and maintain such features to ensure the safety of workers and the public, protect the work, and protect existing facilities during excavation works.

The cost of constructing, maintaining and removing shoring, sheeting and bracing shall be considered as incidental to the construction of the project, and all costs, therefore, shall be included under the item or items for excavation.

TS 2.10.07.04 Excavation Method

The Contractor shall employ such construction methods, plant, procedures and precautions as shall ensure that excavations are stable, free from disturbance and, unless designated as sub-aqueous work.

Methods used in excavation shall be such as not to cause damage to surrounding property or to unnecessarily damage pavement. Mats shall be utilized for backhoe outriggers, track excavators and other equipment to prevent unnecessary damage to paved and unpaved surfaces.

TS 2.10.07.05 Excavating and Subgrade Preparation

All muck, peat and other unsuitable material shall be removed and disposed of off the site. All suitable excavated earthen materials approved by the Contract Administrator, shall be used in the construction of the earth grade and at such other places as shown on the plans of designated by the City. Existing road surfacing or granular base and subbase shall be removed and reused or disposed of.

The maximum amount of approved excavated materials available within the designated areas shall be salvaged. Reasonable care shall be exercised in removing and handling the designated material to prevent incorporation of foreign or undesirable material.

The Contractor shall schedule his operations so that all approved excavated material shall be incorporated directly into the work. Where this is not possible, the Contractor will be required to stockpile these materials within or outside construction limits at locations approved by the Contract Administrator for later inclusion in the work.

If there is an excess of salvaged material above that required in the new construction, the stockpiles of surplus material shall be managed by the Contractor according to OPSS 180.

In all cuts, the subgrade shall be graded, sloped and compacted to not less than 98% of the maximum dry density, according to TS 501, before placing any subsequent subbase or base material. The grading shall be so conducted as to avoid removing or loosening any material outside of the required slopes, and any such material which may be removed or loosened shall be replaced and compacted according to TS 501 and to the required profile and cross-section. All intersecting roads, approaches, entrances and driveways shall be graded as shown on the Contract Plans.

TS 2.10.07.06 Drainage and Dewatering

When either ground water or surface run-off is encountered, the Contractor shall furnish, install, maintain, and operate all necessary pumps, materials and equipment to keep excavation reasonably free from water until the placement of any subsequent material has been completed, inspected and approved.

All pumped or drained water shall be disposed of without undue interference to other work, or causing damage to pavements, other surfaces, or property. Water removed from the excavation shall be disposed of.

The roadbed, trenches and ditches shall be maintained in such condition, that the work will be well drained at all times. If it is necessary during construction to interrupt existing surface drainage, sewers or under-drainage, then temporary drainage facilities shall be provided until the permanent drainage work is completed. No additional payment will be made for this work.

Dewatering and the construction of all temporary drainage facilities shall be considered as incidental to the construction of the project, and all costs, therefore, shall be included under the item or items for excavation.

TS 2.10.07.07 Constructing Ditches and Channels

All suitable and approved materials excavated from ditches and from channel changes shall be used in the construction of earthen grade, or shall be otherwise managed and disposed of according to OPSS 180. No waste or surplus excavation shall be left within one metre from the edge of the ditch or channel. All roots, stumps and other objectionable materials in the slopes and bottom of the ditch shall be removed and the voids backfilled with approved material. All ditches and channels constructed on the project shall be maintained to the required cross-section and shall be kept free from debris until final acceptance.

TS 2.10.07.08 Unauthorized Excavation

When the bottom or sides of any excavation is taken out beyond the limits indicated or specified, the excess excavation shall be backfilled at the Contractor's expense, with Granular A and compacted according to TS 501. In areas that cannot be properly compacted unshrinkable fill shall be used.

TS 2.10.07.09 Backfilling of Over-excavated Areas and Voids

Where voids are encountered or unsuitable material has been excavated below the design grade, the excavation shall be backfilled, to the subgrade level, with material approved by the Contract Administrator and compacted according to TS 501 for the type of material chosen. If the backfill is granular or a non-clay material, the work area shall be fully drained prior to the backfill of the over excavation. Drainage shall be accomplished using 150 mm subdrain to the nearest ditch or catch basin and shall be according to TS 405, or an alternative recommended drainage plan provided by the Contractor and approved by the Contract Administrator.

The Contractor should note that the ditch or storm system may have to be adjusted to facilitate the drainage. No additional payment will be made for this work.

If the excavation cannot be drained in the above manner, the area is to be backfilled to the subgrade level, with unshrinkable fill according to TS 13.10.

TS 2.10.07.10 Disposing of Stones, Broken Rock and Boulders

All stones and boulders occurring within construction limits and all broken rock from rock cuts that are not required for the construction of cobble, gutter, riprap, or like structures, shall be placed in embankments, where possible. The stones, broken rock and boulders shall be placed in layers, and all voids shall be completely filled with sound, clean earth, thoroughly compacted according to TS 501. No layer of such material shall be placed within 300 mm of the surface of the earth grade, or within the limits of assumed 1H:1V slopes spreading outward from lines one metre outside of the edges of the proposed roadway construction such as pavement, interlocking brick, sidewalk and so on.

TS 2.10.07.11 Removal of Maintenance Items

All asphalt, concrete and contaminated granular used in the "Maintenance of Traffic" item(s) shall be excavated and disposed of, off the site.

All other material deemed reusable by the Contract Administrator shall be graded into and form part of the roadway subbase, in which case no allowance or payment will be made for the removal, re-handling and re-compaction of this material.

TS 2.10.07.12 Disposing of Surplus and Unsuitable Material

All suitable surplus excavated material approved by the Contract Administrator, which conforms with the requirements of TS 2.10.07.11, herein, shall be used when directed by the City to uniformly widen embankments, to flatten slopes and to fill low places in the right-of-way. Other suitable material shall be deposited in low places within the right-of-way as approved by the Contract Administrator.

All surplus or unsuitable excavated materials that cannot be used in the above manner shall be disposed of off the site and managed according to OPSS 180. No surplus material shall be placed or stored within the public right of way.

All such removal shall be completed before surfacing operations commences. No re-handling allowance will be made for any surplus material which requires disposal by the Contractor, at an approved offsite waste disposal location.

All excavated material of value to or required by the City, including materials from existing structures such as old lumber, stone flagging, granite blocks, cobble stones, paving brick, sewer or other pipe, sewer brick, maintenance holes or catch basin tops, valves, hydrants, and earth or any other materials, shall be neatly piled, deposited or evenly spread by the Contractor in such place as may be directed by the Contract Administrator. The whole expense including that of hauling, unloading and spreading shall be borne by the Contractor.

TS 2.10.08 QUALITY ASSURANCE

Quality assurance (QA) acceptance testing of the Work shall be conducted by the City's quality assurance consultant. Quality assurance inspection and testing shall include the following:

- a) Visual inspection and witnessing of proof rolling operations to determine soft spots or poor soil support conditions in excavated zones.
- b) Compaction testing according to TS 501.

All defective work areas uncovered through the quality assurance inspection and testing process shall be identified by the consultant to the Contract Administrator and Contractor and shall be immediately corrected by the Contractor. All corrected defect areas shall be inspected and re-tested by the quality assurance consultant.

Prior to leaving the construction site, the quality assurance consultant shall provide a copy of the field inspection and testing report to the Contract Administrator, on completion of the quality assurance inspection or testing. The Contractor may have a representative present during any quality assurance testing. During the quality assurance testing, the representative shall immediately comment on any aspects of the testing which the representative does not consider valid and the Contract Administrator will respond to the comments in order to resolve them. Prior to leaving the quality assurance testing, any unresolved comments regarding the testing procedures are to be given to the Contract Administrator in writing. Any comments on the testing procedures which are made subsequent to the Contractor's representative leaving the tested work zone will not be considered.

TS 2.10.09 MEASUREMENT FOR PAYMENT

TS 2.10.09.01 General Excavation Additional Excavation of Soft Spots

Measurement shall be by volume in cubic metres (m³). The volume shall be calculated as the difference between cross sections of the original ground and the cross sections of the final finished grade, in areas of cut according to T-216.02-9. The volume of excavated material may be as measured and agreed upon in the field if the average end area is impracticable.

Where a separate item is included for removal of concrete, asphalt, topsoil, sod or other material within the excavation limits, the volume shall not be deducted from measured volume of general excavation. Excavation beyond the lines and grades of the proposed cross sections will be disallowed unless authorized by the Contract Administrator in writing. Field cross sections shall be taken, by the Contractor, to establish the actual lines and grades where they differ from the proposed cross sections.

The volume of surplus of unsuitable material trucked from the site shall be calculated by box measurement only if the average end area is impracticable.

TS 2.10.09.02 Strip Topsoil and Other Material from Ditches and Other Low Areas

Topsoil and other organic materials stripped from ditches and other low areas shall be measured in linear metres (m) parallel to the direction of traffic. The Contractor shall investigate the depth of this material and the width of ditches before bidding on the above item.

TS 2.10.09.03 Place and Compact Approved Material Ditches and Other Low Areas

Approved excavated material from storm sewer and roadway excavations placed and compacted in ditches and other low areas shall be measured in linear metres (m) parallel to the direction of traffic.

TS 2.10.10 BASIS OF PAYMENT

TS 2.10.10.01 General Excavation – Item Additional Excavation of Soft Spots – 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 excavating of all materials encountered, for hauling, stockpiling, trimming, placing and compacting materials suitable for fill, for disposal of surplus or unsuitable materials off the site and all trimming, grading and compaction of the subgrade. Payment shall also include the removal and disposal of all temporary asphalt and contaminated aggregate.

No payment will be made for any and all excavation below the grades shown on the drawings, except where directed by the Contract Administrator in writing.

The cost to excavate and dispose of material to allow for the placement of new granular, concrete, asphalt, topsoil, sod or other material shall be incidental to the associated items. No separate payment shall be made.

TS 2.10.10.02 Strip Topsoil and Other Organic Material from Ditches and Other Low Areas – 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 the stripping of topsoil and other organic material from the ditches, the stockpiling of reusable material and the disposal off the site of any excess topsoil or other organic material.

TS 2.10.10.03 Place and Compact Approved Material in Ditches and Other Low Areas – 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 the placing and compacting or approved excavated material in ditches and other low areas.

**Construction Specification for
Concrete Curb and Concrete Curb and Gutter****Table of Contents**

TS 3.50.01	SCOPE	3
TS 3.50.02	REFERENCES	3
TS 3.50.03	DEFINITIONS	3
TS 3.50.04	DESIGN AND SUBMISSION REQUIREMENTS.....	4
TS 3.50.04.01	General.....	4
TS 3.50.04.02	Materials	4
TS 3.50.05	MATERIALS	4
TS 3.50.05.01	Concrete.....	4
TS 3.50.05.02	Reinforcement.....	5
TS 3.50.05.03	Granular Base and Curb Backfill.....	5
TS 3.50.05.04	Expansion Joint Material	5
TS 3.50.06	EQUIPMENT	5
TS 3.50.06.01	Forms	5
TS 3.50.06.02	Slipform Equipment.....	5
TS 3.50.06.03	Finishing Tools	6
TS 3.50.07	CONSTRUCTION	6
TS 3.50.07.01	Excavation	6
TS 3.50.07.02	Subgrade Preparation.....	6
TS 3.50.07.03	Granular Base Placement.....	6
TS 3.50.07.04	Utility Adjustment	6
TS 3.50.07.05	Utility Isolation.....	6
TS 3.50.07.06	Reinforcement.....	6
TS 3.50.07.07	Placing Concrete.....	7
TS 3.50.07.07.01	Concrete Curb.....	7
TS 3.50.07.08	Finishing Concrete.....	7
TS 3.50.07.09	Identification Stamp.....	7
TS 3.50.07.10	Joints.....	8
TS 3.50.07.10.01	Contraction Joints	8
TS 3.50.07.10.02	Expansion Joints	8
TS 3.50.07.10.03	Construction Joints	8
TS 3.50.07.11	Concrete Curing.....	8
TS 3.50.07.11.01	Curing with Burlap and Water.....	8

TS 3.50.07.11.02	Curing with Geotextile Fabric and Water	9
TS 3.50.07.11.03	Curing with Polyethylene Film	9
TS 3.50.07.11.04	Curing with Membrane Compound	9
TS 3.50.07.12	Concrete Curb and Curb and Gutter Protection	9
TS 3.50.07.13	Backfill.....	9
TS 3.50.08	QUALITY ASSURANCE	9
TS 3.50.08.01	Visibly Defective or Damaged Concrete	9
TS 3.50.09	MEASUREMENT FOR PAYMENT	10
TS 3.50.09.01	Concrete Curb Integral to Road Base	10
TS 3.50.09.02	Supplemental Cost for 7 Day Concrete.....	10
TS 3.50.09.03	Supplemental Cost for 24-hour Concrete.....	10
TS 3.50.10	BASIS OF PAYMENT	10
TS 3.50.10.01	Concrete Curb Integral to Road Base – Item	10
TS 3.50.10.02	Supplemental Cost for 7 Day Concrete – Item	11
TS 3.50.10.03	Supplemental Cost for 24-hour Concrete – Item	11

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-310.020-2	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 408	Construction Specification for Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers
OPSS 919	Construction Specification for Formwork and Falsework

Canadian Standards Association

A 23.1	Concrete Materials and Methods of Concrete Construction
--------	---

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 TS 1350.

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

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 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 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

Mark with an approved stamp at each end of the work, at each tenth bay or no less than 20 m interval. 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.

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.

**Construction Specification for
Concrete Sidewalk and Concrete Raised Median****Table of Contents**

TS 3.70.01	SCOPE	3
TS 3.70.02	REFERENCES	3
TS 3.70.03	DEFINITIONS	4
TS 3.70.04	DESIGN AND SUBMISSION REQUIREMENTS.....	4
TS 3.70.04.01	General.....	4
TS 3.70.04.02	Materials	4
TS 3.70.04.03	Contract Drawings Provided.....	5
TS 3.70.04.04	Contract Drawings Not Provided	5
TS 3.70.05	MATERIALS	5
TS 3.70.05.01	Concrete	5
TS 3.70.05.02	Granular Base and Backfill.....	6
TS 3.70.05.03	Welded Steel Wire Fabric	6
TS 3.70.05.04	Expansion Joint Material	6
TS 3.70.05.05	Tactile Walking Surface Indicators	6
TS 3.70.06	EQUIPMENT	7
TS 3.70.06.01	Forms	7
TS 3.70.06.02	Slipforming Equipment.....	7
TS 3.70.06.03	Finishing Tools.....	7
TS 3.70.07	CONSTRUCTION	7
TS 3.70.07.01	Excavation	7
TS 3.70.07.01.01	General.....	7
TS 3.70.07.01.02	Sidewalk	7
TS 3.70.07.01.03	Concrete Raised Median.....	8
TS 3.70.07.02	Subgrade	8
TS 3.70.07.03	Granular Base.....	8
TS 3.70.07.04	Form Placement.....	8
TS 3.70.07.05	Utility Adjustment	8
TS 3.70.07.06	Utility Isolation.....	9
TS 3.70.07.07	Reinforcement.....	9
TS 3.70.07.08	Placing Concrete.....	9
TS 3.70.07.09	Finishing Concrete	9
TS 3.70.07.10	Identification Stamp	10

TS 3.70.07.11	Joints.....	10
TS 3.70.07.11.01	Contraction Joints.....	10
TS 3.70.07.11.02	Expansion Joints	10
TS 3.70.07.11.03	Construction Joints.....	10
TS 3.70.07.12	Concrete Curing	10
TS 3.70.07.12.01	Curing with Burlap and Water	11
TS 3.70.07.12.02	Curing with Geotextile Fabric and Water	11
TS 3.70.07.12.03	Curing with Polyethylene Film	11
TS 3.70.07.12.04	Curing with Membrane Compound	11
TS 3.70.07.13	Concrete Protection.....	11
TS 3.70.07.14	Headers.....	12
TS 3.70.07.15	Ramps.....	12
TS 3.70.07.15.01	Installation of Tactile Walking Surface Indicators	12
TS 3.70.07.15.02	Installation Tolerances of TWSI Plates	12
TS 3.70.07.16	Restoration of Asphalt	12
TS 3.70.08	QUALITY ASSURANCE	12
TS 3.70.08.01	Visibly Defective or Damaged Concrete	12
TS 3.70.08.02	Concrete Thickness.....	13
TS 3.70.09	MEASUREMENT FOR PAYMENT	14
TS 3.70.09.01	Concrete Sidewalk.....	14
TS 3.70.09.02	Tactile Walking Surface Indicator	14
TS 3.70.09.03	Supplemental Cost for 7 Day Concrete.....	14
TS 3.70.09.04	Supplemental Cost for 24-hour Concrete.....	14
TS 3.70.10	BASIS OF PAYMENT	14
TS 3.70.10.01	Concrete Sidewalk – Item.....	14
TS 3.70.10.02	Concrete Raised Median – Item	15
TS 3.70.10.03	Tactile Walking Surface Indicator – Item.....	15
TS 3.70.10.04	Supplemental Cost for 7 Day Concrete – Item.....	15
TS 3.70.10.05	Supplemental Cost for 24-hour Concrete – Item.....	15

TS 3.70.01 SCOPE

This specification covers the requirements for the construction of plain or reinforced concrete sidewalks and concrete raised medians.

TS 3.70.02 REFERENCES

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

City of Toronto Standard Specifications

TS 310	Construction Specification for Hot Mixed, Hot Laid, Asphaltic Concrete Paving
TS 3.50	Construction Specification for Concrete Curb and Concrete Curb and Gutter
TS 3.80	Construction Specification for Concrete Unit Pavers
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	Amendments to OPSS.MUNI 1350 – Material Specification for Concrete – Material and Production

City of Toronto Standard Drawings

T-310.010-1	Location and Detail of Joints for Sidewalk
T-310.010-5	Joints at Sidewalk Openings
T-310.010-6	Construction Stamp Location for New Sidewalk Installation
T-310.010-7	Stamp for Concrete Work by Contractor
T-310.010-11	Stamp for Concrete Work by Utility
T-310.030-7	Signalized Intersection Configurations of Pedestrian Crossings
T-310.030-8	Controlled Non Signalized Intersection Configuration of Pedestrian Crossings
T-310.030-9	Location of Dropped Curbs at Controlled Intersections
T-310.030-10	Tactile Walking Surface Indicator and Curb Ramp Detail
T-310.030-11	Tactile Walking Surface Indicator and Depressed Curb Detail

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Materials
OPSS 919	Construction Specification for Formwork and Falsework

Canadian Standards Association

A 23.1	Concrete Materials and Methods of Concrete Construction
B 651-12	Accessible Design for the Built Environment

American Society of Testing and Materials

A 48	Standard Specification for Grey Iron Castings
C 174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
C 501-84	Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser

TS 3.70.03 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.

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 3.70.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 3.70.04.01 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 3.70.04.02 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 3.70.04.03 Contract Drawings Provided

The Contractor shall provide shop drawings and installation layout details (radius and tangent plate layout) for each radius. The Contractor shall not order any material until shop drawings have been approved. The City is not responsible for restocking or return charges or both for material ordered prior to the approval of the shop drawings.

All costs associated with this Work shall be incidental to all related items of Work. No separate payment shall be made.

TS 3.70.04.04 Contract Drawings Not Provided

The corner radius at the intersections varies from location to location. The City shall neither provide corner locations in advance nor will it supply any radius measurements to the Contractor. It shall be the sole responsibility of the Contractor to conduct survey and make assessment to retrofit corners with appropriate rectangular or radial tactile walking surface indicator plates or both. The Contractor shall provide shop drawings and installation layout details (radius and tangent plate layout) for each radius.

The City is not responsible for restocking or return charges or both for materials.

All costs associated with this Work shall be incidental to all related items of Work. No separate payment shall be made.

TS 3.70.05 MATERIALS

TS 3.70.05.01 Concrete

The materials for and the production of concrete sidewalks 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 3.70.05.02 Granular Base and Backfill

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

TS 3.70.05.03 Welded Steel Wire Fabric

Welded steel wire fabric shall be according to TS 1350.

All welded steel wire fabric detailed on the Contract Plans or ordered by the City for incorporation in the concrete sidewalk or raised median shall be 152 x 152 - MW 13.3 x MW 13.3 welded steel wire fabric at 1.46 kilograms per square metres.

TS 3.70.05.04 Expansion Joint Material

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

TS 3.70.05.05 Tactile Walking Surface Indicators

Tactile walking surface indicators shall be according to drawing T-310.030-10 and T-310.030-11 and made of cast iron according to CSA B651, follow Ontario Regulation 191/11 and meet the following requirements:

Table 1: Tactile walking surface indicators

Standard	Property	Minimum Result
ASTM A 48	tensile strength	class 30 B
ASTM C 1028	slip resistance	dry 0.8 min, wet 0.65 min
ASTM C 501-84	wear resistance	wear index: > 15

The truncated domes shall be of uniform size and shape. Units shall be uniform in texture, be free from pouring faults, sponginess, cracks, blowholes, and other defects, and have clean-cut and well-defined edges. All surfaces shall be bare, without any coating, and be uniform and free of flaking rust or mounts of rust or debris. Tactile walking surface indicators shall have ribs cast to the underside of the unit, have vent holes, and have a minimum plate thickness of 5 mm.

TS 3.70.06 EQUIPMENT

TS 3.70.06.01 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 3.70.06.02 Slipforming Equipment

The equipment shall be designed for slipforming concrete sidewalks and shall have automatic horizontal and vertical controls to be used in conjunction with at least one stringline.

TS 3.70.06.03 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 3.70.07 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 3.70.07.01 Excavation

TS 3.70.07.01.01 *General*

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

TS 3.70.07.01.02 *Sidewalk*

The excavation for the sidewalk shall be to the lines and grades specified by the Contract Administrator. Care shall be taken to prevent damage to utilities, window openings, areaways, and other appurtenances such as hydrants, water services, poles and gas valves which may be in or under the proposed sidewalk.

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.

TS 3.70.07.01.03 *Concrete Raised Median*

Where a raised median is to be placed on an existing pavement, the existing asphalt shall be removed down to the concrete base in the case of a composite pavement, or in the case of a flexible pavement, the asphalt shall be removed to a minimum depth of 75 mm. The existing asphalt shall be removed to form a straight vertical face by saw cutting to the required depth and to a sufficient offset to accommodate framework, but shall not exceed 150 mm from the face of the curb, gutter or median. The asphalt shall be completely removed to the required depth and all loose material swept from the area over which the raised median is to be constructed.

Where a raised median is to be placed, other than as described above, the requirements of the specifications for the individual components shall be used. The individual specifications shall include TS 3.50 and TS 3.80 for concrete curb and concrete curb and gutter, and interlocking pavers.

TS 3.70.07.02 *Subgrade*

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

TS 3.70.07.03 *Granular Base*

The granular base shall be placed to the required lines and grades. The compacted depth of granular base shall be 150 mm or as specified in the Contract Documents. 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.

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

TS 3.70.07.04 *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 crossfall of the sidewalk or raised median shall be at a slope of 2 per cent toward the gutter. When the optimum slope cannot be achieved, the Contract Administrator may instruct the Contractor to adjust the slope to a maximum of 4 per cent.

