



**CONSTRUCTION SPECIFICATION FOR THE PLACEMENT OF
UNSHRINKABLE FILL**

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578.01 SCOPE

This specification covers the requirements for the placement of unshrinkable fill.

578.01.01 Specification Significance and Use

This specification is written as a provincial-oriented specification. Provincial-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of the Ontario Ministry of Transportation.

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

578.01.02 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.

578.02 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.

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

Ontario Provincial Standard Specifications, Construction

OPSS 350	Concrete Pavement and Concrete Base
OPSS 517	Dewatering

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production

Ontario Ministry of Transportation Publications

Laboratory Testing Manual:

LS-407	Method of Test for Compressive Strength of Moulded Cylinders
LS-610	Organic Impurities in Concrete Sands
LS-618	The Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	The Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

MTO Forms:

PH-CC-322	Concrete Construction Report
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CSA Standards

A23.1	Table 3, Additional requirements for concrete subjected to sulphate attack*
A23.2-3B	Total or Water-Soluble Sulphate Ion Content of Soil*
A23.2-8B	Water-Soluble Sulphate Ion Content of Recycled Aggregates Containing Crushed Concrete*
A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens*
A23.2-5C	Slump and Slump Flow of Concrete *
A3001	Cementitious Materials for Use in Concrete**
	* [Part of CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
	** [Part of CSA A3000-13 Cementitious Materials Compendium]

ASTM International

D 1411-09	Standard Test Methods for Water-Soluble Chlorides Present as Admixtures in Graded Aggregate Road Mixes
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578.03 DEFINITIONS

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

Unshrinkable Fill means a self-compacting cement treated aggregate with flowable consistency and controlled low strength properties.

578.04 DESIGN AND SUBMISSION REQUIREMENTS

578.04.01 Design Requirements

Unshrinkable fill shall be according to the following:

- a) The mix shall be designed to provide appropriate strength and performance characteristics for the intended use, and to meet the requirements as specified in the contract documents.
- b) The unshrinkable fill shall contain 25 kg/m³ of Type GU or GUL cement according to CSA A3001 and may contain additional supplementary cementing materials to aid in placement.
- c) The mix may contain foaming agents to aid in placement.
- d) Slump at point of discharge shall be a minimum of 150 mm and the unshrinkable fill shall be uniformly mixed throughout.
- e) The material shall be designed such that it can flow into the excavation and fill the entire space without vibration, and without segregation.
- f) The 28-Day compressive strength shall be a maximum of 0.40 MPa.

578.04.02 Submission Requirements

The Contractor shall be responsible for designing the unshrinkable fill mix and shall submit the unshrinkable fill mix design according to OPSS 1350 except the use of reclaimed concrete material and the amount used expressed in percent by mass of the total aggregate shall be identified on Forms A and B.

578.05 MATERIALS

578.05.01 Cementing Materials

Cementing materials shall be according to OPSS 1301.

578.05.02 Water

Water shall be according to OPSS 1302.

578.05.03 Aggregates

Aggregates shall be according to OPSS 1001 and this specification.

Except as noted below or elsewhere in the Contract Documents, aggregates may be sands, gravel, quarried rock or reclaimed concrete material provided the source is of such a nature and extent as to ensure acceptable processed aggregates of a consistent grading and quality. When any change in the character of the aggregate occurs or when the performance of aggregate meeting the requirements of OPSS 1001 and this specification is found to be unsatisfactory, use of the aggregate shall be discontinued until a reappraisal by the Contractor, with the approval of the Contract Administrator, proves the source to be satisfactory or another source is selected.

Fine and coarse aggregates shall meet the grading requirements of Table 1 and the physical property requirements of Table 2.

578.05.03.01 Reclaimed Concrete Material

Reclaimed concrete material may be used up to a maximum of 25 % by mass of the total aggregate. Reclaimed concrete material shall not be used in unshrinkable fill to be placed in contact with sulphate-bearing soil or ground water with sulphate.

578.06 EQUIPMENT

578.06.01 Mixing Equipment

A central mixing, dry batch plant, capable of accurately proportioning aggregate, cement, and water shall be used. The plant shall be certified according to OPSS 1350.

578.06.02 Transport Equipment

Unshrinkable fill shall be transported to the site by means of ready mix trucks.

578.07 CONSTRUCTION

578.07.01 Operational Constraints

Where vehicular traffic, including construction equipment, is to be accommodated, the unshrinkable fill shall be protected by covering it with a steel plate suitable for the traffic loading for a minimum of 24 hours.

Hot mix asphalt or any other material shall not be placed on unshrinkable fill until a minimum of four hours after the placing of unshrinkable fill.

578.07.02 Unshrinkable Fill Placement Requirements

Individual loads of unshrinkable fill shall be placed within 2 hours from the time of batching.

When placed into excavations, unshrinkable fill shall be placed so that it fills the entire excavation without voids beneath horizontal projections or in other locations within the excavation. When unshrinkable fill is to be placed in an excavation subject to the entry of flowing water, the excavation shall be dewatered according to OPSS 517 prior to placement of the unshrinkable fill.

When placed adjacent to culverts, arches, rigid frames, integral abutments and piers, the unshrinkable fill shall be placed in alternating layers on each side of the structure to balance the earth pressure forces. Unless specified in the Contract Documents, the unshrinkable fill layers shall not exceed 500 mm in thickness and the height of the layers shall be approximately the same. At no time shall the elevation difference between the sides be greater than 500 mm. Each layer shall set for a minimum of four hours before a new layer is placed.

When shoring, bracing, or sheeting is used to support the sides of the excavation or to prevent movements that could damage other services or adjacent pavements, and this support system is to be removed, it shall be removed as filling proceeds to ensure stability of the excavation.

The unshrinkable fill material shall be protected from cold weather according to OPSS