TS 3.70.07.05 *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 3.70.07.06 Utility Isolation

Utility isolations shall be constructed in the concrete sidewalk as shown on drawing T-310.010-5 at the locations as specified in the Contract Documents.

TS 3.70.07.07 Reinforcement

Welded steel wire fabric reinforcement or hook dowels, if necessary, shall be placed in the concrete sidewalk and concrete raised median to the details and location as specified in the Contract Documents.

TS 3.70.07.08 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 so as to provide a uniform rate of progress for the placing operation. Where concrete placing is interrupted for more than 45 minutes, a 12 mm thick bituminous fibre joint filler shall be placed vertically across the sidewalk width, to form an expansion joint, before resuming concrete placement.

The concrete shall be placed to the specified thickness, line and grade. 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 3.70.07.09 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 or swirl float texture.

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.

Sidewalks on grades of more than 5 per cent shall be broom finished transversely to the slope of the sidewalk.

The concrete adjacent to all formwork shall be finished with a tool that produces a 5 mm rounded edge and a smooth, horizontal surface with a maximum width of 50 mm. All tooling shall be uniform and straight and shall be depressed no more than 1 mm below the adjacent surface. Any ridges along the tooled marks shall be removed. Contraction and expansion joints shall not be finished with a tooled edge.

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

TS 3.70.07.10 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, 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.

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

The utility shall mark with an approved stamp according to T-310.010-11 at each end of the work, at each tenth bay, 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.

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

TS 3.70.07.11 Joints

TS 3.70.07.11.01 Contraction Joints

Contraction joints shall be placed transversely as shown on drawing T-310.010-1. Contraction joints shall also be placed longitudinally—parallel to the curb—and 1.5 m from the curb when the slab is 3 m or more in width. The depth of the contraction joint shall be one quarter the concrete thickness.

The maximum distance between joints in the raised median, shall be 2 m.

TS 3.70.07.11.02 Expansion Joints

Expansion joints shall be constructed to the full thickness of the sidewalk or raised median and shall be a maximum of 6 m apart.

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

Full depth (isolation) joints shall be formed where the concrete abuts buildings and rigid structures, changes direction, encounters appurtenances and shall be constructed as shown on drawing T-310.010-1. 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 3.70.07.11.03 Construction Joints

At the end of each day's work, or in the event of an unavoidable stoppage of concrete placement extending more than 45 minutes, an expansion joint shall be constructed at the planned location of a joint. Any excess concrete is to be removed and disposed of, off the site according to OPSS 180.

TS 3.70.07.12 Concrete Curing

Concrete curing shall be according to TS 1350.

TS 3.70.07.12.01 *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 3.70.07.12.02 *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 3.70.07.12.03 *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 3.70.07.12.04 *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 3.70.07.13 *Concrete Protection*

Concrete protection shall be according to TS 1350.

TS 3.70.07.14 Headers

Wooden headers, 40 mm thick and 160 mm deep shall be placed at all unpaved entrances or driveways. They shall be held in place by 40 mm x 80 mm stakes driven into the ground at least 700 mm at one metre centres and with the tops flush with the surface of the sidewalk.

TS 3.70.07.15 Ramps

Sidewalk accessibility ramps shall be according to drawing T-310.030-7, T-310.030-8, T-310.030-9, T-310.030-10 and T-310.030-11 with tactile walking surface indicator plates at all controlled and uncontrolled pedestrian crossings or as specified in the Contract Documents.

TS 3.70.07.15.01 *Installation of Tactile Walking Surface Indicators*

Tactile walking surface indicators plates shall be assembled prior to installation according to the manufacturer's installation instructions. The plates shall be set and pressed into wet concrete at each sidewalk ramp to the final elevation.

Remove any wet concrete that may spill onto the tactile walking surface indicator surface.

Tactile walking surface indicator plates shall be cut to fit around utility maintenance hole covers, hand wells and other appurtenances at no extra cost to the City.

TS 3.70.07.15.02 *Installation Tolerances of TWSI Plates*

Tactile walking surface indicators plates shall be positioned as close to the back of curb as possible; however, in order to accommodate corner radii, a maximum gap of 100 mm between the back of curb and the plates is acceptable.

TS 3.70.07.16 Restoration of Asphalt

The additional asphalt removed for framework is to be restored shall be according to TS 310. The asphalt shall be placed in lifts not to exceed 50 mm in depth after compaction.

TS 3.70.08 QUALITY ASSURANCE

Quality assurance shall be according to TS 1350.

TS 3.70.08.01 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 3.70.08.02 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 as per 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 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 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 3.70.10.

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 percent 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 3.70.10. Adjustment of the Contract Price for the lot shall be based on Table 2.

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 3.70.09 MEASUREMENT FOR PAYMENT

TS 3.70.09.01 Concrete Sidewalk Concrete Raised Median

Measurement of concrete sidewalk and raised median placed shall be by surface area in square metres (m²), without any deduction for maintenance holes and appurtenances. Concrete sidewalk that is monolithic with concrete curb shall be measured from the edge of the back of the sidewalk to the back of the curb—200 mm from the typical face of the curb.

TS 3.70.09.02 Tactile Walking Surface Indicator

Measurement of the above tender item shall be along the curb edge of the tactile walking surface indicators in linear metres (m).

TS 3.70.09.03 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 3.70.09.04 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 3.70.10 BASIS OF PAYMENT

TS 3.70.10.01 Concrete Sidewalk – 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 the supplying, placing and removal of the formwork, the supplying, placing, consolidating and finishing of the concrete and the curing and protection of the concrete sidewalk.

At the discretion of the Contract Administrator, payment for the item may be adjusted according to TS 3.70.08.02 and Table 2.

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.

TS 3.70.10.02 Concrete Raised Median – 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 the removal and disposal of the asphalt and granular material, the supplying, placing and removal of the formwork, the supplying, placing, consolidating and finishing of the concrete and the curing and protection of the concrete raised median.

At the discretion of the Contract Administrator, payment for the item may be adjusted according to TS 3.70.08.02 and Table 2.

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 2: Payment adjustment

Thickness Tx	Per cent payment
100 per cent of specified thickness or	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	remove and replace at no extra cost to the City

TS 3.70.10.03 Tactile Walking Surface Indicator – Item

Payment at the Contract Price for the above item 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, the supplying, placing, consolidating and finishing of the concrete, the supplying and placing of tactile walking surface indicators, and the curing and protection of the concrete curb, gutter and sidewalk.

TS 3.70.10.04 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 3.70.10.05 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.

Appendix 3.70-A, September 2019

For Use While Designing and Administering City Contracts

Note: This is a non-mandatory commentary appendix intended to provide information to a designer and contract administrator during the design and construction stage of a contract on the use of this TS specification in a City 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.

Notes to Designer:

The AODA mandates that tactile walking surface indicators (TWSI's) must be installed at a curb ramp or depressed ramp location when a new sidewalk is being constructed or when the sidewalk at the curb ramp / depressed ramp location is impacted by construction. As such, the designer must specify TWSI's when:

- new sidewalks are constructed;
an existing intersection is being reconstructed, widened or narrowed and impacts the existing sidewalk ramps;
- the existing sidewalk requires replacement due to condition; or,
- the existing sidewalk is being removed and replaced due to new traffic signal installation or other work.

There is no requirement under the AODA to retrofit TWSI's at intersection corners or other pedestrian crossing locations if the existing sidewalks are not impacted by construction. However, the above-noted AODA requirement is a minimum requirement and municipalities may choose to go beyond this minimum requirement.

To that end, Transportation Services division has developed its own operational guidelines for TWSI installation on all road resurfacing and road reconstruction projects, as follows:

- TWSI's are to be installed at all sidewalk ramps within the project limits.
- Typically, limits of projects will be at intersections. For these intersections at project limits, TWSI installation is not required if intersection corners are not impacted by the road work. However, if at least one corner is impacted by construction and requires TWSI's, then all intersection corners should be outfitted with TWSI's, regardless of condition and regardless of whether the pavement rehabilitation extends into the intersection.

Construction Specification for Concrete Unit Pavers

Table of Contents

TS 3.80.01	SCOPE	3
TS 3.80.02	REFERENCES	3
TS 3.80.03	DEFINITIONS	4
TS 3.80.04	DESIGN AND SUBMISSION REQUIREMENTS.....	4
TS 3.80.04.01	Bedding and Joint Sand	4
TS 3.80.04.02	Concrete Pavers	4
TS 3.80.04.03	Manufacturers Materials.....	4
TS 3.80.05	MATERIALS	5
TS 3.80.05.01	Granular Subbase	5
TS 3.80.05.02	Concrete Base	5
TS 3.80.05.03	Granular Base.....	5
TS 3.80.05.04	Bedding Sand	5
TS 3.80.05.05	Joint Sand.....	6
TS 3.80.05.06	Polymeric Sand – High Strength	6
TS 3.80.05.07	Concrete Pavers	6
TS 3.80.05.07.01	Concrete Paver Types	7
TS 3.80.05.07.02	Colour and Finish.....	8
TS 3.80.05.08	19 mm Type II Clear Stone	8
TS 3.80.05.09	Geotextile Fabric.....	8
TS 3.80.05.10	Edge Restraints	9
TS 3.80.06	EQUIPMENT	9
TS 3.80.07	CONSTRUCTION	9
TS 3.80.07.01	Excavation	9
TS 3.80.07.02	Base	9
TS 3.80.07.02.01	Granular Base.....	9
TS 3.80.07.02.02	Concrete Base	9
TS 3.80.07.02.03	Concrete Paver for Walkways, Sidewalks and Boulevards.....	10
TS 3.80.07.02.04	Concrete Paver for Roads.....	10
TS 3.80.07.02.05	Concrete Paver for Parking Lots	10
TS 3.80.07.02.06	Geotextile.....	11
TS 3.80.07.03	Bedding Sand	11
TS 3.80.07.04	Concrete Paver Placement	11

TS 3.80.08	QUALITY ASSURANCE	11
TS 3.80.08.01	Surface Tolerance	11
TS 3.80.08.02	Acceptance	12
TS 3.80.09	MEASUREMENT FOR PAYMENT	12
TS 3.80.09.01	Unit Pavers.....	12
TS 3.80.10	BASIS OF PAYMENT	12
TS 3.80.10.01	Unit Pavers – Item.....	12

TS 3.80.01 SCOPE

This specification covers the requirements for the installation of concrete unit pavers.

TS 3.80.02 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 501	Amendment to OPSS.MUNI 501 – Construction Specification for Compacting
TS 1003	Amendment to OPSS 1003 – Material Specification for Aggregates – Hot Mixed, Hot Laid, Asphaltic Concrete
TS 1010	Amendment to OPSS 1010.MUNI – Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
TS 1350	Amendment to OPSS 1350.MUNI – Material Specification for Concrete – Material and Production

City of Toronto Standard Drawings

T-310.020-2	Sidewalk Paved with Unit Paver Band at Curb
T-310.050-2	Vehicular Crossing of Sidewalk with Unit Paver Installation
T-561.030-1	Unit Pavers on Concrete Base Non-Vehicular Locations
T-561.030-2	Unit Pavers on Granular Base Non-Vehicular Locations

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Materials
OPSS.MUN1004	Material Specification for Aggregates – Miscellaneous

Canadian Standards Association

A23.1-FA1	Concrete Material and Methods of Concrete Construction, Table 4 Grading Limits for Fine Aggregate
A23.2-11C	Water Absorption of Concrete
A179	Mortar and Grout for Unit Masonry
A231.2	Precast Concrete Pavers

American Association of State Highway and Transportation Officials Standards

M-288	Standard Specification for Geotextile Specification for Highway Application
-------	---

American Society for Testing and Materials

C144	Standard Specification for Aggregate for Masonry Mortar
C979	Standard Specification for Pigments for Integrally Coloured Concrete
D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)

Interlocking Concrete Pavement Institute

Tech Spec 2	Construction of Interlocking Concrete Pavements
Tech Spec 3	Edge Restraints for Interlocking Concrete Pavements
Tech Spec 4	Structural Design of Interlocking Concrete Pavement for Roads and Parking Lots

Tech Spec 17	Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications
Tech Spec 22	Geosynthetics for Segmental Concrete Pavements

TS 3.80.03 DEFINITIONS

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

Aspect Ratio means the overall length of a paver divided by its thickness. Example: A 100 mm wide by 200 mm long by 80 mm thick paver has an aspect ratio of 2.5. Compare to Plan Ratio.

Bedding Sand means a layer of uncompacted sand that is screeded smooth prior to placement of the pavers.

Concrete Paver means a precast concrete paving product according to CSA A231.2.

Edge Paver means a precast concrete unit made or field cut with a straight side for placement flush with a concrete curb or other edge restraint.

Edge Restraint means a curb, edging, building or other appurtenance that is intended to confine the bedding sand and concrete pavers so that the pavers do not spread and lose interlock.

Laying Face means the exposed vertical face of a row of pavers on the bedding sand.

Plan Ratio means the overall length of a paver divided by its width. Example: A 100 mm wide by 200 mm long by 80 mm thick paver has an aspect ratio of 2.0. Compare to Aspect Ratio.

TS 3.80.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 3.80.04.01 Bedding and Joint Sand

Submit sieve analysis for the bedding and joint sand according to CSA A23.2A. Bedding material should be a minimum of 60 per cent sub-angular and sub-rounded according to ASTM D2488.

TS 3.80.04.02 Concrete Pavers

Submit five labelled representative full-size samples of each paver type, thickness, colour and finish expected in the finished installation. The Contract Administrator shall inspect the pavers for conformance. The City may require concrete pavers to be tested according to CSA A231.2 for dimensional tolerance, compressive strength and freeze thaw durability by an independent testing laboratory. Testing shall be at no extra cost to the City.

TS 3.80.04.03 Manufacturers Materials

Provide manufacturer's certification of concrete pavers having met all applicable CSA standards. Provide manufacturer's catalog product data, installation instructions and material safety data sheets for the safe handling of the specified materials and products.

TS 3.80.05 MATERIALS**TS 3.80.05.01 Granular Subbase**

The granular subbase material shall be Granular A according to TS 1010.

TS 3.80.05.02 Concrete Base

The materials for and the production of concrete base shall be according to TS 1350 and the following:

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

TS 3.80.05.03 Granular Base

The granular base material shall be Granular A according to TS 1010.

TS 3.80.05.04 Bedding Sand

Bedding sand shall be according to CSA A23.1 (FA1) gradation for concrete sands.

Table 1: Bedding sand gradation

Sieve number	Per cent passing
10 mm	100
5 mm	95-100
2.5 mm	80-100
1.25 mm	50-80
630 µm	25-65
315 µm	10-35
160 µm	2-10
80 µm	0-2

Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.

Limestone screenings or stone dust shall not be used. Mason sand or sand according to CSA A179 shall not be used for bedding sand.

TS 3.80.05.05 Joint Sand

Joint sand shall be according to CSA A179 gradation for joint sand.

Table 2: Joint sand gradation

Sieve number	Per cent passing
5.0 mm	100
2.5 mm	90-100
1.25 mm	85-100
630 µm	65-95
315 µm	15-80
160 µm	0-35
80 µm	0-10

TS 3.80.05.06 Polymeric Sand – High Strength

Polymeric sand shall be blended native sands according to ASTM C144 sand mixed with synthetic polymers for pavement joint stabilization. The use of polymeric sand shall be as specified in the Contract Documents.

TS 3.80.05.07 Concrete Pavers

Concrete pavers shall be according to CSA A231.2. Concrete pavers shall have the following material characteristics:

- (a) Minimum average cube or core compressive strength of 50 MPa for laboratory cured specimens or 40 MPa for unconditioned field samples.
- (b) Resistance to 28 freeze-thaw cycles while immersed in a 3 per cent solution with no greater mass lost than 225 g/m² if surface area after 28 cycles, or 500 g/m² after 49 cycles.
- (c) Concrete pavers shall be uniform in size and texture.

The concrete pavers shall not differ in length or width by –1.0 to +2.0 mm and in height by more than ± 3.0 mm.

Failure to meet any of the requirements (a) through (c) shall result in the rejection of all of the concrete pavers represented by the failed set. All rejected pavers shall be replaced, with all associated costs, including the testing of the replacement set, at no extra cost to the City.

All units shall be free of defects that would interfere with the proper placing of the units or impair the strength or permanence of the construction. Minor cracks incidental to the usual methods of manufacture, or minor chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection of the lot. Individual concrete pavers having visually significant imperfections, chipped edges or cracks shall not be used and shall be rejected.

TS 3.80.05.07.01 Concrete Paver Types

The type, size, colour, joint width and radius chamfer and finish shall be specified in the Contract Documents. City standard paver types shall meet the following specifications.

Type 1 – Interlocking Precast Concrete Paver	
Sizes	100 mm x 200 mm x 80 mm
	200 mm x 200 mm x 80 mm
	200 mm x 300 mm x 80 mm
Colours	Medium Grey
	Light Grey
	Dark Grey
	Dark Red
	Light Red
Joint Width and Top Radius/Chamfer	2 – 3 mm joint width with spacer
	2 mm top radius/chamfer width

Type 2 – 3D Locking Precast Concrete Road Paver	
Locking Requirements	Robust, 3d/dual-direction locking suitable for public roadways with heavy automobile usage
Ratio	Ratio between 2:1 or 3:1. Size as recommended by proponent (no smaller than 100 mm x 200 mm)
Depth	100 mm
Colours	Medium Grey
	Light Grey
	Dark Grey
	Dark Red
	Light Red
Finish	Tumbled or as specified
Joint Width and Top Radius/Chamfer	Maximum 5 mm joint width with spacer
	2 mm maximum top radius/chamfer width

TS 3.80.05.07.02 Colour and Finish

City standard concrete pavers shall have a high albedo for colours medium grey and light grey having a Solar Reflex Index (SRI) greater than 29. All colours shall be integral to the concrete paver not surface finish referred to as face-mix. Pigment shall be according to ASTM C979. No surface sealers allowed.

TS 3.80.05.08 19 mm Type II Clear Stone

Clear stone shall be 19 mm Type II, according to OPSS.MUNI 1004 and meet the following physical properties.

Table 3: Clear Stone – 19 mm Type II

Laboratory test	MTO test number	Clear Stone 19 mm Type II
loss by washing, pass 75µm sieve, % maximum	LS-601	2.0
percent crushed particles, % minimum	LS-607	60
micro-deval abrasion Loss, % maximum	LS-618	25

Clear stone shall be 19 mm Type II, according to OPSS.MUNI 1004 and meet the following gradation requirements.

Table 4: Clear Stone – 19 mm Type II

Sieve sizes	Nominal maximum size
63 mm	-
53 mm	-
26.5 mm	100
19.0 mm	90-100
16.0 mm	65-90
13.2 mm	-
9.5 mm	20-55
6.7 mm	-
4.75 mm	0-10
75 µm	0-2.0

TS 3.80.05.09 Geotextile Fabric

Geotextile fabric shall be non-woven needle punch, Class II according to AASHTO M288. For roadway applications use non-woven needle punch Class I according to AASHTO M288. Overlay of geotextile shall be according to AASHTO M288.

TS 3.80.05.10 Edge Restraints

Where not otherwise retained, provide edge restraints installed around the perimeter of all interlocking concrete paving unit areas. Timber shall not be used as an edge restraint. Edge restraints shall be as specified on the Contract Drawing.

TS 3.80.06 EQUIPMENT

Concrete pavers shall be set into the bedding sand using a high frequency, low amplitude, mechanical flat plate vibratory compactor. The plate compactor shall transmit an effective force of not less than 22 kN. The frequency of vibration shall be within the range of 75 to 100 Hz to vibrate the pavers into the sand.

TS 3.80.07 CONSTRUCTION

TS 3.80.07.01 Excavation

Prior to any excavation, the Contractor shall have all utilities located and clearly marked, including an areaway locate to mark all underground walkways, rooms, coal chutes and so on.

The excavation shall be to the lines and grades shown on the Contract Drawings. All surplus or unsuitable material is to be disposed of, off the site, according to OPSS 180.

The subgrade shall be prepared according to TS 2.10.

The Contractor shall be required to make good all damage caused during the course of the construction to any part of the roadway, boulevard and private property and to restore the same, to as good or better condition as existed prior to commencement of work.

TS 3.80.07.02 Base

The concrete pavers shall be placed using a granular or a concrete base, as specified in the Contract Documents. The slope of the base shall match the final slope of the concrete pavers.

TS 3.80.07.02.01 Granular Base

Granular base shall be placed at a minimum depth of 150 mm for walkways and boulevards, and 200 mm, for driveways. It shall be compacted to a minimum of 100% of maximum dry density according to TS 501.

The surface of the compacted granular base shall be such that when tested with a 3 m long straightedge, placed in any direction on the surface, the gap between the straightedge and the surface of the compacted granular base shall not be greater than 10 mm, at any point..

TS 3.80.07.02.02 Concrete Base

Prior to the placement of the concrete base, the Contractor shall construct a granular subbase. The subbase shall be placed to a depth of 75 mm and shall be compacted to a minimum of 95% of maximum dry density according to TS 501.

The concrete base shall be poured to a minimum depth of 100 mm. At the outer limits of the concrete pavers, the concrete depth shall be increased to form a 200 mm wide edge restraint, level with the proposed surface of the pavers. The 200 mm wide edge restraint shall be omitted when the pavers are placed adjacent to a concrete curb or other permanent structure.

The surface of the concrete base shall be such that when tested with a 3 m long straightedge, placed in any direction on the surface, the gap between the straightedge and the surface of the concrete base shall not be greater than 10 mm, at any point.

At all maintenance holes, valve boxes, handwells and so forth, the surrounding concrete shall be increased to the proposed surface of the pavers. The concrete shall be squared off and the outer edge of the appurtenance shall be encased by a minimum of 50 mm of concrete. The size and location of the raised concrete shall be governed by the alignment of the concrete pavers. No concrete paver shall be cut or trimmed to less than one-third of its original area. For 100 x 200 x 80 mm size concrete pavers, they shall be cut or trimmed to no less than 50 mm in length.

Plastic drain pipes (50 mm diameter) shall be placed at the low side of the base, spaced at every 3 m along the length of the concrete base. The drain shall be a minimum of 400 mm long and shall be flush with the top of the base. A drainage pocket shall be constructed at every drain. The pocket shall consist of 19 mm Type II clear stone placed 200 mm wide x 200 mm long x 300 mm deep from the bottom of the concrete base. It shall be situated to drain into the granular material at the back of the curb. If the drain cannot be discharged into a well-draining granular material, the drainage pocket shall be increased to 300 mm wide x 300 mm long. Prior to placing the bedding sand, the drain shall be covered by centering a 200 mm x 200 mm piece of geotextile fabric over the opening.

TS 3.80.07.02.03 *Concrete Paver for Walkways, Sidewalks and Boulevards*

Concrete pavers for walkways, curb edges and boulevards shall be Type 1 – Interlocking Precast Concrete Paver and shall have an aspect ratio of 4:1 or less.

Concrete pavers on sidewalks and boulevards shall be installed in either a running bond pattern according to T-310.02-2 or 90 degree herringbone pattern.

Concrete pavers along the curb edge shall be installed as a double row in a stack bond pattern.

TS 3.80.07.02.04 *Concrete Paver for Roads*

Concrete pavers for roads shall be Type 2 – 3D Locking Precast Concrete Road Paver. Concrete paver for roads shall have an aspect ratio of 3:1 or less. Portland cement concrete base thickness under Type 2 concrete paver shall be according to the Contract Documents.

TS 3.80.07.02.05 *Concrete Paver for Parking Lots*

Concrete pavers for parking lots shall be the following as specified in the Contract Documents

-
- 1) Type 1 – Interlocking Precast Concrete Paver 100 mm x 200 mm x 80 mm in applications designed for up to 5 million ESAL installed in a running bond or 90 degree herringbone pattern, or
 - 2) Type 2 – 3D Locking Precast Concrete Road Paver installed according to the manufacturers recommend pattern Portland cement concrete base thickness under Type 2 concrete paver shall be according to the Contract Documents.

Concrete paver for parking lots shall have an aspect ratio of 3:1 or less.

TS 3.80.07.02.06 Geotextile

Place geotextile strips, a minimum of 300 mm wide, to cover areas where bedding sand loss may occur such as at cuts for joints in curbs, around drainage structures and other appurtenances.

TS 3.80.07.03 Bedding Sand

Spread bedding sand evenly over the base course and screed to a nominal 25 mm thickness. Spread bedding sand evenly over the base course and screed rails, using the rails or edge restraints or both to produce a 25 mm un-compacted thickness.

Do not disturb screeded sand. Screeded area shall not substantially exceed that which is covered by pavers in a one day. Do not use bedding sand to fill depressions in the base surface. Concrete pavers shall be placed only on loose, moist bedding sand.

TS 3.80.07.04 Concrete Paver Placement

Concrete pavers shall be placed uniformly and hand tight, such that all joints are correctly aligned. Provide joints between pavers between 2 and 3 mm wide. No more than 5 percent of the joints shall exceed 5 mm wide to achieve straight bond lines. Joint or bond lines shall not deviate more than 15 mm over 15 m from string lines.

Where concrete pavers require trimming, they shall be cut with a dry diamond blade with vacuum abatement measures, wet cut or a guillotine, to give a straight edge. Fill gaps at the edges of the paved area with cut pavers or edge units. All cut pavers exposed to vehicular tires shall be no smaller than one-third of a whole paver.

Simultaneously spread, sweep and compact dry joint sand into joints continuously until full. At least four passes with a plate compactor shall applied to the surface while simultaneously spreading the sand into the joints. All joints should be filled to the bottom of the edge radius/chamfer. Do not compact within 2 m of unrestrained edged of paving units. Remove excess joint sand from the surface when installation is complete. Surface shall be broom clean after removal of excess joint sand.

TS 3.80.08 QUALITY ASSURANCE

TS 3.80.08.01 Surface Tolerance

The surface of the concrete pavers shall be such that when tested with a 3 m long straightedge, placed in any direction on the surface, the gap between the straightedge and the surface of the pavers shall not be greater than 10 mm, at any point.

The surface elevation of pavers shall be 3 to 10 mm above adjacent drainage inlets, concrete collars or channels at the completion of construction, in anticipation of post construction consolidation of the base and bedding materials.

Lippage: No greater than 3 mm difference in height between adjacent pavers.

TS 3.80.08.02 Acceptance

If any pavers are loose, chipped or unevenly cut, these concrete paver units shall be rejected. Areas failing to meet the requirement for surface tolerance shall be rejected.

Any rejected concrete pavers or areas shall be removed and either reinstalled or replaced by the Contractor. All costs associated with the removal, reinstallation and replacement of rejected concrete pavers shall be at no extra cost to the City.

TS 3.80.09 MEASUREMENT FOR PAYMENT

TS 3.80.09.01 Unit Pavers

Measurement of unit pavers shall be of the surface area, including any edge restraint, in square metres (m²). No deduction will be made for poles or utility frames and covers.

TS 3.80.10 BASIS OF PAYMENT

TS 3.80.10.01 Unit Pavers – 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 all excavation, the supply, placing, levelling and compacting of all granular, the supply and placement of concrete base and edge restraints, the supply and placement of drains, the supply and placement of concrete pavers and bedding sand, and the filling of all joints.

Appendix 3.80-A, April 2018

For Use While Designing and Administering City Contracts

Note: This is a non-mandatory commentary appendix intended to provide information to a designer and contract administrator during the design and construction stage of a contract on the use of this TS specification in a City 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.

Notes to Designer:

The designer should specify the following in the Contract Documents:

- type, size, colour, joint width and top radius chamfer and finish of the concrete pavers (3.80.05.07.01)
- calculate granular base thickness based on soil subgrade strength and ESAL's for walkways, sidewalks and parking lots. To calculate granular base thicknesses for different load requirements, see ICPI Tech Spec #4 or ASCE 58-16. (3.80.07.02.03 or 3.80.07.02.05)
- material type such as plastic, concrete, aluminum, steel, pre-cast stone, cut stone or concrete based on the application. To select and edge restraint, see ICPI Tech spec #3 (3.80.05.10)
- calculate the Portland cement concrete base thickness based on soil subgrade strength and ESAL's for roads and parking lots. To calculate concrete base thicknesses for different load requirements, see ICPI Tech Spec #4 or ASCE 58-16. (3.80.07.02.04 or 3.80.07.02.05)

Construction Specification for Utility Adjustments

Table of Contents

TS 4.50.01	SCOPE	2
TS 4.50.02	REFERENCES	2
TS 4.50.03	DEFINITIONS – Not Used.....	2
TS 4.50.04	DESIGN AND SUBMISSION REQUIREMENTS.....	2
TS 4.50.05	MATERIALS	2
TS 4.50.05.01	Granular Material.....	2
TS 4.50.05.02	Concrete.....	2
TS 4.50.05.03	Precast Adjustment Units	3
TS 4.50.05.04	Adjustment Bricks	3
TS 4.50.05.05	Cement Mortar.....	3
TS 4.50.05.06	New Frame and Covers	3
TS 4.50.06	EQUIPMENT	3
TS 4.50.07	CONSTRUCTION	4
TS 4.50.07.01	General.....	4
TS 4.50.07.02	Precast Concrete Adjustment Units	5
TS 4.50.07.02.01	Installation Procedure	5
TS 4.50.07.02.02	Adjustment Bricks	6
TS 4.50.07.03	Concrete Extensions	6
TS 4.50.08	QUALITY ASSURANCE.....	6
TS 4.50.09	MEASUREMENT FOR PAYMENT	7
TS 4.50.09.01	Utility Adjustments.....	7
TS 4.50.09.02	Concrete Extension.....	7
TS 4.50.09.03	New Frame and Covers	7
TS 4.50.10	BASIS OF PAYMENT.....	7
TS 4.50.10.01	Utility Adjustments – Item	7
TS 4.50.10.02	Concrete Extension – Item.....	8
TS 4.50.10.03	New Frame and Covers – Item	8

TS 4.50.01 SCOPE

This specification covers the requirements for the adjustment of all the utilities frames and covers, including catch basins, maintenance holes, valve boxes and valve chambers.

TS 4.50.02 REFERENCES

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

City of Toronto Standard Specifications

TS 3.40	Construction Specification for Concrete Road Base
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 – Materials and Production

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Material
OPSS 919	Construction Specification for Framework and Falsework
OPSS.MUNI 1004	Material Specification for Aggregates – Miscellaneous
OPSS 1351	Material Specification for Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers
OPSS 1850	Material Specification for Frames, Grates, Covers and Gratings

Canadian Standards Association

A82-06 (R2011)	Fired Masonry Brick Made from Clay or Shale
----------------	---

TS 4.50.03 DEFINITIONS – Not Used

TS 4.50.04 DESIGN AND SUBMISSION REQUIREMENTS

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 design and submission requirements shall be according to TS 1350.

TS 4.50.05 MATERIALS

TS 4.50.05.01 Granular Material

All granular material shall be Granular A and shall be according to TS 1010.

TS 4.50.05.02 Concrete

Concrete shall be according to TS 3.40 for concrete road base.

TS 4.50.05.03 Precast Adjustment Units

Adjustment units for maintenance holes, valve chambers and catch basins shall be according to OPSS 1351.

Approved precast adjustment unit tape shall be used between the units. The tape shall be stored in a dry location where the temperature does not exceed 25°C or falls below 10°C. Any such tape that experiences temperatures outside the above range shall not be used.

TS 4.50.05.04 Adjustment Bricks

Bricks shall be of hard, dense, thoroughly burnt clay and shall be according to CSA A82 (Type S). They shall be of compact texture, free from injurious cracks or checks and shall be free from stones, pebbles and organic impurities. The sides, ends, and faces shall be plane surfaced, at right angles and parallel to each other.

Bricks shall not be less than 57 x 95 x 203 mm nor more than 76 x 102 x 216 mm. Minimum compressive strength shall be 20 MPa and absorption shall not exceed 15 per cent according to CSA A82.

Concrete bricks shall not be used.

TS 4.50.05.05 Cement Mortar

Cement mortar shall consist of three parts sand and one part Portland cement meeting the requirements of OPSS 1004 for mortar sand, except that the gradation shall be as follows:

Table 1: Cement mortar gradation

Sieve number	Per cent passing
2.36 mm	100
300 µm	15–40
150 µm	0–10
75 µm	0–5

TS 4.50.05.06 New Frame and Covers

All new frame and covers shall meet the requirements of OPSS 1850.

TS 4.50.06 EQUIPMENT

Forms shall be of steel, wood or metal plate and shall meet the requirements of OPSS 919. They shall be of sufficient cross section and strength, and secured so 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 cleaned and coated with form oil before each use.

TS 4.50.07.01**General**

The Contractor shall adjust all water boxes, raise or lower frame and covers of all maintenance access units and other related castings, gratings and appurtenances within the area of work, to the required grade, providing for the transverse and longitudinal slope of the finished surface. The tolerance from the plane of the finished pavement shall not exceed ± 3 mm when tested with a 3 m straightedge. Where steps exist, the top shall be a maximum of 450 mm below the finished grade.

The adjustment of all appurtenances belonging to utility companies shall not be performed by the Contractor. The Contract Administrator shall arrange for work orders and contact names and phone numbers for the respective utility companies. The Contractor shall be responsible for organizing and coordinating this work with the respective utility company. The Contractor shall assist by excavating to the edge of the appurtenances and indicating the required grade of the new road for adjustment.

Frame and covers requiring replacement will generally be worn smooth, cracked or have covers sitting below frame rims.

The Contractor shall remove all frames that require adjusting, being careful not to damage that part of the structure that is to remain.

For maintenance holes, valve chambers and catch basins, if the total depth of bricks or adjustment is 300 mm or less, brick and mortar or precast concrete adjustment units shall be used. If the frame is to be raised more than 300 mm, poured concrete shall be used with one or two courses of brick or precast concrete adjustment units immediately below the frame.

Where adjustment requires the lowering of the frame, the contractor shall break out the concrete or masonry to the required level and seat the frame on a 12 mm mortar levelling pad.

For all adjustments, the remaining concrete, masonry and mortar shall be sound and solid, with no loose or separated joints or cracks.

All sewer maintenance holes and catch basins, utility chambers, valve chambers and valve boxes within the contract limits, whether they were adjusted or not, shall be thoroughly cleaned of debris prior to the completion of the contract, regardless of the source of the debris. The debris shall be disposed of off the site at the Contractor's expense, according to OPSS 180. The cleaning of any other utility chambers made necessary due to the Contractor's operations shall be done by the owner of the utility at the Contractor's expense.

All sewer maintenance holes are to be cleaned without any disruption to the normal flows. Under no circumstances shall the Contractor divert, block or interrupt the flow in the storm or sanitary sewers, by pumping or any other action. If the debris is such that it constitutes any impedance or blockage to normal flows or cannot be removed without diverting the flow by pumping or further interference with normal flows, the Contractor shall immediately advise the Contract Administrator who will seek assistance of the department with the responsibility for maintenance and operation of the sewer and its appurtenances. In the absence or unavailability of the Contract Administrator, the Contractor may directly contact the emergency section of the appropriate department for assistance. In either case, the Contractor shall provide whatever equipment and assistance necessary to facilitate actions by the operating department to overcome the difficulties, including providing and clearing a separate, clearly defined work area for the forces of the operating department.

TS 4.50.07.02 Precast Concrete Adjustment Units

The use of precast modular concrete units for the adjustment of catch basins, maintenance holes, and valve chambers shall be permitted provided the following conditions are met:

- a) All existing bricks are removed.
- b) The walls are in sound condition or have been properly repaired using concrete material.
- c) The precast concrete units are fully and uniformly supported on the top of the walls of the catch basin, maintenance hole or valve chamber.
- d) The precast modular concrete units shall be reinforced and be parallel faced.
- e) No cracked, broken or chipped units will be accepted.
- f) The total depth of adjustment does not exceed 300 mm

Where adjustment to the chamber tops of water valves or maintenance holes, is necessary, or if the chamber is constructed entirely of brick, only hard red clay sewer bricks shall be used for any necessary adjustment of the chamber top.

TS 4.50.07.02.01 *Installation Procedure*

The foundation on which the adjustment units are to be placed must be sound and solid, with no loose or separated joints or cracks.

The installation of the adjustment units shall be as follows:

- 1) A 10 to 15 mm layer of mortar shall be placed to level the top of the valve chamber, maintenance hole or catch basin. The adjustment units shall sit level. Adjustments for grade and slope are to be made on the final layer of mortar.
- 2) The first unit shall be set upside down (feet/key up) on the levelling layer of mortar.
- 3) For stepped maintenance holes, the Contractor shall place step units in proper sequence to provide the correct distance between steps, and be sure to set the first unit in the correct orientation so that the steps line up vertically.
- 4) The Contractor shall place a continuous strip of precast adjustment unit tape sealer on the upper surface, pressing down firmly. The sealer shall be placed along the centre of the precast adjustment unit section. The surface shall be clean and dry for the precast adjustment unit tape to adhere. The Contractor shall remove the paper backing from the precast adjustment unit tape.
- 5) The Contractor shall place the second and subsequent units with the keys in the proper direction to interlock. Precast adjustment unit tape shall be placed on each and every unit to provide a seal.
- 6) A 3 to 15 mm layer of mortar shall be placed on the top of the final unit. The mortar shall be shaped to provide the necessary grade and slope for the frame.
- 7) Under no circumstances shall pebbles or broken pieces of masonry, brick or concrete be used to set frames to grade, crossfall and slope. Any adjustments completed using such material will be rejected and the units will be removed and replaced at the Contractor's expense.

-
- 8) For catchbasins, lateral adjustments may be made by shifting – corbelling – the adjustment units to conform to the curb adjustment. The slope shall be limited to 100 mm horizontal to 300 mm vertical. The resulting opening shall not be less than 375 mm measured at right angles to the curb.

TS 4.50.07.02.02 *Adjustment Bricks*

The installation of the adjustment bricks for the precast units shall be as specified in the Contract Documents, except for the following:

- a) No precast adjustment unit tape is required.
- b) No lateral adjustment or corbelling is permitted.
- c) All bricks shall be completely covered, on the sides adjacent to the structure, frame or other bricks, with a uniform layer of cement mortar having a thickness of 5 mm. The inside face of the innermost bricks shall be fully parged with cement mortar.

TS 4.50.07.03 **Concrete Extensions**

Formwork shall be used on all sides of the extension. The top of the concrete on the existing structure shall be thoroughly cleaned and roughened to ensure a satisfactory bond. For catch basins, lateral adjustments may be made by sloping the concrete extension to conform to the curb alignment. The slope shall be limited to 100 mm horizontal to 300 mm vertical, and the resulting opening shall not be less than 375 measured at right angles to the curb.

TS 4.50.08 **QUALITY ASSURANCE**

Quality assurance for the concrete and mortar shall be according to TS 1350.

The grade, cross-fall and slope of the adjustment shall be within the specified surface tolerance of the adjacent material.

The Contract Administrator shall inspect all adjustments prior to the placement of the frame and cover. If the Contractor has been found to be using pebbles, broken pieces of masonry, brick, concrete or any other non approved methods of adjusting the utility, all adjustments to date shall be deemed to have been done in a similar fashion and therefore all adjustments shall be rejected.

Adjustments that do not meet the requirements of this specification will be rejected and shall be made good by the Contractor at no extra cost to the City.

All rejected adjustments shall be completely removed to the full depth of the original adjustment, except those that have been rejected solely on the requirements surface tolerance. Adjustments rejected, based solely on surface tolerance, shall be removed only as deep as necessary to correct the situation.

If the adjustment was rejected, after the placement of the final lift of asphalt, it shall be made good by the Contractor at no extra cost to the City.

All costs associated with the repair of any and all rejected adjustments shall be borne by the Contractor.

TS 4.50.09 MEASUREMENT FOR PAYMENT**TS 4.50.09.01 Utility Adjustments**

For measurement purposes, a count shall be made of the number of adjustments performed and prorated in accordance with Table 2. Changes in height of 300 mm or less will be paid at the specified rate. For changes in height of more than 300 mm, the rate will be prorated based on a height of 300 mm. Measurements shall be made to the nearest 10 mm increment.

Table 2: Adjustment distance and rate

Utility	Rate
Standard frames and covers whose width or diameter of the frame is between 500 mm and 1000 mm	1
Small frames and covers whose width or diameter of the frame is less than 500 mm	$\frac{1}{3}$
Large frames and covers whose width or diameter of the frame is larger than 1000 mm	2

TS 4.50.09.02 Concrete Extension

Measurement for the above item shall be by height of extension, including up to two courses of bricks and mortar or adjustment units in metres (m) and will be paid at the specified rate according to Table 2. Measurements shall be made to the nearest 10 mm increment.

TS 4.50.09.03 New Frame and Covers

For measurement purposes, a count shall be made of the number of new frame and covers installed.

TS 4.50.10 BASIS OF PAYMENT**TS 4.50.10.01 Utility Adjustments – Item**

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include, the removal and disposal of loose brick and material, the supplying and placing of brick or precast adjustment units, supply and installation of any necessary steps adjusting the appurtenance to final grade, the coordination of utility owners with the contract staging and the cleaning of all utility chambers, maintenance holes, valve boxes and catch basins within the contract limits.

No additional payment shall be made for any interim adjustments to raise or lower the appurtenance, in order to perform the work as specified.

Adjustment of any valves, utility frame and covers within the sidewalk area shall be considered part to the Contract Price. No separate payment shall be made.

TS 4.50.10.02 Concrete Extension – Item

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include, the removal and disposal of debris, existing bricks and adjustment units, the construction of concrete extensions, supply and installation of any necessary steps adjusting the appurtenance to final grade, the supply and installation of one or two courses of brick and mortar or adjustment units, the coordination of utility owners with the contract staging and the cleaning of all utility chambers, maintenance holes, valve boxes and catch basins within the contract limits.

No additional payment shall be made for any interim adjustments to raise or lower the appurtenance, in order to perform the work.

Adjustment of any valves, utility frame and covers within the sidewalk areas shall be considered part of the Contract Price. No separate payment shall be made.

TS 4.50.10.03 New Frame and Covers – Item

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the work and shall include all adjustments required. No separate payment shall be made for utility adjustments when new frame and covers are installed.

**Construction Specification for
Utility Cut and Restoration****Table of Contents**

TS 4.60.01	SCOPE	3
TS 4.60.02	REFERENCES	3
TS 4.60.03	DEFINITIONS	4
TS 4.60.04	DESIGN AND PERMIT REQUIREMENTS.....	5
TS 4.60.05	MATERIALS.....	6
TS 4.60.05.01	Supply of Materials	6
TS 4.60.05.02	Unshrinkable Fill	6
TS 4.60.05.03	Suitable Backfill Materials	6
TS 4.60.05.03.01	Imported Granular Materials.....	6
TS 4.60.05.03.02	Existing Material in Trench.....	6
TS 4.60.06	EQUIPMENT – Not Used	7
TS 4.60.07	CONSTRUCTION	7
TS 4.60.07.01	General.....	9
TS 4.60.07.02	Installation of Plant.....	9
TS 4.60.07.02.01	Sawcutting of Pavement, Sidewalk, Curb and Driveway	9
TS 4.60.07.02.02	Excavation	9
TS 4.60.07.02.03	Backfilling.....	11
TS 4.60.07.03	Temporary Repair	12
TS 4.60.07.04	Permanent Repair.....	13
TS 4.60.07.04.01	Extent of Permanent Restoration	13
TS 4.60.07.04.02	Permanent Repair to Utility Cut Surfaces	14
TS 4.60.07.04.03	Placing Asphalt for Permanent Repair	15
TS 4.60.07.04.04	Permanent Restoration of Cuts in Composite Pavements.....	16
TS 4.60.07.04.05	Permanent Restoration of Cuts in Sodded Areas	16
TS 4.60.07.05	Traffic Control	17
TS 4.60.07.06	Management and Disposal of Excess Materials.....	17
TS 4.60.08	QUALITY ASSURANCE.....	17
TS 4.60.08.01	Warranty	17
TS 4.60.09	MEASUREMENT FOR PAYMENT	17
TS 4.60.09.01	Restoration	17

TS 4.60.10	BASIS OF PAYMENT	18
TS 4.60.10.01	Restoration – Item	18

TS 4.60.01 SCOPE

This specification covers the requirements for utility cutting, excavating, backfilling, and repair of City streets.

TS 4.60.02 REFERENCES

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

City of Toronto Standard Specifications

TS 1.00	Construction Specification for Maintenance of Traffic
TS 3.40	Construction Specification for Concrete Road Base
TS 3.45	Construction Specification for Repair of Concrete Pavement and Base
TS 3.50	Construction Specification for Concrete Curb and Concrete Curb and Gutter
TS 3.70	Construction Specification for Concrete Sidewalk and Concrete Raised Median
TS 4.70	Construction Specification for Keyhole Excavation and Permanent Reinstatement of Keyhole Cores
TS 5.00	Construction Specification for Sodding
TS 5.10	Construction Specification for Growing Medium
TS 13.10	Construction Specification for Unshrinkable Fill
TS 310	Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving
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 – Materials and Production

City of Toronto Standard Drawings

T-508.010-1	Anchored Hook Bolt Dowel and Concrete Repair
T-509.010-1	Composite Pavement Patching for Utility Cuts (Sheet 1 of 2)

City of Toronto Publications

MCR	Municipal Consent Requirements
Tree Protection Policy and Specifications for Construction Near Trees	
Utility Cut Repair Guidelines	

Ontario Provincial Standard Specifications

OPSS 180	General Specification for the Management of Excess Materials
----------	--

Ontario Ministry of Transportation

Ontario Traffic Manual Book 7 Temporary Conditions
--

American Concrete Pavement Association

Utility Cuts in Concrete Pavements

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

12-Bag Mix means a type of concrete containing 480 kilograms of cement in one cubic metre of volume which yields to properties that allow the concrete road base to gain sufficient strength in 4-hours and receive an asphalt layer on the top for quick reopening of traffic lanes. This material only to be used for the permanent restoration of utility cuts.

Applicant means a person applying for a permit or other consent to cut a street. This shall be extended, where applicable, to include the Applicant's direct employees and its agents, consultants and contractors.

Boulevard means that part of a public street that is not used, or intended to be used, for vehicle travel by the general public, and that is situated between the travelled portion of the road and the adjoining Property line.

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

Deep trench means a trench deeper than 1.2 m.

Emergency Work means work within a street that must be completed immediately due to health or safety concerns or because the provision of essential services is endangered.

Essential Services means energy (including natural gas, steam, and electricity), water, sanitary sewage, traffic control, and the following communication services: 911 service; communications for financial transactions; business networks; and Internet.

Excavating means the breaking, digging up, tearing up, tunneling, boring, coring, cutting into or removing any portion of the surface or subsurface of the street, including pavement, sidewalk, curbs, gutter or landscaping.

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

City means the City of Toronto.

General Manager means the General Manager of Transportation Services for the City of Toronto and his or her designate or successor.

Municipal Consent Requirements (MCR) means the document specifying the requirements for the installation of plant within city of Toronto streets.

Narrow trench means the width of a trench is less than or equal to 350 mm.

Native Material means excavated material for placement into the exact location from which it was removed.

Shallow trench means the depth of trench is less than or equal to 1.2 m.

Permanent Repair means the process whereby a cut and/or excavation is reinstated to a condition which requires no further repair.

Plant means any poles, cables, pipes, conduits, ducts, pedestals, regulators, antennas, towers, wires, amplifiers, vaults, maintenance holes, hand holes, support structures and or other appurtenances or ancillary facilities or structures used for the provision of telecommunications, internet, energy, water, waste water, steam, fuel and/or other materials. Any encasement, steel plating or other non-excavatable material shall be considered to be part of the plant.

Road means the portion of the street designed, improved and ordinarily used by vehicle traffic. The terms pavement and roadway shall have the same meaning as road.

Sidewalk means that part of a public street located within the Boulevard that is improved for the exclusive use of pedestrians.

Street means a common and public highway, street, avenue, parkway, driveway, square, place, bridge, viaduct or trestle, any part of which is intended for or used by the general public for the passage of vehicle and includes the area between the lateral property lines thereof. The terms City's public road allowance, right-of-way and highway shall have the same meaning as street.

Suitable Backfill Material means the native materials or imported granular materials that can be used as utility trench backfill materials in lieu of unshrinkable fill.

Temporary Repair means the process whereby a cut and/or excavation is reinstated as a temporary measure pending completion of a permanent repair.

Tree Protection Zone means the area of the tree roots must be protected during construction according to Tree Protection Policy and Specifications for Construction Near Trees.

TTC means the Toronto Transit Commission

Unshrinkable Fill means a mixture of aggregates, cementing material and water, with or without chemical admixtures, according to TS 13.10.

Utility Company means a company owning, operating and maintaining plant in the public right-of-way.

Wide trench means a trench wider than 350 mm.

TS 4.60.04 DESIGN AND PERMIT REQUIREMENTS

For submission and permit requirements to make an installation within the City streets refer to the Municipal Consent Requirements:

TS 4.60.05 MATERIALS

TS 4.60.05.01 Supply of Materials

The Applicant / Contractor shall supply all materials necessary for the execution and completion of the work.

TS 4.60.05.02 Unshrinkable Fill

The materials for the production of unshrinkable fill shall be according to TS 13.10.

The supplied unshrinkable fill may be tested, and any material that does not meet the requirements of TS 13.10 shall be removed and replaced at the Contractor's expense. All costs associated with the removal and replacement of deficient unshrinkable fill shall be borne by the Applicant / Contractor, including the cost of administration and retesting.

Temporary plating shall be used to support loads from pedestrian and vehicular traffic until the temporary asphalt is laid. Traffic shall not be permitted to travel directly onto the surface of the unshrinkable fill.

TS 4.60.05.03 12-Bag Mix Concrete

The materials for the production of 12-bag mix concrete shall be according to TS 3.40.

TS 4.60.05.04 Suitable Backfill Materials

TS 4.60.05.04.01 *Imported Granular Materials*

Granular materials – free of RAP; reclaimed asphalt pavement – may be imported for use as trench backfill provided the imported materials shall be according to TS 1010.

TS 4.60.05.04.02 *Existing Material in Trench*

Materials excavated during trench construction may be considered for reuse as trench backfill where permitted under clause 4.60.07.02.03, herein. The materials shall have suitable physical and environmental properties; and the materials should be properly managed during construction. The excavated materials that may be considered for reuse as backfill include either a suitable existing granular material or a suitable existing cohesive material. The physical properties of the materials shall meet the following requirements:

- a) the material is free of any obvious objectionable or deleterious materials such as topsoil, organics, wood chips, reclaimed asphalt pavement and metal pieces if the material is to be used in trenches located under a pavement

Note: Material containing topsoil, organics, or wood chips, is acceptable when backfilling within sodded or soil surfaces in the boulevard.

- b) the material is free of large pieces of rock or boulders
- c) the material is free of shale pieces

-
- d) the compaction equipment deployed on site is able to compact the material to its required density
 - e) the material is not considered to be frost susceptible
 - f) the material is not wet, frozen or lumpy

All excavated materials to be reused as trench backfill shall be managed to prevent contamination, and shall be protected to preserve or maintain its moisture condition.

Where the excavated material has been identified to be contaminated, the Contractor shall comply with all applicable legislation. Contaminated soil shall not be used as backfill and shall be disposed of off-site according to the applicable requirements.

When the suitability of excavated material for reuse is in dispute, the City, in its sole discretion, shall determine the suitability of the material based on the physical properties mentioned in this section and as recommended in a report, submitted by the Applicant, from a geotechnical consultant.

TS 4.60.06 EQUIPMENT – Not Used

TS 4.60.07 CONSTRUCTION

Table 1: Repair responsibility according to surface types

Surface type	Material	Repair responsibility	
		Temporary repair	Permanent repair
road pavement	asphalt	Applicant	Applicant
	concrete	Applicant	Applicant
sidewalk	asphalt	- - -	Applicant
	concrete	Applicant	Applicant
curb	asphalt	- - -	Applicant
	concrete	Applicant	Applicant
boulevard	asphalt	- - -	Applicant
	concrete	Applicant	Applicant
	interlocking bricks/flagstone on a granular base	- - -	Applicant
	interlocking bricks/flagstone on a concrete base	Applicant	Applicant
	sod	- - -	Applicant
	gravel or soil	- - -	Applicant
driveway	asphalt with abutting concrete repair	Applicant	Applicant
	asphalt with no abutting concrete repair	Applicant	Applicant
	concrete	Applicant	Applicant
	interlocking bricks/flagstone on a granular base	- - -	Applicant
	interlocking bricks/flagstone on a concrete base	Applicant	Applicant

Notes: Any repairs on private property shall be the responsibility of the Applicant.

All work performed by the Applicant or its contractor shall be carried out according to City standards and specifications.

Restoration of areas with decorative or specialized surfaces, landscaping, and subsurface treatments such as patterned / impressed concrete, snow melting systems, sprinkler systems, granite pavers and so forth shall be the responsibility of the Applicant.

Where interlocking bricks/flagstone on a granular base are adjacent to sidewalk that must be replaced as a result of the Applicant's work, the City will remove and relay the interlocking bricks/flagstone at the Applicant's expense as part of the restoration work.

TS 4.60.07.01 General

Where keyhole excavation is being proposed to complete utility installations or repairs or both, the work shall be carried out according to TS 4.70.

TS 4.60.07.02 Installation of Plant

TS 4.60.07.02.01 *Sawcutting of Pavement, Sidewalk, Curb and Driveway*

Unless judged unfeasible, the sawcut area shall have a maximum of four sides that are all parallel or perpendicular to the direction of travel. Sawcuts shall be straight and vertical to the full depth of the asphalt and concrete layers of the pavement.

Sawcutting operations shall be performed with suitable equipment and methods and not with heavy machinery or jackhammers that may cause damage to the surrounding road.

Saw cutting shall stop at, or just short of, corners to avoid overcutting. After sawcutting the edges, removal of pavement materials shall be performed with care to avoid lifting and breaking the road pavement beyond the sawcut borders.

Sawcutting of TTC surface track structure, including track base, shall not be permitted without the written consent of the TTC.

TS 4.60.07.02.02 *Excavation*

During the installation of any Plant, excavation equipment with stabilizers shall be suitably outfitted to prevent damage to the pavement surface or else wood or rubber pads shall be placed on the road to support the stabilizers. Any damage to the street attributable to the Applicant's work shall be repaired, at the Applicant's expense, in conjunction with the utility cut.

Excavation shall not extend beyond the limits of the sawcut area. Care is to be taken to ensure that undermining of the adjacent pavement, curb and sidewalk is minimized. Where the pavement, curb and/or sidewalk are undermined by construction activities or from other causes, these undermined areas shall be filled and the settled structures shall be restored to their original grades at the expense of the Applicant.

Where necessary, bracing, shoring and/or sheeting shall be according with any occupational health and safety regulations, to support the sides of the excavation and to prevent any movement that could damage other services, adjacent pavements, sidewalks and so on. This excavation support system shall be removed as backfilling proceeds to eliminate voids between the fill and adjacent soils. Appropriate restoration of all displaced services to their original positions is the responsibility of the Applicant.

The Applicant / Contractor shall, at its own expense, provide adequate support and protection of the underground and above ground plant and structures that exist inside the excavation and in the vicinity of the excavated area. Any damage to plant or structures attributable to the Applicant / Contractor's work shall be repaired to the satisfaction of the City and/or the owner(s) of the damaged plant or structures, at the Applicant / Contractor's expense, in conjunction with the utility cut.

Except where native cohesive material is to be used for backfill, as permitted by the City and/or under the conditions of this specification, stockpiling of excavated material within City Streets is not permitted under any circumstances for any length of time. All excavated material shall be loaded directly into appropriate haulage trucks and disposed of off-site immediately upon removal. The Applicant shall remove, transport and dispose of all excavated materials in accordance with the latest *Ontario Environmental Protection Act* and, where appropriate, the *Occupational Health and Safety Act*.

All excavations shall have a minimum horizontal clearance of one metre from the edge of a TTC surface track structure, including track base, unless otherwise authorized by written consent from the TTC.

All tunnelling shall maintain a minimum vertical clearance of 500 mm below the TTC track structure including granular sub base, all concrete construction, and, where present, track subdrains.

Inspection of Excavation

Prior to backfilling, the Applicant shall inspect the utility cut excavation to ensure the following requirements are met:

- a) the edges of the pavement have been saw cut in a straight line and to the full depth of the pavement, or if permitted, to partial depth in composite pavement
- b) the bottom of the trench has been compacted and is free of water before the bedding material is placed
- c) all loose or wet material at the bottom of the trench has been removed and replaced with suitable bedding materials
- d) pipe bedding and pipe cover materials are free of reclaimed asphalt and compaction of the bedding and cover have been carried out to City's or utility agency's requirements
- e) necessary shoring/bracing meeting Ontario *Occupational Health and Safety Act* and regulations has been used to prevent the trench from cave-in and to protect adjacent services, pavement and sidewalk
- f) undermining of the adjacent pavement and sidewalk has been prevented/repaired.

Excavation near Trees

Refer to the City's Tree Protection Policy and Specifications for Construction Near Trees.

Protection of Excavation

All excavations must be backfilled to match the adjacent grade or properly protected at the end of each working day.

When temporary steel plates are used to maintain vehicular, bicycle and pedestrian traffic flow, the plates shall have a skid resistant surface treatment and shall be fastened down to prevent moving. The plates shall be set flush with the surface of the pavement. The recessed plates should overlap the cut by no less than 300 mm on all sides. Asphalt mix shall be used to fill the voids on the outside edges of the plates.

Plates shall be used only as a temporary measure during construction and shall not be used for extended periods of time.

TS 4.60.07.02.03 *Backfilling*

Bedding and covering material shall be compacted to at least 98% of standard proctor maximum dry density, or according to the Applicant's installation requirements, whichever is greater.

If unshrinkable fill is used, backfill trench with unshrinkable fill to within 80 mm of the top of the existing surface.

If temporary shoring or bracing has been used to support adjacent infrastructure, it shall be removed in a safe manner continuously as backfilling proceeds.

Backfilling in Pavements

If suitable backfill material is to be used, backfilling shall be carried out in uniform lifts not exceeding 150 mm loose thickness with the layer thickness decreased to 100 mm around obstacles. Each lift of suitable backfill material shall be compacted to a minimum of 98% of standard proctor maximum dry density, or in accordance with the Applicant's utility agency installation requirements, whichever is greater.

For temporary restoration of pavements, suitable backfill materials shall be brought to within 80 mm of the top of the existing surface.

The type of backfilling required in utility cuts made in road pavements shall be as follows:

- a) Unshrinkable fill shall be used for all cuts made in road pavements unless otherwise approved by the City.
- b) The City, in its sole discretion, may allow an Applicant to apply, in writing, for an exemption from using unshrinkable fill where a utility cut is to be located at the shoulder area or for backfilling of a wide and deep trench. No such exemptions will be granted on roads for reconstruction or resurfacing within the current construction season as advised by the City.
- c) Where an exemption from using unshrinkable fill has been granted, the Applicant or its Contractor shall provide Geotechnical Certificates from a geotechnical consultant within 30 days of completion of work certifying that the trench backfill meets the backfill materials requirements and compaction requirements as specified in this specification.
- d) Where suitable native backfill is used, a 400 mm layer of Granular A, compacted to 98% of maximum dry density, shall be placed immediately below the asphalt in flexible pavements and immediately below the concrete base in composite pavements.

Backfilling in Boulevards

The use of unshrinkable fill is strictly prohibited for backfilling in boulevards except in the following two scenarios:

- 1) Where cuts are in close proximity to the road and the limits of the excavation encroach into the 1H:1V structural prism commencing from the bottom of the adjacent curb, unshrinkable fill shall be used within the envelope of the structural prism; or
- 2) Where cuts are made in hard surfaces such as curbs, public sidewalks, concrete driveways, and interlocking bricks/flagstone on a concrete base that are immediately adjacent to the road, unshrinkable fill shall be used under these hard surfaces.

Where an excavation extends beyond the areas described above, the Applicant / Contractor shall ensure that the unshrinkable fill is contained within the appropriate area.

Note: Notwithstanding the above, unshrinkable fill is strictly prohibited for any excavation within a Tree Protection Zone (TPZ) regardless of the surface treatment.

For areas of sod or soil, see clause TS 4.60.07.04.05, herein.

For all boulevard areas other than those specifically described above, only suitable native material or Granular B Type II shall be used. Backfill materials shall be placed in lifts not exceeding 200 mm loose thickness and each lift shall be compacted to 95% of standard proctor maximum dry density. Permanent restoration of sodded area shall be performed according to TS 5.00.

Backfilling in Tunnels

Any facility that is placed underground in any method other than open cut trenching shall be considered as tunnelling.

In backfilling a tunnel, the final density of the backfill must match or exceed that of the surrounding soil. All voids resulted from tunnelling shall be completely backfilled using suitable materials as defined in this specification.

TS 4.60.07.03 Temporary Repair

Backfill material shall be brought to within 80 mm below the existing surface. The remainder of the trench shall be filled with compacted hot mix asphalt as a mean for temporary pavement restoration.

All temporary repairs shall be Superpave 12.5, Traffic Category B, PG 58-28 hot mix asphalt. The Superpave 12.5, Traffic Category B, PG 58-28 shall be mechanically compacted according to TS 310 and neatly match the finished grade of the existing pavement or sidewalk. Prior to placement of the asphalt, all faces, including vertical saw cut surfaces, shall be tack coated using SS-1 emulsified asphalt or equivalent.

Temporary utility cut repairs shall be stenciled by the Applicant with a 75 mm x 75 mm thermoplastic identifier logo. The colour of the logo shall be according to the unique colour assigned for the Applicant.

No permanent repairs shall be carried out between November 1st to May 1st of the calendar year.

TS 4.60.07.04 Permanent Repair

TS 4.60.07.04.01 *Extent of Permanent Restoration*

Notwithstanding the following, the nature and extent of the required reinstatement of the cuts will be at the sole discretion of the City based upon field assessment of the section of roadway prior to the permanent reinstatement.

TS 4.60.07.04.01.01 *Pavement*

Wherever a utility cut is parallel to and coincides with a wheel path, the cut shall be extended to include the wheel path.

If a utility cut is located within one metre of a curb or construction joint, such that the integrity of the adjacent pavement/base may be compromised, the permanent restoration will include the removal of the adjacent road base to the edge of the curb or construction joint. In all cases, the permanent repairs shall match the cross-section of the adjacent pavement.

Where keyhole cores are densely located in one area, less than 2 m apart, they will be treated as a trench cut.

Pavements with extensive trenching or numerous cuts may require milling and paving to address one or more of the following issues: to restore the quality of the driving surface; to eliminate visual impact of significant road cutting; and/or to better preserve the service-life of a pavement that has experienced excessive cutting.

For longitudinal trenches, whether in the wheel path or otherwise, the affected lane will be milled and paved for the length of the trench plus an additional 5 m at either end of the trench. If however, the total length of all trenches within a street block is: equal to or greater than 75 per cent of the block's length (for block lengths exceeding 250 m) or equal to or greater than 60 per cent (for block lengths less than or equal to 250 m), then the total length of the block will be milled and paved, that is to say between block intersections.

Milling of the surface course, in any of the aforementioned cases, will be a minimum of 3 m width in order to accommodate the placement of the asphalt surface course with a mechanical spreader.

If the longitudinal trench affects two lanes, then both lanes will be milled and paved for lengths defined above.

Where a series of transverse cuts, pits or shafts occur in close proximity along a roadway—that is within 12 m of each other or less—with a flexible pavement structure, the permanent restoration will include milling of the asphalt surface to a depth of 40 mm for the full width of the lane (or to a minimum width of 3 m) to accommodate the placement of hot-mix asphalt using a mechanical spreader.

Where a series of transverse cuts, pits or shafts occur in close proximity along a roadway—that is within 12 m of each other or less—with a composite pavement structure, the concrete road base shall be restored and the asphalt surface shall be milled to a depth of 40 mm for the full width of the lane or lanes, as the case may be, (or to a minimum width of 3 m) to accommodate the placement of hot-mix asphalt using a mechanical spreader.

Transverse Cuts

If there are multiple transverse cuts and the distance between trenches is less than or equal to 12 metres, then continuous milling and paving of the transverse cuts shall be performed.

For every transverse grind and pave, allow 5 metres on each end of permanent repair trench.

TS 4.60.07.04.01.02 *Sidewalk and Curb*

Wherever a side of a cut falls between expansion joints, the removal and subsequent restoration shall be extended to the nearest expansion joint.

Where the concrete sidewalk is monolithic with the curb, the sidewalk and the curb shall be cut and removed as a unit.

Wherever space for concrete forms are required to perform sidewalk or curb repairs adjacent to an existing driveway or pavement, the Contractor shall saw cut the driveway or pavement neatly parallel to the sidewalk or curb.

TS 4.60.07.04.01.03 *Driveway*

The surface asphalt restoration shall be extended 300 mm on all sides of the cut.

If the edge of the restoration area is less than or equal to one metre from the nearest edge of the driveway or edge of a previously repaired cut, the restoration area shall be extended to that edge.

Whenever the restoration area is more than half of the width of the driveway, the restoration shall be extended to include the entire width of the driveway.

Whenever a cut of any size is made in the driveway apron—the area between the edge of sidewalk and the back of curb—the entire area shall be restored.

The Applicant may request an exemption from this requirement by demonstrating that site-specific existing conditions warrant a reduced level of restoration. Any exemption shall be at the sole discretion of the City.

TS 4.60.07.04.02 *Permanent Repair to Utility Cut Surfaces*

All permanent repairs to utility cut surfaces that include sidewalks, curbs, boulevards, and driveways shall be constructed to meet the current City standards and to match the material and thickness design of the structure.

The permanent reinstatement for a roadway pavement structure that consists of asphalt over granular base/subbase—flexible pavement structure—or asphalt over concrete road base—composite pavement structure—shall be constructed to match the material and thickness design of the existing structure.

The Superpave mix to use for utility cut repairs when asphalt will be hand laid shall be according to Table 2.

Table 2: Superpave mix selection for any hand laid jobs

Surface type	Laneway	Local	Collector	Minor Arterial	Major Arterial
Surface Course		SP 12.5 B PG 58-28		SP 12.5 FC 1 C PG 58-28	
Base Course			SP 19.0 D PG 58-28		

Utility cuts backfilled with suitable native backfill material or imported materials will typically be subjected to one full freeze-thaw cycle before permanent repairs are completed.

All hot-mix asphalt materials shall be supplied and placed in according to TS 310. Prior to placement of the asphalt layers, the existing pavement shall be tack coated using SS-1 emulsified asphalt or equivalent. The perimeter of the permanent restoration shall be routed and sealed with a bead of rubberized asphalt.

TS 4.60.07.04.03 *Placing Asphalt for Permanent Repair*

In addition to TS 310 the following shall be adhered to:

Before asphalt is laid, the aggregate base shall be inspected and locations with loose material shall be re-compacted to the recommended density level. Whenever space permits, a steel roller with vibration capability shall be used on the final surface of the aggregate base. Caution shall be exercised in moving the equipment into the trench to avoid damage to the edges of the road. Prior to placement of the asphalt, the vertical faces of the saw cut shall be tack coated using SS-1 emulsified asphalt or equivalent.

The hot mix asphalt delivered to site shall be visually inspected and removed if the hot mix asphalt is non-uniform, lean or dry characterized by brown colour and fat or over-asphalted recognized by sticky or greasy appearance.

The temperature of the hot mix asphalt delivered to site shall be checked with an appropriate temperature-measuring device. Any hot mix asphalt with temperature that has fallen below 120°C at the point of discharge before spreading shall be rejected.

Asphalt shall be laid in lifts of 50 mm or less. Each lift shall be thoroughly compacted by the suitable compaction method and allowed to cool to 50°C before the next lift is laid on top. Density check shall be carried out using a nuclear gauge device. Coring is to be used only in case of doubt or disagreement or both about the accuracy of measurements made by the nuclear gauge.

After compaction, the hot asphalt surface shall be protected from the potential for accumulating excessive deformation. Cuts restored using hot mix asphalt should be protected from direct traffic for enough time to gain adequate strength before allowing traffic on the restored cut. Lanes affected by the cut are kept closed to traffic until the temperature of the air-cooled asphalt drops below 40°C. Alternatively, whenever safety considerations allow, the hot asphalt surface should be covered with steel plates until the temperature of the asphaltic concrete layer drops below 40°C.

Regardless of the thickness of the asphalt found in the existing road, proper asphalt thickness shall be re-laid without compromising cross-fall drainage requirements of the road. All construction joints of the cut shall be sealed with a joint sealant to impede the flow of surface water to the cut.

TS 4.60.07.04.04 *Permanent Restoration of Cuts in Composite Pavements*

Where the existing roadway pavement structure consists of an asphalt concrete surface over concrete base (composite pavement structure), the pavement reinstatement shall be completed according to TS 3.45.

The aggregate base upon which the concrete is poured shall be free of ice and snow, and shall not be frozen.

When permanent restoration is performed on concrete composite pavement, the asphaltic concrete and Portland cement concrete layers of the road shall be cut back beyond the intended cut width to a minimum of 300 mm on each side. Cutting shall only be performed after backfilling of the utility trench reaches the level of the bottom of the concrete slab. The T-section configuration facilitates bridging of backfill layers in the cut where the concrete slab transmits critical levels of traffic-induced stresses directly to the undisturbed granular road base next to the trench.

If inspection of the cutback revealed that the granular road base in the cutback section is undisturbed, the two ends of the concrete slab should rest directly on top of the existing granular base of the road. The granular base layer in the cut shall be constructed at the same level of the road granular base for the cut structure to benefit from load distribution facilitated by this T-section design configuration.

If the road base material is disturbed during cutting, excavation or construction of layers below the concrete base, or if there is no granular base in the road structure, an additional 150 mm depth shall be excavated from the road as part of the cut back and backfilled with compacted Granular A.

The concrete slab shall be allowed to cure for a minimum of seven days in order to reach its specified strength before the road is allowed to reopen to traffic. High early strength concrete shall be used if the road is expected to reopen to traffic in less than seven days. 12-bag mix concrete shall be used if the road is expected to reopen to traffic after four hours.

TS 4.60.07.04.05 *Permanent Restoration of Cuts in Sodded Areas*

Sod shall not be laid when ground is in a frozen condition or when the site is in adverse conditions such as high wind, frozen soil or soil covered with snow, ice or standing water.

All surface areas designated for sodding shall be fine graded to a uniform surface to meet all design requirements. The surface shall be uniformly cultivated according to TS 5.00.

The Applicant or its contractor shall:

- Carry out regular inspection of utility cuts during a 2-year warranty period.
- Immediately correct any and all settlements during the 2-year maintenance warranty period.
- Maintain the sod according to subsection 5.00.07.05 of TS 5.00.

TS 4.60.07.05 Traffic Control

Compliance with all City traffic control standards, including the latest editions of the Ontario Traffic Manual Book 7 and the Municipal Consent Requirements is required

TS 4.60.07.06 Management and Disposal of Excess Materials

Management and disposal of excess material shall be according to OPSS 180.

TS 4.60.08 QUALITY ASSURANCE

The quality assurance requirements for all materials used for the temporary and permanent utility cut restoration shall be in full conformance the quality assurance requirements specified for the respective materials:

- The supply and placement of unshrinkable fill shall be according to TS 13.10.
- The supply and placement of concrete shall be according to TS 3.40, TS 3.45, TS 3.50, TS 3.70, and TS 1350.
- The supply and placement of hot mix, hot laid asphalt shall be according to TS 310.

The supply and placement of aggregates and backfill materials shall be according to TS 1010.

TS 4.60.08.01 Warranty

The Applicant will warrant the utility cut repairs it undertakes in accordance with the repair responsibility—Table 1 in TS 4.60.07—for 2-years. The Applicant shall maintain a rigorous control and assurance program such that each utility cut repair will be inspected once every 12 months, during the warranty period.

TS 4.60.09 MEASUREMENT FOR PAYMENT

TS 4.60.09.01 Restoration

Where the permanent restoration of the utility cut is not included in the any items, the measurement of the restored area shall be according to TS 3.45, except:

-
- a) The width of the restoration for composite or concrete pavement shall be measured from the edges of the remaining concrete base or concrete pavement.
 - b) The width of the restoration for asphalt pavement shall be measured from the edges of the remaining bottom course of asphalt.

TS 4.60.10 BASIS OF PAYMENT

TS 4.60.10.01 Restoration – Item

Where the permanent restoration of the utility cut is not included in any items, the payment shall be according to TS 3.45 using the appropriate repair item

**Construction Specification for
Surface Sealing for Structural Concrete**

Table of Contents

TS 9.00.01	SCOPE	2
TS 9.00.02	REFERENCES	2
TS 9.00.03	DEFINITIONS – Not Used.....	2
TS 9.00.04	DESIGN AND SUBMISSION REQUIREMENTS.....	2
TS 9.00.05	MATERIALS	2
TS 9.00.06	EQUIPMENT – Not Used	2
TS 9.00.07	CONSTRUCTION	2
TS 9.00.08	QUALITY ASSURANCE.....	3
TS 9.00.09	MEASUREMENT FOR PAYMENT	3
TS 9.00.09.01	Surface Sealing for Structural Concrete	3
TS 9.00.10	BASIS OF PAYMENT.....	4
TS 9.00.10.01	Surface Sealing for Structural Concrete – Item	4

TS 9.00.01 SCOPE

This specification covers the requirements for the surface sealing of structural concrete to protect it against damage caused by water penetration, deicing chemical penetration and chemical attack.

TS 9.00.02 REFERENCES

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

Ontario Provincial Standard Specifications

OPSS 929 Construction Specification for Abrasive Blast Cleaning – Concrete Construction

TS 9.00.03 DEFINITIONS – Not Used

TS 9.00.04 DESIGN AND SUBMISSION REQUIREMENTS

Submissions from the Contractor shall provide at least the following information:

- 1) The source of the concrete sealer, manufacturer's installation guidelines and data, and the samples of the sealer intended for use in the work.
- 2) Material Safety Data Sheets (MSDS).

TS 9.00.05 MATERIALS

The sealer shall be a two coat system. The primer coat shall be an oligomeric alkoxysilane (alkylalkoxysiloxane) with a minimum 10 per cent suspended solids of silane. The top coat shall be a methylmethacrylate based material with a minimum 20 per cent suspended solids of methylmethacrylate.

The sealer shall be compatible with the surface over which it is to be applied. The resultant coating shall have the ability to breathe, be water resistant, durable, non-yellowing, and resistant to ultraviolet light and weathering.

All materials shall be delivered in original sealed containers, clearly marked with the manufacturer's name, brand name, type of materials, batch number and date of manufacture.

Delivery, storage, handling, applicable temperature range and environmental restrictions on use shall be according to the manufacturer's recommendations.

TS 9.00.06 EQUIPMENT – Not Used

TS 9.00.07 CONSTRUCTION

The following locations shall be surface sealed:

- a) all exposed concrete surfaces in the substructure under an expansion joint including the ballast walls, piers and abutment walls;
- b) the tops, ends and traffic sides of the parapet walls;

-
- c) the sidewalks and curb faces; and
 - d) the tops of the expansion joint end dams.

The surface of the concrete to be sealed must be clean and dry at the time of the sealer application. Relative humidity conditions during time of application shall be according to the manufacturer's application instructions. The material shall be applied only after the concrete has air cured for a minimum of 7 Days or as specified on the manufacturer's material safety data sheets (MSDS). Material shall not be applied under any rainy conditions or within 7 Days after surface becomes wet from rainfall or other moisture. Concrete surface sealer shall not be applied when weather is foggy or overcast.

Asphalt pavement, steel handrail components, joint seals and armouring, and other adjacent bridge components shall be taped or otherwise masked during sealer application.

The surface to be sealed is to be prepared according to the manufacturer's specifications. Existing concrete shall be given a light sandblasting according to OPSS 929 to remove all dirt and provide a clean sealing surface.

The Contractor shall apply both coats of the sealer using a roller. Each coat shall be free from spills, splatter and rundown. The Contractor shall ensure complete coverage of the area being sealed.

The sealer shall be applied in accordance with the manufacturer's specifications and recommendations with regard to the ambient temperature and moisture content ranges allowable. The minimum rate of application shall be 4 m²/L/coat.

After suitable time lag to allow for sealer penetration, post-wetting of sealed concrete surfaces shall be carried out, strictly in accordance with the manufacturer's recommendations.

The Contractor shall take precautions to ensure that workmen and work areas are adequately protected from fire and health hazards resulting from handling, mixing and application of material, observing all necessary safety precautions required by regulating authorities.

The Contractor shall furnish all scaffolding and necessary equipment to complete the work.

TS 9.00.08 QUALITY ASSURANCE

Spills, over spray, splatter, rundown and insufficient coverage of the concrete sealer shall be repaired at no extra cost to the City.

TS 9.00.09 MEASUREMENT FOR PAYMENT

TS 9.00.09.01 Surface Sealing for Structural Concrete

Measurement of concrete surface satisfactorily prepared and sealed with the two coat system of sealer shall be by area in square metres (m²).

TS 9.00.10**BASIS OF PAYMENT****TS 9.00.10.01****Surface Sealing for Structural Concrete – 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.

No payment shall be made for the abrasive blast cleaning of concrete surfaces.

**Construction Specification for
Unshrinkable Fill****Table of Contents**

TS 13.10.01	SCOPE	2
TS 13.10.02	REFERENCES	2
TS 13.10.03	DEFINITIONS	2
TS 13.10.04	DESIGN AND SUBMISSION REQUIREMENTS.....	2
TS 13.10.04.01	General	2
TS 13.10.04.02	Materials	2
TS 13.10.05	MATERIALS.....	2
TS 13.10.05.01	Use of Reclaimed Concrete Material.....	2
TS 13.10.05.02	Unshrinkable Fill	3
TS 13.10.06	EQUIPMENT	3
TS 13.10.06.01	Mixing Equipment	3
TS 13.10.06.02	Transport and Discharge Equipment.....	3
TS 13.10.06.03	Bracing and Shoring	3
TS 13.10.07	CONSTRUCTION	3
TS 13.10.07.01	Placing Unshrinkable Fill.....	3
TS 13.10.07.02	Removal of Shoring and Bracing.....	4
TS 13.10.07.03	Finishing Unshrinkable Fill	4
TS 13.10.07.04	Unshrinkable Fill Protection.....	4
TS 13.10.08	QUALITY ASSURANCE.....	4
TS 13.10.08.01	Acceptance Sampling and Testing	4
TS 13.10.08.02	Acceptance Criteria.....	4
TS 13.10.08.02.01	General.....	4
TS 13.10.08.02.02	Unshrinkable Fill Compressive Strength.....	4
TS 13.10.09	MEASUREMENT FOR PAYMENT	5
TS 13.10.09.01	Unshrinkable Fill	5
TS 13.10.10	BASIS OF PAYMENT.....	5
TS 13.10.10.01	Unshrinkable Fill – Item.....	5

TS 13.10.01 SCOPE

This specification covers the requirements for the placing of unshrinkable fill, in underground service and utility trenches, and around structures.

TS 13.10.02 REFERENCES

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

City of Toronto Standard Specifications

- | | |
|---------|--|
| TS 1010 | Amendment to OPSS 1010.MUNI – Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material |
| TS 1350 | Amendment to OPSS.MUNI 1350 – Material Specification for Concrete – Materials and Production |

Canadian Standards Association

- | | |
|-------|--|
| A23.2 | Test Methods and Standard Practices for Concrete |
|-------|--|

TS 13.10.03 DEFINITIONS

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

Reclaimed Concrete Material (RCM) means removed or processed old hydraulic cement concrete.

Unshrinkable Fill means a mixture of aggregates, cementing material and water, with or without chemical admixtures, that hardens into a material with higher strength than soil that can be removed with hand tools.

TS 13.10.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 13.10.04.01 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 are given in TS 1350.

TS 13.10.04.02 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.

TS 13.10.05 MATERIALS

TS 13.10.05.01 Use of Reclaimed Concrete Material

The producer shall ensure that the level of RCM used in the fill does not compromise the performance of the fill. Recycled aggregates shall satisfy environmental regulations and be in according to TS 1010.

The maximum passing the 75 µm shall be 5 per cent or less of the total aggregate weight.

TS 13.10.05.02 Unshrinkable Fill

The materials for and the production of unshrinkable fill shall be according to TS 1350 and the following:

1) Cement type	Normal Portland GU Portland limestone GUL
2) Maximum 28 day cylinder compressive strength	0.7 MPa
3) Class of exposure	N/A
4) Maximum nominal size of coarse aggregate	25 mm
5) Minimum slump at point of discharge	150 mm
6) Minimum cement content	25 kg/m ³

Supplementary cementing materials, for example fly ash, silica fume and/or slag cement may be used to meet the requirements of this specification.

TS 13.10.06 EQUIPMENT

TS 13.10.06.01 Mixing Equipment

A central mixing or dry batch plant capable of accurately proportioning aggregate, cement and water shall be used according to TS 1350.

TS 13.10.06.02 Transport and Discharge Equipment

Unshrinkable fill shall be transported to the site by means of ready mix trucks.

Unshrinkable fill shall be placed into the excavation using the chutes of the conveying equipment, by pumping, or with the use of buckets.

TS 13.10.06.03 Bracing and Shoring

Bracing, shoring or sheeting shall be placed to protect the services, utilities or surrounding excavation, and shall be removed as the backfilling proceeds.

TS 13.10.07 CONSTRUCTION

TS 13.10.07.01 Placing Unshrinkable Fill

The material shall flow into the excavation so that it fills the entire space without vibration and segregation. Care shall be taken that no air is trapped beneath horizontal projections or in other locations in the excavation.

Unshrinkable fill shall not be placed in direct contact with gas mains or plastic pipe. A layer of carefully compacted granular material shall be placed to ensure a separation of 300 mm between the unshrinkable fill and the gas or plastic pipes.

TS 13.10.07.02 Removal of Shoring and Bracing

When bracing, shoring or sheeting is used to support the sides of the excavation or to prevent movements that could damage other services or adjacent structures, this support system shall be removed as the backfilling progresses.

TS 13.10.07.03 Finishing Unshrinkable Fill

The unshrinkable fill surface shall be screeded while it is still sufficiently flowable to achieve the desired grades and elevation. The surface shall be uniform and free from undulations and projections.

TS 13.10.07.04 Unshrinkable Fill Protection

Where unshrinkable fill is placed, it shall be protected from vehicular traffic including construction equipment for at least 24 hours, by covering with a steel plate of sufficient strength to support the traffic during this period. The steel plates shall be countersunk to the asphalt surface with steel spikes to prevent any displacement of the plate. The steel spikes shall be hammered flush with the top of the plates and extend the full depth of the asphalt or a maximum of 150 mm. The edges of the plates shall then be ramped with Superpave 12.5 temporary asphalt.

Where vehicular traffic is not being accommodated, the backfilled excavation shall be covered with wooden planking or other protection for users of the road allowance until the unshrinkable fill can support the mass of an adult person.

TS 13.10.08 QUALITY ASSURANCE

TS 13.10.08.01 Acceptance Sampling and Testing

All acceptance sampling and testing necessary to determine conformance with the Contract Documents shall be performed by the Contract Administrator. Sampling and testing shall be according to CSA A23.2. The City will determine the lot sizes. The Contractor shall assist, as necessary, in obtaining samples of unshrinkable fill for testing.

The Contractor shall be responsible for the collection and disposal of the remains of all unshrinkable fill used for testing purposes. In order to simplify collection and handling, the Contractor should set aside a designated location for the temporary piling of this discarded material close to the point of discharge from the delivery truck and shall provide assistance to transport the material into the designated location.

TS 13.10.08.02 Acceptance Criteria

TS 13.10.08.02.01 *General*

The compressive strength shall be the criteria for the acceptance of unshrinkable fill.

TS 13.10.08.02.02 *Unshrinkable Fill Compressive Strength*

The unshrinkable fill shall be sampled and tested according to CSA A23.2.

Slump testing shall be completed each time the unshrinkable fill is sampled for compressive strength according to CSA A23.2. To conform to the specified nominal minimum 28 day strength requirements:

- 1) Compressive strength testing shall be the average of two 150 mm diameter by 300 mm long cylinder specimens (must be waxed cardboard moulds), tested at the same age.
- 2) The cylinders shall only be demoulded on the same day of testing for the compressive strength to minimize handling damage to the cylinder specimens.
- 3) The load indicating mechanism of the compression testing machine shall be capable of showing load changes of 100 N (Newton) or less. The loading rate shall be 0.11 MPa/s or lower.

The minimum frequency of testing requirement shall be one set of two test cylinders, per supplier, per day.

Unshrinkable fill represented by compressive strength samples or cores exceeding the requirements shall be removed and replaced at no extra cost to the City.

TS 13.10.09 MEASUREMENT FOR PAYMENT

TS 13.10.09.01 Unshrinkable Fill

Measurement of unshrinkable fill shall be by volume, in cubic metres (m³). Measurement shall be by the summation of delivery tickets, except that the total volume shall not exceed 10 per cent of the theoretical volume.

TS 13.10.10 BASIS OF PAYMENT

TS 13.10.10.01 Unshrinkable Fill – 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 the supplying, placing and finishing of the unshrinkable fill and the supplying, placing and removal of steel plates, including the steel spikes and the Superpave 12.5 asphalt ramping, wooden planking or any other protection required.

No payment will be made when the supply and placement of the above item is included in a separate contract item, other than unshrinkable fill.

**Amendment to OPSS.MUNI 206 (Nov 2013) –
Construction Specification for
Grading**

OPSS 206.07 CONSTRUCTION

OPSS 206.07.01.03 Compaction

Clause 206.07.01.03 of OPSS 206 is amended by deleting the first sentence and replacing it with the following:

Materials shall be compacted according to TS 501.

OPSS 206.07.07.01 General

Clause 206.07.07.01 of OPSS 206 is amended by the addition of the following paragraphs:

Fill, for embankment construction shall consist of sound, clean earth or a mixture of sound, clean earth and stones, broken rock, concrete or masonry from a source designated by the Contractor and approved by the City. The materials for the fill shall be deposited and spread in layers not more than 230 mm in depth prior to compaction, extending to the full width of the fill area.

Where fill less than 300 mm in depth is proposed over an existing flexible pavement, such pavement shall be uniformly plowed or scarified, full depth and spread to form a uniform foundation before any new fill is placed thereon. Where such a fill is proposed over an existing rigid pavement or other structure, such pavement or structure shall be broken up and removed.

Where fills are to be constructed on existing slopes steeper than 6H:1V, steps with a horizontal dimension of not less than 1 m and a vertical dimension of not greater than 230 mm shall be formed in the slopes before any of the fill is placed.

Where the use of frozen material is permitted by the Contract Administrator, it shall be placed outside the limits of assumed 1H:1V slopes, spreading outward from lines one metre outside of the edges of the proposed construction for example pavement, interlocking brick and sidewalk..

Stones more than 750 mm in diameter shall be disposed of, off the site.

Where, in the opinion of the Contract Administrator, filling in layers of the specified thickness is not feasible, as in the case of filling in water, the fill may be constructed in one layer to the minimum elevation at which the equipment can be operated as determined by the Contract Administrator. The fill material placed in this manner shall be thoroughly compacted by approved methods capable of producing a uniform and well consolidated roadway foundation. Above this elevation, the fill shall be constructed in layers of the specified thickness.

In areas where stones are prevalent, the material shall be carefully placed so that any large stones will be well distributed and the interstices completely filled with smaller stones, earth, sand or gravel so as to form a solid fill. Any rock or fragmental material of such size as would prohibit it from being placed in layers of the specified depth shall be placed in the fill only where and as directed or approved by the Contract Administrator.



CONSTRUCTION SPECIFICATION FOR GRADING

TABLE OF CONTENTS

206.01	SCOPE
206.02	REFERENCES
206.03	DEFINITIONS
206.04	DESIGN AND SUBMISSION REQUIREMENTS
206.05	MATERIALS - Not Used
206.06	EQUIPMENT
206.07	CONSTRUCTION
206.08	QUALITY ASSURANCE
206.09	MEASUREMENT FOR PAYMENT
206.10	BASIS OF PAYMENT

APPENDICES

206-A	Commentary
--------------	-------------------

206.01 SCOPE

This specification covers the requirements for grading, including earth and rock excavation and embankment construction, and management of excavated material.

206.01.01 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.

206.01.02 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.

206.02 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 209	Embankment Over Swamps
OPSS 212	Borrow
OPSS 501	Compacting
OPSS 802	Topsoil
OPSS 804	Seed and Cover

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
-----------	----------------------------

206.03 DEFINITIONS

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

Angle of Repose means the maximum angle, measured from the horizontal, at which fill remains stable.

Backslope means the slope in a cut between the invert of the roadside ditch and the point where the slope intersects original ground.

Benching means the keying of new fill slopes into existing slopes by excavating horizontal planes in the existing slopes and backfilling the benches and placing the fill simultaneously. Benching also means the stepping of cut slopes at intermediate levels in deep cuts.

Bulking Factor means the ratio of the volume of earth or rock material following excavation, placement, and compacting to the original in situ volume of the same material. The bulking factor for the purposes of this contract shall be 1.35. For rock excavation quantities identified as shatter, the bulking factor shall be 0.35.

Cushion Blasting means the placing of a single row of lightly loaded closely spaced holes along the excavation limits as specified in the Contract Documents and firing them coincident with the main excavation blast as the last delay sequence to remove rock inside the cut limits.

Ditching means the excavation in earth or rock for all water courses. The term shall include roadside ditches, all excavation lying beyond the end of drainage structures, and stream and watercourse diversions and corrections.

Earth means all soils except those defined as rock, and excludes stone masonry, concrete, and other manufactured materials.

Embankment means the material placed within the sideslopes; below the top of subgrade; and above the original ground, excavated base, or theoretical bottom, as applicable, to the limits specified in the Contract Documents.

Existing Rock Surface means the exposed rock surface or the rock surface after removal of overburden.

Frontslope means the slope in a cut section between the edge of shoulder and the invert of the roadside ditch.

Line Drilling means the placing of a single row of very closely spaced holes without explosives along the rock excavation limits specified in the Contract Documents.

Mucking means the excavation of broken rock.

Overbreak means any broken, displaced, or loosened rock material that originates outside the rock excavation limits specified in the Contract Documents.

Pre-Shearing means the placing of a single row of closely spaced lightly loaded holes placed along the rock excavation limits specified in the Contract Documents, which are fired prior to the main excavation blast.

Profile Grade means the elevation of the surface of the Base as specified in the Contract Documents.

Roadside Ditch means a ditch with one of its sideslopes coincident with the road frontslope.

Rock means natural beds or massive fragments of the hard, stable, cemented part of the earth's crust, either igneous, metamorphic, or sedimentary in origin, which may or may not be weathered and includes boulders having a volume of 1 m³ or greater.

Rock Face means the vertical or near vertical face between the top of the existing rock surface and the designated rock or ditch grade line.

Rock Surplus means the rock excavation tender quantity multiplied by the bulking factor minus the rock embankment tender quantity. Rock overbreak and rock materials resulting from scaling are specifically excluded from this definition.

Scaling means the removal of loose, broken, or overhanging rock fragments from a rock face.

Shale means a fine grained, low strength, sedimentary rock that undergoes rapid deterioration on exposure.

Shatter means fractured rock broken by the use of explosives or mechanical means and left in place.

Sideslope means the slope in a fill between the edge of shoulder and the point where the slope intersects original ground.

Spall means a rock fragment, chip, or splinter from a rock surface created by weathering, stress relief, blasting, or a combination thereof.

Stripping means the excavation of the upper lay of soil, which is predominantly organic and unsuitable for the construction of embankments. It is commonly referred to as topsoil.

Tolerance means a construction working tolerance only, minus or plus:

a) Minus

- i. Narrower than the Contract standard pertaining to horizontal dimensions as measured from centreline, and
- ii. lower in elevation than the Contract standard pertaining to vertical dimensions.

b) Plus

- i. Wider than the Contract standard pertaining to horizontal dimensions as measured from centreline, and
- ii. higher in elevation than the Contract standard pertaining to vertical dimensions.

Wall Control Blasting means a blasting method using carefully spaced and aligned drill holes intended to produce a relatively flat rock surface, generally characterized by noticeable drill hole traces, with a minimum of blast induced fractures beyond the rock excavation limits specified in the Contract Documents. Wall control blasting techniques are cushion blasting, line drilling, and pre-shearing.

206.04 DESIGN AND SUBMISSION REQUIREMENTS

206.04.01 Submission Requirements

206.04.01.01 Rock Material Management Plan

When a rock material management plan is specified in the Contract Documents, the following information shall be submitted to the Contract Administrator a minimum of 5 Business Days prior to undertaking the work of rock excavation or rock embankment:

- a) A plan for rock excavation corresponding to the station intervals shown in the Contract Documents. The plan shall identify the volume in cubic metres of the following:
 - i. In situ rock prior to blasting, with shatter quantity shown separately.
 - ii. Excavated rock available calculated by applying a bulking factor of 1.35 to the quantity of in situ rock prior to blasting less the quantity of shatter.
 - iii. Excavated rock to be placed in rock embankment.
 - iv. Excavated rock to be processed into granular material.
 - v. Excavated rock to be used for other purposes in completing the Work and the type and location of that Work.
 - vi. Excavated rock not incorporated into the Work and the location and use of the material.

- b) A plan for construction of embankments identifying locations and volume in cubic metres from where material is supplied that corresponds to the station intervals in the Contract Documents.
- c) The source locations and volume in cubic metres for additional rock and granular material required to complete the Work.

The Contractor shall update the rock material management plan monthly. The Contractor shall be solely responsible for the assumptions and the reasonableness of the rock material management plan.

206.04.01.02 Trial Section

A minimum of 48 hours prior to commencing any work on the trial section required by the modified layer compaction method, a detailed plan shall be submitted in writing to the Contract Administrator for approval. The plan shall include full details of the placing and compaction procedure, including layer thickness; number and type of compaction units and number of passes; and a method of evaluating the compaction achieved throughout the full lift.

206.06 EQUIPMENT

206.06.01 Tractor Bulldozer, Crawler Type

Tractor bulldozer, crawler type, shall have a minimum net flywheel power of 200 kW.

Rollers for compacting shale embankments shall weigh:

- a) 18 tonnes - first stage.
- b) 9 tonnes, minimum - second stage.

206.07 CONSTRUCTION

206.07.01 General

206.07.01.01 Removal of Ice and Snow

All ice and snow shall be removed from any earth excavation and embankment areas under construction.

206.07.01.02 Embankments

Only materials approved by the Contract Administrator shall be used. Frozen earth materials shall not be incorporated into embankments. Materials shall not be placed over either frozen earth or ice surfaces.

Reclaimed asphalt pavement (RAP) used in embankments shall be surplus to the recycling requirements of the Contract.

206.07.01.03 Compaction

Materials shall be compacted according to OPSS 501.

For the purpose of compaction, RAP and reclaimed Portland cement concrete included in the embankment shall be treated as earth or rock corresponding to the embankment being constructed.

206.07.01.04 Management of Excavated Material

As much of the excavated materials as possible shall be used within the contract limits. Material surplus to embankment requirements or unsuitable material that cannot be accommodated in embankments shall be placed adjacent to the embankments by widening embankments, flattening side slopes, and constructing modified cross-sections, as specified in the Contract Documents or as directed by the Contract Administrator.

Materials that cannot be accommodated as above shall be treated as excess material.

206.07.01.05 Borrow

When borrow is specified in the Contract Documents to complete embankments or backfill requirements, borrow shall be according to OPSS 212.

206.07.01.06 Tolerances - General

In the event of a conflict between meeting horizontal grading tolerances and meeting vertical grading tolerances, the vertical grading tolerances shall take precedence.

206.07.01.07 Tolerances for Earth

Upon completion, all earth grade surfaces, excluding swamp excavations, shall be shaped to the grades and cross-sections specified in the Contract Documents within the following tolerances:

- a) Vertical grading tolerances for the finished earth subgrade within the limit of the roadway:

+ 30 mm
- 30 mm

- b) Horizontal grading tolerances for the vertical faces of excavations to be backfilled:

+ 100 mm
- 0 mm

- c) Horizontal grading tolerances for ditch slopes, excluding roadside ditches:

+ 300 mm
- 0 mm

Sideslopes beyond the plus tolerance may be accepted by the Contract Administrator where they are not detrimental to the work.

- d) Vertical grading tolerances for all ditching in earth:

+ 30 mm
- 30 mm

- e) Horizontal grading tolerances for the backslopes in earth cut sections:

+ 300 mm
- 300 mm

Backslopes beyond the plus tolerance may be accepted by the Contract Administrator where they are not detrimental to the work.

- f) Horizontal grading tolerances for each sideslope in earth embankment construction:

+ 300 mm
- 0 mm

- g) Horizontal grading tolerances for roadside ditch frontslopes:

+ 30 mm
- 0 mm

Irrespective of compliance with the above tolerances, the completed slopes shall present a uniform appearance.

206.07.01.08 Tolerances for Rock

Completed rock grade surfaces shall be shaped to the grades and cross-sections specified in the Contract Documents within the following tolerances:

- a) Vertical grading tolerances for the finished rock subgrade within the limits of the roadway:

+ 30 mm
- 100 mm

Excavation below the minus tolerance may be accepted by the Contract Administrator where it is not detrimental to the work and is brought up to grade according to the General clause of the Rock Excavation, Grading subsection.

- b) Horizontal grading tolerances for vertical rock face cut limits:

+ 0 mm
- 300 mm

Final faces beyond the plus tolerance may be accepted by the Contract Administrator where they are not detrimental to the work.

- c) Horizontal grading tolerances for sloped rock face cut limits:

+ 300 mm
- 300 mm

- d) Horizontal grading tolerances for ditch slopes, excluding roadside ditches:

+ 300 mm
- 0 mm

Excavation beyond the plus tolerance may be accepted by the Contract Administrator where it is not detrimental to the work.

- e) Vertical grading tolerances for all ditching in rock cuts:

+ 30 mm
- 100 mm

Excavation below the minus tolerance may be accepted by the Contract Administrator where it is not detrimental to the work.

f) Horizontal grading tolerances at the top of each sideslope of rock embankment construction:

+ 300 mm
- 0 mm

206.07.02 Drainage

Excavation operations shall be performed in such a manner as to avoid water saturation of embankment material and roadway foundation material and to avoid leaving undrained pockets in rock excavations by providing effective drainage during all stages of the work.

In excavations below subgrade and in stripping operations where provision for surface drainage is impractical, backfill materials shall be placed as soon as possible following the excavation work.

Ditching required to provide for drainage of an embankment shall be completed in advance of the embankment construction. Ditches in roadway cuts shall be constructed as soon as possible to provide drainage from the cuts. Ditches located above and beyond roadway cuts shall be constructed prior to excavating adjacent cuts. Where pipe subdrains are required in the base of roadway cuts, such work shall be carried out at the time that the roadside ditches are being constructed.

206.07.03 Earth Excavation, Grading

206.07.03.01 General

The work shall include excavating, hauling, handling and placing in embankments, shaping, compacting, trimming of earth material and applying temporary cover, and the management of excavated material.

Suitable excavated earth from roadway cuts, ditching, and other associated sites shall be used in embankment construction and as specified in the Contract Documents.

206.07.03.02 Provision for Temporary Cover

Mulch for cover used in temporary applications shall be applied according to OPSS 804 to areas specified in the Contract Documents.

206.07.03.03 Excavation Below Subgrade

Unsuitable materials, other than swamp material, shall be removed below the subgrade to the lengths, widths, and depths specified in the Contract Documents. The resulting excavation shall be backfilled with approved material and compacted.

206.07.03.04 Backfilling of Overexcavated Areas

Where overexcavation occurs, it shall be backfilled with approved material and compacted. With the exception of frontslopes and where boulders are encountered in the excavated slopes, backfilling shall not be permitted to obtain required slopes for excavations. When boulders are encountered in the excavated slopes, the boulders shall be removed when directed by the Contract Administrator and the cavity backfilled with approved material and compacted.

206.07.03.05 Overexcavation of Cut Slopes

Suitable material from overexcavation of cut slopes shall be used in embankment construction.

206.07.03.06 Swamp Excavation

Swamp excavation shall be according to OPSS 209.

206.07.03.07 Stripping

Except where swamp treatment is required, the original ground under embankments of 1.2 m or less in height and the original surface over the entire width of all excavation shall be stripped as specified in the Contract Documents. The height of embankment shall be measured from original ground to profile grade.

Material meeting the requirements of topsoil according to OPSS 802 shall be stockpiled.

Stripped material that does not meet the requirements of OPSS 802 shall be managed as per the Management of Excavated Material clause.

206.07.03.08 Excavation for Widening

Excavation that is adjacent to the travelled portion of the roadway shall at no time be in advance of the backfilling operation by a distance greater than the limits specified in the Contract Documents. Any such excavation shall be backfilled and compacted with material specified in the Contract Documents prior to closing down operations each day.

206.07.04 Excavation for Pavement Widening

The work shall include excavating a trench adjacent to the existing pavement, to the widths and depths specified in the Contract Documents. Excavated material shall be spread on the adjacent shoulders and slopes.

206.07.05 Rock Excavation, Grading

206.07.05.01 General

The work shall include drilling and blasting to obtain the required rock excavation and shatter, mucking, and bringing to grade any overexcavation. The use of explosives in the blasting operation shall be according to the Contract Documents.

All excavated rock materials, including rock materials resulting from overbreak and scaling, except the quantity of rock surplus, shall be placed in embankments.

Where rock is to be excavated, all overlying stumps, roots, and vegetation shall be treated as excess material. Where earth overlies the rock to be excavated, the earth shall be removed. This work shall be performed sufficiently in advance of blasting operations to allow rock cross-sections to be taken.

Scaling and the removal of all rock or boulders liable to slide or roll down rock cuts either on or outside the excavation areas shall be performed during or after mucking. Cut ditches shall be excavated at the same time as the main excavation.

Excavation below grade in rock cuts shall be brought to grade within the specified tolerances with approved material.

Rock in roadway cuts shall be shattered to a uniform minimum depth of 300 mm below the theoretical rock subgrade for the full width of the cut, including the ditch.

206.07.05.02 Shale

The Contractor shall determine the method of excavation of shale according to site conditions. Side slopes in shale shall be as specified in the Contract Documents. Rock face and shatter are not required in shale.

206.07.05.03 Drilling

All drilling shall be performed within the design excavation limits and to provide shatter as specified in the Contract Documents.

206.07.06 Rock Face

The work shall include drilling and blasting using one or more wall control blasting techniques to produce rock face when specified in the Contract Documents. The work shall also include scaling, removing all overbreak and scaled rock, and incorporating removed rock into embankments.

The spacing and diameter of drill holes for wall control blasting of rock face shall be decided by the Contractor. The spacing and diameter of holes shall be adjusted where necessary to ensure a uniform shear face between holes.

The first line of production holes shall be positioned and loaded with explosives in such a manner as to produce the required rock face.

206.07.07 Earth Embankments

206.07.07.01 General

Embankment material shall be deposited and spread in uniform layers for the full width of the embankment and each layer shall be compacted before the succeeding layer is placed. The lower portion of side hill or sloping sections shall be constructed as above until a full width surface of the specified cross-section is obtained. The embankment shall be completed thereafter with full width layers or as stage construction allows.

The construction of a core through the embankment and the subsequent completion of the embankment are prohibited except where core construction is permitted in swamps as specified in OPSS 209. The use of surplus material and the placing of material in difficult locations by side dumping may be permitted subject to the approval of the Contract Administrator.

Boulders, cobbles, fragments of rock, RAP, and reclaimed concrete material over 150 mm in their maximum dimension shall not be placed within 300 mm of the surface of the earth grade.

Boulders, cobbles, fragments of rock, RAP, and reclaimed concrete material up to 0.5 m³ may be incorporated into an earth embankment provided:

- a) They are placed only in the bottom layer of the embankment.
- b) The maximum dimension of the largest particle shall not exceed 800 mm.
- c) They are not located within 300 mm of the final embankment side slopes.
- d) They are not located within 1.0 m of the surface of the earth grade.

When the earth embankment has been completed to the limits specified in the Contract Documents, the Contract Administrator shall be notified before placing any surplus, unsuitable material, and topsoil on the embankment slopes.

Topsoil placed on earth embankments shall be according to OPSS 802.

206.07.07.02 Layer Compaction Method

Except as provided in the Modified Layer Compaction Method clause, all earth embankments shall be built using a layer compaction method. The embankment material shall be spread in uniform full width layers not more than 300 mm in depth prior to compaction. Each layer shall be shaped and compacted to the line and cross-section specified before the succeeding layer is placed. All boulders, cobbles, fragments of rock, RAP, and reclaimed Portland cement concrete greater in dimension than the fully compacted layer depth shall be removed.

Where the ground cannot support construction equipment using this method initially, then the first layer may be increased in thickness according to the modified layer compaction method.

206.07.07.03 Modified Layer Compaction Method

When it is deemed practical to construct an earth embankment or portion of an embankment in thicker lifts than specified in the Layer Compaction Method clause, permission may be requested to do so by supplying full details of the proposed method. The maximum thickness of allowable lifts shall not exceed 600 mm. All boulders, cobbles, and fragments of rock shall not exceed the modified layer depth. All RAP and reclaimed Portland cement concrete shall not exceed 300 mm in thickness.

Before placing material, proof of the ability of the proposed method to achieve the specified density shall be demonstrated by means of a trial section consisting of a single uniform lift covering a minimum area of 400 m².

The location and extent of the trial section is subject to approval by the Contract Administrator.

All necessary excavation for establishing the compaction results throughout the layer shall be done by hand.

When the placing and compacting procedure has successfully demonstrated that compaction can be achieved over the entire lift that procedure shall be permitted for the remainder of the work to which it is applicable.

If at any time, test results show that the permitted procedure is no longer producing the required degree of compaction, a new trial area shall be required. Changes in the procedure shall be made to satisfy the requirements of this specification. Such changes shall be in writing to the Contract Administrator before commencing work on the new trial area.

206.07.08 Rock Embankments

206.07.08.01 General

The work shall include, hauling, placement, and compaction of broken rock.

Each rock fill layer shall be compacted with a tractor bulldozer, crawler type. The minimum number of complete passes is six and the maximum number of passes is eight. A complete pass is 100% coverage of the layer surface. The maximum speed of the equipment during each pass shall be 3.2 km/h.

Embankments to be constructed of rock other than shale shall be constructed by placing embankment materials full width in successive, uniform layers. Layers shall not exceed 1.5 m thickness prior to compaction. Material in each layer shall be fully compacted before the succeeding layer is placed.

Materials shall be placed in final position by blading. End dumping or depositing of rock over the end of any layer by hauling equipment is not permitted, except as otherwise noted below. Each layer shall be levelled in place and compacted to minimize voids and bridging of large rock fragments within the embankment.

Rocks fragments exceeding a maximum dimension of 1 m shall be well distributed throughout the embankment. Rock fragments up to a maximum size of 3 m in size may be incorporated into the embankment provided that the rock fragments are less than two-thirds the remaining embankment height, when measured from the bottom of the oversized rock fragment at the point of placement to the top of the rock embankment, and are sufficiently spaced to allow free access of the specified equipment to compact the intervening fill.

Placement and compaction in layers are not required for rock to be placed under water. Rock placed underwater may be placed by end dumping. End dumping shall only be used to an elevation of 1.0 m above the water level after which the rock embankment shall be constructed using the equipment and method specified. The materials shall be well distributed to form a solid embankment constructed to full width as the work progresses, or as stage construction allows.

Where rock embankment is constructed in a wet area such as swamps with full, partial, or no excavation, the direction of the rock placement shall be such that mud waves generated by the rock placement would move away from the embankment. Mud waves shall be displaced or removed to prevent its entrapment below or within the embankment.

Voids on the top surface of the embankment shall be minimized to prevent migration of the roadway subbase and base into the rock fill embankment by chinking the top surface with rock fragments and spalls to form the subgrade prior to the placement of the roadway subbase.

Care shall be taken to avoid large boulders and rock fragments protruding above the average embankment surface within a distance of 3.0 m beyond the edge of shoulder.

Dumping of surplus rock over the sides of embankments is permitted only after the rock embankments have been completed. Dumping over the sides of embankments shall be restricted to areas not affecting features within the right-of-way (e.g., ditches, culverts, and signs) or right-of-way limits. The Contractor shall receive written approval from the Contract Administrator before commencing these operations.

When the rock embankment has been completed, the Contract Administrator shall be notified before placing any surplus, unsuitable material, and or top soil on the embankment slopes.

206.07.08.02 Shale Embankments

Shale embankment materials shall be deposited and spread in uniform layers for the full width of the embankment. Layers shall not exceed 450 mm in thickness prior to compaction. Where a harder more durable rock, such as limestone, is present as an integral part of a shale formation, no pieces greater than 150 mm measured vertical to the embankment layer, or greater than 600 mm measured parallel to layers shall be placed in the embankment.

Compaction of each layer shall be in two stages. In the first stage, a minimum of two passes shall be made with a static sheepsfoot, packall, padfoot, or tamping foot type roller. In the second stage, a minimum of two passes shall be made with a vibratory steel drum or pneumatic-tired roller. Maximum speed of rollers shall not exceed 10 km/hr.

When the shale embankment has been completed, the Contract Administrator shall be notified before placing any surplus, unsuitable material, and or top soil on the embankment slopes.

206.07.08.03 Rock Backfill to Structure

When rock backfill to structures is specified, the rock shall be clean, free from contaminants, with no fragments larger than 250 mm in its greatest dimension.

Rock backfill shall be placed in such a manner that the structure is not damaged. Dumping of rock backfill against a structure shall not be permitted.

206.07.09 Quality Control

206.07.09.01 General

The Contractor shall be responsible for carrying out all quality control grade checks to ensure that horizontal and vertical grading tolerances are met.

206.07.09.02 Submission of Grade Checks

All grade checks relating to horizontal and vertical grading tolerances, including all non-compliances, shall be submitted to the Contract Administrator within 2 Business Days following completion of the grade.

Where grading templates are available, the Contractor shall sign and certify the template as correct. If no template is available, the Contractor shall complete, sign, and submit the attached form OPSF 206-1 to the Contract Administrator.

206.07.09.03 Finished Grades Outside Specification

Where the finished grade or cross-section does not meet the requirements of the Contract Documents, the earth or rock grade surface shall be brought to grade within the specified tolerances.

206.07.10 Management of Excess Material

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

206.08 QUALITY ASSURANCE

The Contract Administrator may conduct random quality assurance grade checks to verify horizontal and vertical grading tolerances. If the finished grade or cross-section is found to be outside the specified tolerances, the Contractor shall be required to bring the earth or rock grade within the specified tolerances.

206.09 MEASUREMENT FOR PAYMENT

206.09.01 Actual Measurement

206.09.01.01 Earth Excavation, Grading

Measurement of earth excavation, grading, shall be by volume in cubic metres measured in its original position and based on cross-sections taken prior to grubbing.

Benching of slopes shall not be measured.

206.09.01.01.01 Overbuilding, Earth

Where the Contract requires borrow, the quantity of material placed beyond the earth grading tolerance shall be deducted from the measured quantity of borrow on a cubic metre for cubic metre basis, with no correction for changes in density of the material.

206.09.01.02 Excavation for Pavement Widening

Measurement of excavation for pavement widening shall be the horizontal length in metres along each edge of existing pavement where widening is specified in the Contract Documents.

206.09.01.03 Rock Excavation, Grading

206.09.01.03.01 General

Measurement of rock excavation, grading, shall be by volume in cubic metres computed from field measurement of cross-sections taken after earth overburden has been removed and shall be based on the designated limits. The theoretical bottom of the cut shall be the shatter line, which shall be 300 mm below the rock grade.

The quantity of rock beyond that specified in the Contract Documents, as ordered by the Contract Administrator in writing, shall be included in the rock excavation computation.

Deductions shall not be made from the rock excavation quantity for any material conforming to OPSS 1004 and used as rip-rap or rock protection.

206.09.01.03.02 Overbuilding, Rock

Where the Contract requires borrow, the quantity of material placed beyond the rock grading tolerance at the top of subgrade and beyond the angle of repose for rock fills, below the subgrade, shall be deducted from the measured quantity of borrow on a cubic metre for cubic metre basis, with no correction for changes in density of the material.

206.09.01.03.03 Boulders

The volume of boulders classified as rock shall be determined on the basis of actual rock measurement.

206.09.01.04 Rock Face

Measurement of rock face shall be by area of the rock face in square metres.

206.09.01.05 Rock Embankment

Measurement of rock embankment shall be by volume in cubic metres of the material placed within the embankment.

206.09.02 Plan Quantity Measurement

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

206.10 BASIS OF PAYMENT

206.10.01 Earth Excavation, Grading - 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.

Benching of materials excavated as required to key new fills into existing slopes shall not be included for payment.

206.10.02 Excavation for Pavement Widening - 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.

Material used to backfill the excavation shall be paid for at the Contract price for the tender item of the material used.

Where the Contract Administrator directs that material excavated under this item is to be managed other than as specified in the Excavation for Pavement Widening subsection, then such material shall be managed as excess materials as specified in the Contract Documents and shall be paid as Extra Work.

206.10.03 Rock Excavation, Grading - 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.

When a rock face item is not included in the Contract, rock scaling and the removing of all overbreak and scaled materials shall be included in the rock excavation, grading item.

When a rock embankment item is not included in the Contract, the work of rock embankments shall be included in the rock excavation, grading item.

When excavated rock is to be used for other Contract item work (e.g., rock embankment, granular, and rip-rap) the hauling costs are deemed to be included in payment for the work associated with the appropriate tender item.

Where drilling, blasting, and mucking are required as a part of the work for this tender item, the following progress payments shall be made:

- a) 33% of the progress volume for drilling
- b) 33% of the progress volume for blasting

206.10.04 Rock Face - 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.

When the Contract does not contain a separate tender item for rock face, the Contract price for Rock Excavation, Grading, shall include full compensation for all labour, Equipment, and Material to do the work of rock face.

On completion of drilling and blasting, a progress payment of 50% of the above item shall be made.

On completion of mucking, a progress payment of 75% shall be made.

206.10.05 Rock Embankment - 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.

When the Contract does not contain a separate tender item for rock embankment, the Contract price for Rock Excavation, Grading, shall include full compensation for all labour, Equipment, and Material to do the work of rock embankment.

206.10.06 Backfill for Overexcavation

Payment shall not be made for backfill for any overexcavation in excess of the specified tolerances.

206.10.07 Backfill for Subexcavation

Material used to backfill subexcavations and transition or grade point treatments shall be paid for at the Contract price for the tender item of material used.

206.10.08 Finished Grades Outside Specification

When finished grades are outside specifications, bringing the earth or rock surface to grade within the specified tolerances shall be at no extra cost to the Owner.

206.10.09 Rock Borrow

When the Contract does not contain sufficient rock within the Contract limits and the Contract does not contain a rock embankment item, rock borrow shall be paid according to OPSS 212.

CERTIFICATION OF GRADE ELEVATION / CROSSFALL

CONTRACT _____ **LOCATION** _____

COMPONENT _____ **LOCATION** _____

In compliance with the Contract, I hereby certify that the following portions of the above component of the work have been correctly constructed to the specified line and grade tolerances.

FROM STATION	TO STATION	TYPE OF GRADE	DATE	CERTIFIED BY	
				Print Name	Signature

OPSF 206-1

Appendix 206-A, November 2013 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:

- Locations for use of excavated material. (206.07.01.04)
- Areas requiring temporary cover. (206.07.03.02)
- Location and extent of unsuitable material below subgrade to be removed. (206.07.03.03)
- The stripping limits. (206.07.03.07)
- The maximum limit of open excavation allowed adjacent to the travelled roadway. (206.07.03.08)
- The widths and depths when excavation is required adjacent to the travelled roadway. (206.07.04)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Rock material management plan. (206.04.01.01)
- Borrow requirements. (206.07.01.05)
- Rock face item. (206.07.06)
- Rock embankment item. (206.10.05)

The designer should be aware that in estimating fill quantities, where displacement may be anticipated, an allowance should be made for losses into bottom of fills in material due to displacement.

Consideration should be given to the use of trial blast over a limited extent to ensure that the method spacing and diameter wall control blast holes are properly selected to achieve an acceptable rock face for the given rock condition.

On reconstruction projects, areas of subgrade shatter, rock fill, and previously blasted rock to be removed should be clearly defined in terms of location, depth, etc.

When a rock embankment item is not included in the Contract, the designer should include a rock borrow item if there is insufficient rock within the Contract limits.

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

Appendix 206-A

Related Ontario Provincial Standard Drawings

OPSD 200.010	Earth/Shale Grading, Undivided Rural
OPSD 200.020	Earth/Shale Grading, Divided Rural
OPSD 201.010	Rock Grading, Undivided Rural
OPSD 201.020	Rock Grading, Divided Rural
OPSD 202.010	Slope Flattening Using Excess Material on Earth or Rock Embankment
OPSD 202.020	Drainage Gap for Slope Flattening on Rock or Granular Embankment
OPSD 202.030	Embankment Widening for Guide Rail End Treatments and Transitions
OPSD 203.010	Embankments Over Swamp, New Construction
OPSD 203.020	Embankments Over Swamp, Existing Slope Excavated to 1H:1V
OPSD 203.030	Embankments Over Swamp, Existing Slopes Maintained
OPSD 203.040	Embankments Over Swamp at Pipe Culverts $\leq 1,500\text{mm}$
OPSD 204.010	Boulder Treatment, Cut Sections - Subgrade
OPSD 205.010	Transition Treatment, Earth Cut to Earth Fill
OPSD 205.020	Transition Treatment, Rock Cut to Rock Fill
OPSD 205.030	Transition Treatment, Rock Cut to Earth Fill
OPSD 205.040	Transition Treatment, Earth Fill to Rock Fill and Earth Fill to Granular Fill
OPSD 205.050	Transition Treatment, Rock Cut to Earth Cut
OPSD 205.060	Frost Heave Treatment
OPSD 208.010	Benching of Earth Slopes
OPSD 209.010	Rural Pavement Widening
OPSD 209.011	Rural Pavement Widening with Curb and Gutter
OPSD 209.020	Widening, Existing Rock Cut with Grade Raise
OPSD 300.010	Side Road Intersection, Fill
OPSD 300.020	Side Road Intersection, Cut
OPSD 301.010	Rural Entrances to Roads on Fill
OPSD 301.020	Rural Entrances to Roads in Earth Cut With Culvert Installation
OPSD 301.030	Rural Entrance, Rock Cut

**Amendment to OPSS 405 (Nov 2008) –
Construction Specification for
Pipe Subdrains**

OPSS 405.05 MATERIAL

OPSS 405.05.01 General

Subsection 405.05.01 of OPSS 405 is amended by deleting the first and second paragraphs in its entirety and replacing it with the following:

Perforated corrugated polyethylene pipe shall be used for all sub-drains. All sub-drain pipes shall include the connection of outlet to drainage structure or approved drainage outlet.

Outlet pipes shall be a non-perforated smooth inside wall pipe constructed of high density polyethylene or polyvinyl chloride.

OPSS 405.05.07 Granular

Subsection 405.05.07 of OPSS 405 is amended by deleting the first sentence in its entirety and replacing it with the following:

Granular material shall be according to TS 1010 and as specified in the Contract Documents.

OPSS 405.07 CONSTRUCTION

OPSS 405.07.02 Excavation

Subsection 405.07.02 of OPSS 405 is amended by deleting the first sentence in its entirety and replacing it with the following:

The trench shall be excavated beginning at the outlet end and proceeding toward the upper end true to the line and grade required. It is the Contractors responsibility to locate any and all buried utilities before the trench is excavated, to ensure that the flow of the pipe is not impeded.

OPSS 405.07.05 Bedding

Subsection 405.07.05 of OPSS 405 is amended by the addition of the following sentence:

Bedding material shall be clear stone as specified in OPSS 405.05.08.

OPSS 405.07.06.01 General

Clause 405.07.06.01 of OPSS 405 is amended by the addition of the following paragraphs:

The entire trench shall be wrapped with a Class 1 non-woven geotextile fabric according to OPSS 1860 and shall have a minimum thickness of 0.9 mm. Each section shall be overlapped by a minimum of 300 mm in all directions.

The upstream end of the subdrain shall be plugged with an approved polyethylene plug and the geotextile sock knitted sock shall be extended over the plug and tied with a knot. Where joints are required, they shall be constructed with approved polyethylene joint connectors and the geotextile sock shall be overlapped by a minimum 150 mm and secured in place with plastic cable ties.

OPSS 405.07.06.03 Connection to Drainage Structures

Clause 405.07.06.03 of OPSS 405 is amended by the addition of the following paragraphs:

The outlet invert elevation shall be located not less than 75 mm nor more than 150 mm above the drainage structure or ditch outlet.

Subdrains shall be connected to drainage structures by coring only. The use of jackhammers or saw cutting shall not be permitted. When two subdrains are to be connected to a drainage structure, a tee connection shall be made outside the drainage structure and then connected to a single outlet in the drainage structure. The tee connection shall be a snap-on, self-locking, male-ended tee.

OPSS 405.07.07 Embedment and Backfill Material

Subsection 405.07.07 of OPSS 405 is amended by deleting the first sentence in its entirety and replacing it with the following:

Embedment and backfill material shall be clear stone as specified in OPSS 405.05.08.

OPSS 405.10 BASIS OF PAYMENT

OPSS 405.10.01 Pipe Subdrain – Item

Subsection 405.10.01 of OPSS 405 is amended by deleting the second, third and fourth paragraphs in its entirety.



CONSTRUCTION SPECIFICATION FOR PIPE SUBDRAINS

TABLE OF CONTENTS

405.01	SCOPE
405.02	REFERENCES
405.03	DEFINITIONS
405.04	DESIGN AND SUBMISSION REQUIREMENTS
405.05	MATERIALS
405.06	EQUIPMENT - Not Used
405.07	CONSTRUCTION
405.08	QUALITY ASSURANCE
405.09	MEASUREMENT FOR PAYMENT
405.10	BASIS OF PAYMENT

APPENDICES

405-A	Commentary
--------------	-------------------

405.01 SCOPE

This specification covers the requirements for the installation of pipe subdrains.

405.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

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

405.01.02 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.

405.02 REFERENCES

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

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 320	Open Graded Drainage Layer
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 421	Pipe Culvert Installation In Open Cut
OPSS 501	Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1801	Corrugated Steel Pipe Products
OPSS 1840	Non-Pressure Polyethylene Plastic Pipe Products
OPSS 1841	Polyvinyl Chloride (PVC) Pipe Products
OPSS 1860	Geotextiles

Canadian Standards Association (CSA)

G164-M92 (R2003) Hot Dip Galvanizing of Irregularly Shaped Articles

Bureau De Normalisation Du Quebec (BNQ)

3624-115 (2007) Polyethylene (PE) Pipe and Fittings - Flexible Corrugated Pipes for Drainage - Characteristics and Test Methods.

Water Research Centre (WRc) Publication

MSCC Manual of Sewer Condition Classification, 4th Edition, December 2003

405.03 DEFINITIONS

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

Backfilling means the operation of filling the trench with embedment and backfill material.

Backfill Material means the material used to fill the trench above the embedment material and below the lower of the subgrade or finished grade or the original ground.

Bedding means the embedment material placed in the subdrain and outlet pipe trenches below the pipe.

CCTV means closed-circuit television.

Embedment Material means the material used to fill the trench from the bottom of bedding to the height specified in the Contract Documents.

Knitted Sock Geotextile means a textile structure produced by knitting in a continuous tube specifically intended to cover perforated subdrain. Knitted geotextiles are suitable only for wrapping of perforated subdrain pipe.

OGDL means open graded drainage layer.

Outlet means the terminal 2.5 m of the outlet pipe.

Outlet Pipe means a non-perforated 100 or 150 mm diameter pipe that is placed for the purpose of conveying subsurface water from a subdrain to a proper outlet.

Subdrain means a perforated 100 or 150 mm diameter pipe that is placed for the purpose of collecting subsurface water and conveying it to a proper outlet pipe.

405.04 DESIGN AND SUBMISSION REQUIREMENTS

405.04.01 Submission Requirements

Upon request, prior to the placement of subdrain or outlet pipe, documentation from the manufacturer verifying that the material supplied meets the Contract requirements shall be submitted to the Contract Administrator.

405.05 MATERIALS

405.05.01 General

Subdrain shall be a perforated polyvinyl chloride pipe, polyethylene pipe, or corrugated steel pipe.

Outlet pipe shall be a non-perforated corrugated steel pipe or a non-perforated smooth inside wall pipe constructed of high density polyethylene or polyvinyl chloride.

Outlets shall be constructed of non-perforated corrugated steel pipe or double-walled polyethylene or polyvinyl chloride pipe having a minimum stiffness of 300 kPa.

405.05.02 Corrugated Steel Pipe Products

Corrugated steel pipe products shall be according to OPSS 1801 and as specified in the Contract Documents.

405.05.03 Polyethylene Pipe Products

Polyethylene pipe products shall be according to OPSS 1840 or BNQ 3624-115 and as specified in the Contract Documents.

405.05.04 Polyvinyl Chloride Pipe Products

Polyvinyl chloride pipe products shall be according to OPSS 1841 and as specified in the Contract Documents.

405.05.05 Geotextiles

Geotextiles shall be according to OPSS 1860 and as specified in the Contract Documents.

405.05.06 Fittings

Fittings shall be suitable for and compatible with the class and type of pipe with which they will be used.

Caps shall be polyethylene.

Galvanizing of rodent gates shall be according to CSA G164.

405.05.07 Granular

Granular material shall be according to OPSS 1010 and as specified in the Contract Documents.

405.05.08 Clear Stone

Clear stone shall be 19 mm, Type I or Type II, according to OPSS 1004.

405.05.09 Open Graded Drainage Layer Aggregate

OGDL aggregate shall be according to OPSS 320.

405.07 CONSTRUCTION

405.07.01 General

Contractor inspection reports shall confirm the following at each outlet pipe connection and at the midpoint between outlets:

- a) Trench alignment, grade, and width.
- b) Grade of bedding material.
- c) Condition of subdrain, outlet pipe, and geotextile.
- d) Compaction.

Contractor inspection reports shall be submitted to the Contract Administrator upon request.

Geotextile, subdrain, or outlet pipe damaged by exposure to sunlight or damaged by any other means shall be replaced.

The stability of the subdrain and outlet pipe trenches shall be maintained at all times during excavation and backfilling.

405.07.02 Excavation

Trenches shall be excavated to the lines, grades, and dimensions specified in the Contract Documents.

The excavation shall be inspected with grade checks and certified by the Contractor prior to placement of the pipe bedding.

405.07.03 Unstable Foundations

When unstable foundation conditions are encountered, the Contractor shall take the necessary steps to ensure a stable foundation as directed by the Contract Administrator. An inspection report to verify the foundation stability shall be submitted to the Contract Administrator upon request.

405.07.04 Geotextile

Subdrain shall be wrapped with a knitted sock geotextile.

When a geotextile wrapped trench is specified in the Contract Documents, wrapping of the subdrain with a knitted sock geotextile shall not be required, and the geotextile shall be installed as specified in the Contract Documents.

When OGDL or 19 mm clear stone embedment are specified in the Contract Documents, the subdrain trench and outlet pipe trench shall be wrapped with geotextile.

When granular embedment and backfill material are specified for an outlet pipe connection to a catch basin, the outlet pipe trench shall not require geotextile wrap.

405.07.05 Bedding

Bedding shall be placed in the trench to the depth specified in the Contract Documents prior to laying the subdrain or outlet pipe.

The pipe bedding grade shall be inspected with grade checks and certified by the Contractor prior to laying the subdrain or outlet pipe.

405.07.06 Laying Subdrain and Outlet Pipe

405.07.06.01 General

Pipe installation shall be according to OPSS 421 and as specified below.

The pipe shall be placed firmly on the bedding and secured in place to prevent any movement or disturbance during backfilling. Pipe with perforations on only one side shall be installed with perforations down. Pipe shall not be laid in water or on saturated bedding. Pipe shall not be used as a drain for the Contractor's operation.

Connections between the subdrain and outlet pipe shall be made with prefabricated 45° elbows or pre-manufactured pipe curves as required.

Outlet pipe shall be installed at all low lying areas, at the end of subdrain, and at a uniform spacing of 100 m along the length of the subdrain.

Subdrain and outlet pipe installation shall be inspected and approved by the Contractor prior to backfilling.

405.07.06.02 Outlets

405.07.06.02.01 General

The outlet shall have an internal diameter that is slightly larger than the outlet pipe diameter so that the outlet pipe can be inserted into the outlet a minimum distance of 300 mm.

Outlets shall extend beyond the front of the ditch or fill slope for a distance of 300 mm.

The ends of all outlets shall be fitted with galvanized rodent gates.

The joint between the outlet pipe and the outlet shall be wrapped with a 0.5 m width of geotextile.

405.07.06.02.02 Marking of Outlets

Each outlet location shall be marked with a 25 x 25 mm square galvanized steel bar, 2.2 m long, embedded from 0.6 to 1.0 m into the ground, adjacent to the outlet, clearly visible from the driving portion of the roadway.

405.07.06.03 Connection to Drainage Structures

Subdrain shall be connected to maintenance holes, catch basins, and ditch inlets by a 1 m section of non-perforated pipe. Subdrain and outlet pipe connections to concrete maintenance holes, catch basins, and ditch inlets shall be cored and grouted as specified in the Contract Documents.

405.07.07 Embedment and Backfill Material

Embedment material shall be clear stone, granular, or open graded drainage layer aggregate as specified in the Contract Documents.

Backfill material shall be as specified in the Contract Documents.

The Contractor shall ensure that the subdrain and outlet pipe are not damaged or dislodged during the placement and compaction of embedment and backfill material. Damaged or dislodged subdrain and outlet pipe shall be removed and replaced.

Any earth from cave-ins and all other unsuitable material shall be removed from embedment and backfill material.

Compaction of embedment and backfill material shall be according to OPSS 501.

At the termination of a day's work, backfilling shall be complete over all subdrain and outlet pipe placed.

405.07.07.01 Winter Grading of Material

All ice and snow shall be removed from all portions of the work area. Frozen material shall not be incorporated into the work. Material shall not be placed over frozen ground, ice or snow, except, at the Contractor's option, a single lift may be placed over frozen ground in which case final grading and compaction shall be done after the underlying materials have thawed.

405.07.08 Closed-Circuit Television Inspection

When specified in the Contract Documents, the Contractor shall inspect the drainage system using CCTV inspection to ensure that the subdrain and outlet pipes are intact and were not crushed or damaged during construction. CCTV inspection shall be according to OPSS 409.

CCTV inspection shall be based on selected sampling at locations identified by the Contract Administrator. A minimum of 5% of the entire length of subdrain pipe and 100% of the outlet pipes shall be video inspected and recorded. Where defective, damaged, or improperly installed pipe is encountered, the Contract Administrator may request additional CCTV inspection. The inspection shall be conducted following the placement of the granular course and prior to the placement of the pavement surface.

The equipment used for CCTV inspection of the drainage system shall be according to OPSS 409 with the following exceptions:

- a) The system shall be capable of providing CCTV inspection of subdrain and outlet pipes of minimum 100 mm inside diameter within a wet environment and shall be capable of negotiating a minimum 45° bend.
- b) The system shall be capable of inspecting a length of pipe up to 90 m by push rodding, pull cabling, jetting, or tractoring the camera through the pipe.
- c) The system shall be capable of recording the distance traversed by the camera to within 150 mm.

When the CCTV inspection report shows any of the following defects, as defined by the MSCC manual, they shall be identified to the Contract Administrator and the defective, damaged, or improperly installed subdrain and outlet pipe sections shall be removed and replaced:

- a) Fracture.
- b) Broken.
- c) Large joint displacement.
- d) Large open joint.

- e) Deformed pipe such that the camera is not able to navigate through the pipe.
- f) Ponding water.

Replaced subdrain and outlet pipes shall be re-inspected by CCTV to verify installation.

405.07.09 Management of Excess Material

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

405.08 QUALITY ASSURANCE

The Contractor shall demonstrate the outlet pipe is on grade and unobstructed for its full length after backfilling.

405.08.01 Acceptance Criteria

Acceptance of the subdrain and outlet pipes shall be installation according to the requirements of the Contract Documents and no damage or defects as defined in this specification. Subdrain and outlet pipe with damage or defects or that is improperly installed shall be removed and replaced.

405.09 MEASUREMENT FOR PAYMENT

405.09.01 Actual Measurement

405.09.01.01 Pipe Subdrain

Measurement of pipe subdrain shall be by length in metres horizontally along the centreline of the pipe between the ends of the pipe subdrain, including outlets, or between the upstream end of the pipe subdrain and the centre of a maintenance hole, catch basin, or ditch inlet.

405.09.01.02 CCTV Inspection

Measurement for a CCTV inspection of subdrain and outlet pipe shall be by length in metres on the ground surface along the centreline of the subdrain from the centre of one drainage structure to the centre of another drainage structure or the outlet end of the subdrain.

405.09.02 Plan Quantity Measurement

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

405.10 BASIS OF PAYMENT

405.10.01 Pipe Subdrain - 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.

When excavation and backfilling of subdrain and outlet pipe overlaps the excavation and backfilling required for other work, payment for overlapping excavation and backfilling shall be made in accordance with the specifications for such other work as though no excavation and backfilling were required for pipe subdrain.

When subdrain and outlet pipe are placed below subgrade and the embedment and backfill material are the same material used in the road base or subbase, the embedment and backfill material shall be paid for with the road base or subbase item. When embedment or backfill material or both are different than the material used for the road base or subbase, payment for the embedment and backfill material shall be included in the Contract price for the pipe subdrain.

When unstable foundations are encountered, payment for stabilization shall be as Extra Work.

Maintenance of the stability of the trench shall be at no extra cost to the Owner.

Correction of any defective workmanship and defective or damaged material shall be at no extra cost to the Owner.

405.10.02 Closed-Circuit Television Inspection - 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.

Re-inspection by CCTV inspection to verify the installation of replaced subdrain or outlet pipe shall be at no extra cost to the Owner.

Appendix 405-A, November 2008 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:

- Pipe size, metal thickness, corrugation profile, and coating requirements of corrugated steel pipe. (405.05.02)
- Pipe size, type, and stiffness requirements of polyethylene and polyvinyl chloride pipe products. (405.05.03 and 405.05.04)
- The width, grade, and alignment of trench excavation. (405.07.02)
- Bedding depth. (405.07.05)

The designer should determine if the following is required and, if so, it should be specified in the Contract Documents:

- Type, Class, and Filtration Opening Size (FOS) of geotextile trench wrap. (405.05.05)
- Whether the subdrain trench and outlet are to be wrapped with geotextile. (405.07.04)
- Installation details of the geotextile trench wrap. (405.07.04)
- Material type(s) for embedment and backfill of subdrain and outlet pipes. (405.05.07 and 405.07.07)
- Tender item for the inspection of subdrain and outlet pipes by CCTV. (405.07.08 and 405.10.02)

In specifying material types for embedment material, the designer should be aware that certain granulars may have lower permeability and may not be suitable as a drainage medium.

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 206.050	Subdrain Pipe Connections and Outlet Details - Rural
OPSD 207.044	Subdrain Pipe Connections and Outlets for Open Graded Drainage Layer
OPSD 216.021	Subdrain Pipe Connections and Outlet Details - Urban

**Amendment to OPSS.MUNI 501 (Nov 2014) –
Construction Specification for
Compaction**

OPSS 501.05 MATERIALS

OPSS 501.05.01 Granular Material

Subsection 501.05.01 of OPSS.MUNI 501 is deleted in its entirety and replaced with the following:

Granular material shall be according to TS 1010.

OPSS 501.08 QUALITY ASSURANCE

OPSS 501.08.01 General

Subsection 501.08.01 of OPSS.MUNI 501 is amended by the addition of the following paragraphs:

Granular and soils shall be compacted according to Method A and according to the field compaction requirements specified in Table A.

The quality assurance consultant is responsible for field testing and quality assurance laboratory testing of soil and granular materials to determine the optimum moisture content and standard proctor maximum dry density (SPMDD), for materials to be incorporated into the works.

The quality assurance laboratory testing results according to LS-706 shall be provided to the Contract Administrator at least 48 hours prior to the placement and compaction of the subject material in the field.

The Contractor shall provide at least 48 hours notice to the Contract Administrator of their intent to place and compact material(s).

OPSS 501.08.02 Method A

Subsection 501.08.02 of OPSS.MUNI 501 is amended by deleting the second and third paragraph in its entirety and replacing it with the following:

Soil and granular materials which satisfies the Contract Document requirements shall be placed and compacted using the appropriate equipment to achieve the maximum dry densities provided in Table A.

Table A: Minimum field compaction requirements

Material type	Applicant	Minimum target density
earth backfill	boulevards and sidewalks	95% SPMDD
granular bedding and cover material	utility cut restorations and trenching works in pavement	98% SPMDD
granular base and subbase	pavements, curbs, sidewalks, boulevards and utility cut restorations	100% SPMDD

The frequency and locations of compaction testing for quality assurance are as follows:

- One test per 0.3 m of testing for each increment or fraction of 150 linear metres of backfill for sewer and water main for embedment, bedding and cover materials.
- One test per lift for each increment or fraction of 500 square metres for granular base/subbase, on each lane, curb or sidewalk.

The Contract Administrator can specify additional test locations, if in the opinion of the Contract Administrator additional testing for quality assurance is required for a specified test section.

OPSS 501.08.02 Method A

Subsection 501.08.02 of OPSS.MUNI 501 is amended by the addition of the following clause:

OPSS 501.08.02.01 Compaction

The acceptance of compaction test results for a specified test section or location shall be based on the minimum specified target densities provided in Table A.

The Contract Administrator may verify that the target density established for a specified test section is based on the use of suitable compaction equipment. Provided that the maximum dry density and optimum moisture content values determined by LS-706, as applicable, indicate an adequate target density is being achieved, the compaction equipment shall be considered suitable. If the compaction equipment is not capable of obtaining an adequate target density at the required moisture content, the equipment shall be considered unsuitable and shall be replaced with equipment that is able to obtain an appropriate target density.

However, if the test section or location is rejected based on compaction testing or demonstrates errors in quality assurance reporting, an investigation shall take place to determine and resolve the discrepancies. The investigation may include any of the following:

- re-compaction of the test location(s)
- retesting by the quality assurance consultant
- establishment of a new target density by control strip
- re-inspection of the gauge or operator or both by the Owner.
- recalibration of the gauges
- removal of unsuitable materials

Subsequent lifts including hot mix asphalt and concrete layers may not be placed until quality assurance testing has been successfully completed for the test section and the results have been provided to the Contract Administrator.



CONSTRUCTION SPECIFICATION FOR COMPACTING

TABLE OF CONTENTS

501.01	SCOPE
501.02	REFERENCES
501.03	DEFINITIONS
501.04	DESIGN AND SUBMISSION REQUIREMENTS - Not Used
501.05	MATERIALS
501.06	EQUIPMENT
501.07	CONSTRUCTION
501.08	QUALITY ASSURANCE
501.09	MEASUREMENT FOR PAYMENT
501.10	BASIS OF PAYMENT

APPENDICES

501-A	Commentary
501-B	Field Compaction Report

501.01 SCOPE

This specification covers the requirements for compaction of earth and granular materials.

501.01.01 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.

501.01.02 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.

501.02 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 206	Grading
OPSS 401	Trenching, Backfilling, and Compacting
OPSS 506	Dust Suppressants

Ontario Provincial Standards Specifications, Materials

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
-----------	--

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-706	Moisture - Density Relationship of Soils Using 2.5 kg Rammer and 305 mm Drop
--------	--

MTO Forms:

PH-CC-009	Field Compaction Report
-----------	-------------------------

ASTM International

D 6938-10	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
-----------	---

501.03 DEFINITIONS

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

Backfill Material means as defined in OPSS 401.

Bedding Material means as defined in OPSS 401.

Cover Material means as defined in OPSS 401.

Earth means as defined in OPSS 206.

Embedment Material means as defined in OPSS 401.

Rut means a sunken track or groove made at the surface by the passage of vehicles.

Utility Structures means maintenance holes, catch basins, valve chambers, ditch inlets, and other similar structures used to access services such as sewer, water, electric, and telephone to carry out maintenance and repair work.

501.05 MATERIALS

501.05.01 Granular Material

Granular material shall be according to OPSS 1010.

501.05.02 Water

Water shall be according to OPSS 506.

501.06 EQUIPMENT

501.06.01 Compaction

501.06.01.01 General

The type of compaction equipment used shall be suited to the material to be compacted, degree of compaction required, and space available.

Compaction equipment for control strips shall have a minimum static weight of 9,000 kg.

501.06.01.02 Hand Operated Vibratory Equipment

Hand operated vibratory equipment shall have a power output no greater than 9.9 kW.

501.06.02 Water

Equipment for applying water shall be capable of uniform distribution with proper flow control.

501.06.03 Nuclear Moisture and Density Gauge

Each nuclear moisture and density gauge (gauge) shall have been calibrated within the last 12 months either by the manufacturer or other qualified agent against certified density and moisture reference blocks. In addition, the Density Standard Count and the Moisture Standard Count shall be within 2.0% and 4.0%, respectively, of the most recent calibration values. The registered owner of the gauge shall maintain a valid Radioisotope License for each gauge.

501.07 CONSTRUCTION

501.07.01 General

The method of placing and lift thickness of earth or granular material shall be according to the specifications that govern the Work. When field tests indicate that the required degree of compaction cannot be obtained with the equipment in use or the procedure being followed, the operations shall be modified so that the equipment and procedures will produce the required results.

501.07.02 Restricted Zones

Hand operated vibratory type compaction equipment shall be used behind all retaining structures to compact fill material within restricted zones as follows:

a) Abutments and Retaining Walls

An area within a plane extending from the base of the back face of the wall where it contacts the footing upwards at a slope of 1H:1.5V to a maximum distance of 2.5 m from the wall.

b) Wingwalls

An area within 1.5 m from the back face of the wall.

501.07.03 Water for Compaction

Water shall be applied, as necessary, to achieve the degree of compaction required.

When the Contract includes a separate item for water for compaction, the water shall be applied with the approval of the Contract Administrator.

501.07.04 Quality Control

501.07.04.01 General

Quality control (QC) testing shall be carried out to ensure that earth and granular materials used in the Work are compacted according to the requirements as specified in the Contract Documents.

The 2 methods for conducting QC for compaction are referred to as Method A and Method B. Method A shall be used when Method B is not specified in the Contract Documents.

Field density and field moisture determinations shall be made according to ASTM D 6938.

501.07.04.02 Method A

The Contractor is responsible for establishing QC procedures.

501.07.04.03 Method B

501.07.04.03.01 General

When Method B is specified in the Contract Documents, QC compaction testing shall be based on material placed and compacted in the Work on a lot-by-lot basis according to the Lot Testing clause. Compaction acceptance shall be according to the Acceptance clause and shall be based on target densities established according to the Target Density clause, QC compaction field test results, and, where applicable, a statistical analysis of those results.

501.07.04.03.02 Submission of Test Data

Prior to construction of a control strip, a copy of all QC laboratory test results for LS-706 required by the Control Strip clause to determine optimum moisture content (OMC) of the control strip material shall be delivered to the Contract Administrator.

All field test results and information relating to control strip, target density, lot location, lift thickness, probe depth, moisture content, and wet density shall be recorded at the time of testing. All of this data, as well as the QC lot compaction calculations, shall be submitted to the Contract Administrator within 2 Business Days following completion of a lot and prior to placement of any subsequent lift using the most recent version of MTO form PH-CC-009.

501.07.04.03.03 Test Equipment and Operator Training

501.07.04.03.03.01 General

Field density and field moisture measurements for QC compaction testing of earth and granular materials shall be carried out using gauges and ancillary equipment.

Only qualified operators using properly calibrated gauges shall conduct QC compaction testing.

501.07.04.03.03.02 Nuclear Moisture and Density Gauge Requirements

A copy of a valid calibration certificate, including the make, model number, and serial number for each gauge, shall be submitted to the Contract Administrator, prior to use of the gauge in compaction testing.

In addition, the Contract Administrator may request that the operator perform a standardization procedure according to ASTM D 6939.

If the gauge does not meet the standardization requirements or exhibits malfunctions of any kind, the gauge shall be replaced.

501.07.04.03.03.03 Operator Requirements

Each operator shall have been trained in the safe operation, transportation, and handling of the gauge.

Prior to conducting QC compaction testing, the operator shall provide acceptable proof of proficiency in the use of a gauge and the correct procedures to determine lot and subplot sizes, field dry density, percent relative compaction, mean, standard deviation, and the Quality Index of a compacted lot of material by submitting one of the following:

- a) a gauge operator certification document or card from a training program acceptable to the Owner and conducted within the Province of Ontario within the last 2 years; or

- b) a document (e.g., instruction notice or letter) signed by the Owner showing that the operator has demonstrated proficiency on a Contract either constructed or being constructed for the same Owner within the same construction year as the compaction testing being carried out for this Contract.

If the operator cannot provide either of the two documents stated above, then at the Contract Administrator's discretion, the operator shall demonstrate his or her proficiency to the Owner. In this case, arrangements shall be made with the Contract Administrator regarding the schedule, location, and materials for such demonstrations. The first 2 demonstrations may include up to 5 operators and 5 gauges and shall be carried out at no charge. Additional demonstrations shall be charged at the rate of \$500. Where a demonstration is carried out, acceptability of the operator shall be valid for the current calendar year only.

501.07.04.03.04 Target Density

New target densities shall be established for each separate component of the Work (e.g., backfilling of a trench, construction of a granular base, or placement of cover) at the following times:

- a) For earth and granular materials:
 - i. At the time of initial use of each source.
 - ii. When there is a perceptible change in the appearance or gradation of materials or both.
 - iii. At least once per calendar year on all carry-over Contracts.
- b) For earth, after each 10 QC lots of material have been completed, whether accepted or rejected, on the basis of one set of target density values.
- c) For granular materials, after each 25 QC lots of material have been completed, whether accepted or rejected, on the basis of one set of target density values.

The target density shall be established by the construction of a control strip according to the Control Strip clause.

When a control strip cannot be reasonably constructed or is impractical, with the consent of the Contract Administrator, the target density shall be based on the maximum dry density (MDD) as determined by LS-706, not more than 14 Days prior to placing the material. In this case, the MDD used for the new target density shall be based on the average of all individual MDD's calculated from a minimum of 3 independent samples selected from materials to be used in the Work.

501.07.04.03.04.01 Control Strip

Prior to construction of a control strip, the Contractor shall:

- a) Give a minimum notice of 24 hours to the Contract Administrator.
- b) Determine the optimum moisture content (OMC) according to LS-706.

Each control strip shall consist of a single uniform lift not more than 0.30 m in depth and covering at least 400 m² in area.

During construction of the control strip, the average field moisture content shall be maintained within the range of no less than 2.0% lower than and no more than 1.0% greater than the OMC of the control strip material.

After initial placement of the material, the compaction equipment for that operation shall make 6 passes over the entire surface of the control strip. The field wet density and field moisture content shall be determined at a minimum of 3 randomly selected locations. The dry density shall be calculated for each of these locations and the average dry density and moisture content values used as the initial values for dry density and moisture content.

The compaction equipment shall then make 2 additional passes over the entire surface of the control strip.

All passes of the compaction equipment for the control strip shall be carried out in vibratory mode at a speed of no more than 5 km/hour.

A minimum of 3 separate random field density and moisture content determinations shall then be made and a new average dry density and moisture content shall be calculated.

If the new average dry density exceeds the previous value by more than 0.030 t/m^3 , additional passes of the equipment shall be carried out as described above. If the new average dry density does not exceed the previous value by more than 0.030 t/m^3 , the compaction of the control strip shall be considered satisfactory and complete.

Upon satisfactory completion of the control strip, an additional 7 field wet density and moisture content tests shall be taken at random locations and the dry density and moisture content values determined. The final dry density and moisture content of the control strip shall be the average of these 7 values plus the 3 most recent values that were obtained upon completion of the control strip. If the final moisture content lies within the allowable range of the OMC specified above, then the final dry density that was determined shall be the target density of the control strip.

501.07.04.03.05 Lot Testing

For compaction control, a unique set of lots distinguished from each other by an appropriate letter or number designation, shall be established for each of the following:

- a) Each separate component of the Work (e.g., backfilling a structure or a trench or construction of a granular base).
- b) Materials from different sources.
- c) Materials with different compaction properties.
- d) When recompaction is carried out following restoration, scarification, or placement of additional material onto previously tested and accepted lots.
- e) When directed by the Contract Administrator.

The individual lots within each unique set of lots shall be consecutively numbered and with no duplication. Lot sizes shall not exceed the limits as shown in Table 1.

All visibly soft or loose areas shall be compacted prior to testing.

For the situations described in Table 1, Part IV, a minimum of 2 field density and moisture content tests shall be carried out at random locations within each lot.

For all other situations, each lot shall be divided into 4 equal sublots and a minimum of one field density and moisture test shall be carried out at random locations within each subplot and the results used to calculate the Quality Index according to the Quality Index clause.

In addition, regardless of the situation, when a lot of material is split between both sides of a pipe, sewer, or culvert, at least one field density and moisture content test shall be taken on each side of that pipe, sewer, or culvert.

The nuclear gauge probe shall extend to the full depth of the lift, unless otherwise allowed by the Modified Layer Compaction Method according to OPSS 206. The probe shall not extend beyond the lift being tested.

For each test, the field wet density value and moisture content shall be immediately recorded on Form PH-CC-009. The dry field density of each subplot shall then be calculated as a percentage of the target density to the nearest 0.1%. The mean and the standard deviation and Quality Index, where applicable, of the field dry density values shall be calculated to the nearest 0.1% and recorded for each lot.

501.07.04.03.06 Quality Index

The Quality Index (Q_i), shall be calculated from the mean (\bar{x}) and standard deviation (s) of the percent target density which has been determined from all sublots within a QC compaction lot. The values for Quality Index, lot mean, and lot standard deviation shall be computed as follows:

- a) For materials placed in embankments within 50 m of a structure; placed as bedding, embedment, cover, or backfill material to pipes, sewers, or culverts; or placed as backfill to structures, utility structures, or small foundations (e.g., anchor blocks, sign posts, and formwork):

$$\text{For earth materials: } Q_i = \frac{\bar{x} - 95}{s} \quad \text{For granular materials: } Q_i = \frac{\bar{x} - 98}{s}$$

- b) For materials placed in all other situations:

$$\text{For earth materials: } Q_i = \frac{\bar{x} - 90}{s} \quad \text{For granular materials: } Q_i = \frac{\bar{x} - 95}{s}$$

Where:

Q_i = Quality Index, calculated to two decimal places.

\bar{x} = Lot mean, the statistical value that describes the arithmetic average of subplot test results (dry density expressed as a percentage of the target density). Lot mean is the sum of individual subplot test results divided by the number of test results, calculated to 0.1% as follows:

$$\bar{x} = \frac{x_1 + x_2 + x_3 + x_4}{4} = \frac{1}{4} \sum_{i=1}^4 x_i$$

S = Lot standard deviation ($n-1$), the statistical value that describes the distribution of subplot test results (dry density expressed as a percentage of the target density) about the lot mean. Standard deviation is the square root of the sum of the squares of the difference between each subplot test result and the lot mean divided by the number of test results minus one. It is calculated to 0.1% using the following expression:

$$s = \sqrt{\frac{\sum_{i=1}^4 (x_i - \bar{x})^2}{3}}$$

501.07.04.03.07 Acceptance

For the situations described in Table 1, Part IV, acceptance or rejection of a QC lot for compaction shall be based on 2 or more random field density and moisture content tests taken within the lot. For a lot to be acceptable, all tests shall be at least 100% and 98% of the target density established for granular and earth materials, respectively. Otherwise, the QC lot shall be rejected for compaction.

For all other situations, acceptance or rejection of a QC lot for compaction shall be established by calculation of the Quality Index, according to the Quality Index clause. When Q_i has a value equal to or greater than 1.47, the QC lot shall be accepted; otherwise, the lot shall be rejected for compaction.

Accepted QC lots damaged by vehicular traffic shall be restored prior to placement of any overlying material. Surfaces of accepted QC lots with ruts greater than 50 mm in depth in earth or 25 mm in depth in granular materials shall be regraded and the upper lift recompact to meet the specified compaction requirements. Materials that cannot be successfully recompact shall be removed and replaced with new material.

501.07.04.03.07.01 Rejected Lots

If a QC lot is rejected for compaction, the lot shall be recompact with adjustment to the moisture content, as required, until satisfactory compaction is achieved. The recompact lot shall be retested and a decision made, as described in the Acceptance clause.

When compaction of a QC lot does not meet the acceptance criteria and when the Contract Administrator has been satisfied that this is not a result of the Contractor's operation or equipment, a new target density shall be established for that operation.

501.07.05 Management of Excess Material

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

501.08 QUALITY ASSURANCE

501.08.01 General

Field density and field moisture determinations shall be made in accordance with ASTM D 6938.

When Method B is specified for the QC of compaction, then Method B shall be used for quality assurance (QA).

501.08.02 Method A

The MDD shall be determined using LS-706.

Granular materials shall be compacted to a density of 100% of the MDD and all earth materials shall be compacted to a density of 95% of the MDD.

The frequency and location of testing for QA shall be as determined by the Contract Administrator.

501.08.03 Method B

501.08.03.01 General

The Contract Administrator shall conduct random testing or inspection of QC records or both to establish the acceptability of the QC compaction testing and verification of the field moisture content, field dry density, OMC, MDD, target density, and the Quality Index, where applicable.

The Contract Administrator may verify that the target density established for a control strip is based on the use of suitable compaction equipment. Provided that the MDD and OMC values determined by LS-706, as applicable, indicate an adequate target density is being achieved, the compaction equipment shall be considered suitable. If the compaction equipment is not capable of obtaining an adequate target density at the required moisture content, the equipment shall be considered unsuitable and shall be replaced with equipment that is able to obtain an appropriate target density.

Reasonable access to a control strip or to compacted QC lots shall be provided prior to placement of subsequent lifts of material. Subsequent lifts, including HMA, may not be placed until QA testing has been conducted or waived by the Contract Administrator.

501.08.03.02 Gauge Verification

Gauge verification QA shall consist of taking 4 random field density and moisture content measurements of a compacted lot or control strip and the subsequent calculation of the average dry density. Provided that the average dry density determined by QC test results for the same material is within 139 kg/m³ for granulars and 150 kg/m³ for earth when compared with the QA average dry density, the QC test results shall be considered valid.

501.08.03.03 Compaction

For the situations described in Table 1, Part IV, compaction QA shall consist of taking 2 or more random field density and moisture content measurements of each compacted lot and the subsequent determination of percent target density.

For all other situations, compaction QA shall consist of taking 4 random field density and moisture measurements of a compacted lot or control strip and the subsequent calculation of the Quality Index for the lot.

Provided that the lot is acceptable, according to the requirements specified in the Acceptance clause, no further action shall be taken.

However, if the lot is rejected based on compaction testing or demonstrates errors in QC reporting, an investigation shall take place to determine and resolve the discrepancies. The investigation may include, but is not limited to, any of the following:

- a) Recompaction of the lot.
- b) Retesting of the lot by the Contractor.
- c) Establishment of a new target density by control strip.
- d) Re-inspection of the gauge or operator or both by the Owner.
- e) Recalibration of the gauges.
- f) Removal of unsuitable materials.

501.08.03.04 Quality Control Records Inspections

QC records of the lot or control strip selected by the Contract Administrator shall be inspected for calculation errors, missing test data, or improper lot quantities. If errors or omissions are found that identify insufficiently compacted or improperly or untested lots, the Contractor shall make all such lots available and recompact or retest these lots or both so that they comply with the specified compaction requirements.

501.08.03.05 Charges

The Contract Administrator shall charge the Contractor \$450.00 for each lot that requires retesting which has been identified through QA compaction testing or a review of QC records. In addition, immediately following the discovery of a discrepancy or inadequate compaction, all new lots shall be subjected to QA compaction testing prior to acceptance. If any of the new lots do not meet the specified compaction requirements, the Contractor shall be charged a fee of \$450.00 for each lot. These conditions shall continue until 3 consecutive new lots have met the specified compaction requirements.

501.09 MEASUREMENT FOR PAYMENT

501.09.01 Actual Measurement

501.09.01.01 Water for Compaction

Measurement of water for compaction shall be in cubic metres using one of the following methods:

- a) The mass of the water shall be determined by weighing as specified in the Contract Documents. The mass of the water shall be converted to cubic metres using a factor of 1,000 kg to 1 m³.
- b) The water tank shall be measured and its volume computed in cubic metres.
- c) The water shall be measured through a water meter of approved design.

501.10 BASIS OF PAYMENT

501.10.01 Compaction

Payment at the Contract price of the appropriate tender item requiring compaction of earth and granular materials shall be full compensation for all labour, Equipment, and Material to do the work of compacting, including the water used for compaction, unless the Contract contains a separate tender item for Water for Compaction.

Any work required to repair or remove and replace damaged QC lots accepted using Method B shall be at no additional cost to the Owner.

Replacement of unsuitable equipment to obtain an appropriate target density using Method B shall be at no additional cost to the Owner.

Replacement of a gauge shall be at no additional cost to the Owner.

Any work required to recompact or retest material as a result of QA compaction testing or QC records inspection shall be at no additional cost to the Owner.

501.10.02**Water for Compaction - 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.

When the Contract does not contain a separate tender item for water for compaction, the Contract price for the tender item in which the water for compaction is used shall include full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Compaction Lot Size

Part	Construction	Lot Size
I	Earth embankments, granular base, granular subbase, and granular shoulders.	Every lift, 500 m maximum length. (Note 1)
II	Structure approach fill for earth.	Every lift, 50 m maximum length.
III	Bedding, embedment, cover, or backfill material for pipe and sewer sections > 20.0 m in length that are being placed in one operation, earth or granular.	Every lift, 200 m maximum length.
IV	Bedding, embedment, cover, or backfill material for pipes and sewer sections ≤ 20.0 m in length that are being placed in one operation or backfill to utility structures or small foundations (e.g., anchor blocks, sign posts, and formwork), earth or granular.	Every lift, 20 m maximum length.
V	Structure backfill and culvert bedding, embedment, cover, or backfill material, granular.	Every lift for every stage of construction.
<p>Note:</p> <ol style="list-style-type: none"> The width of the lot shall be the limits established for the placement of current material only and shall not include adjacent material to be placed at a future date. 		

Appendix 501-A, November 2014
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 determine if the following is required and, if so, specify it in the Contract Documents:

- Use of Method B. (501.07.04.01)

Method A is based on laboratory testing to determine optimum moisture content and maximum dry density and is generally used by municipalities.

Method B is a statistically based end result method that recognizes the variability of materials and testing and is generally used by the Ministry of Transportation of Ontario.

If the form in Appendix 501-B is to be used for submission purposes rather than the MTO form, it needs to be invoked by reference in the Contract Documents and a special provision should be written to delete the MTO form from the specification. (501.07.04.03.02)

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

No information provided here.

FOR USE IN MUNICIPAL CONTRACTS, WHEN REFERENCED IN THE CONTRACT DOCUMENTS

Note: This is a non-mandatory Additional Information Appendix intended to provide supplementary requirements for the OPS specification in a municipal contract, when the appendix is invoked by the Owner. It is written in mandatory language to permit invoking it by reference in the Contract Documents. If the appendix has not been invoked by reference in the Contract Documents, it does not apply.

FIELD COMPACTION REPORT

MATERIAL: _____
SOURCE: _____
GAUGE (make/model): _____
Serial No.: _____

CONTRACT NO.: _____
LOCATION: _____
☐ QC
☐ QA

Standard Readings		
Calibration	Reference	Difference (%)
Density		(± 2.0% max)
Moisture		(± 4.0% max)

Target Density	
Control Strip, t/m ³	
Proctor, %	
MDD, t/m ³	
OMC, %	

Quality Index, Q_i	
For embankments within 50 m of a structure; bedding, embedment, cover, or backfill material to pipes, sewers, or culverts; or backfill to structures, utility structures, or small foundations (e.g., anchor blocks, sign posts; and formwork):	
Earth: $Q_i = \frac{\bar{x} - 95}{s}$	Granular: $Q_i = \frac{\bar{x} - 98}{s}$
For materials placed in all other situations:	
Earth: $Q_i = \frac{\bar{x} - 90}{s}$	Granular: $Q_i = \frac{\bar{x} - 95}{s}$

Test		Location								Lift Thickness cm	Probe Depth cm	Moisture Content %	Density			Relative Compaction				Accepted (A) Rejected (X) Retest (R)
Lot	Sublot	Grade	Structure	Foundation	Pipe	Sewer	Culvert	Other	Station	Offset			Count/ minute	Wet Density, tonnes/m ³	Dry Density, tonnes/m ³	% Target Density	Lot Mean \bar{x}	Lot Standard Deviation s	Quality Index Q_i	
	1																			
	2																			
	3																			
	4																			
	1																			
	2																			
	3																			
	4																			
	1																			
	2																			
	3																			
	4																			

NOTES: a) Where $Q_i \geq 1.47$, then 99% of the lot will have compaction above the specified limits, otherwise, the lot is rejected and shall be recompacted and retested.

b) Retested areas should be indicated with "R" using the original lot number.

REMARKS:

TECHNICIAN:

PRINT NAME

SIGNATURE

DATE

Copies to: Contract Administrator ☐ Contractor ☐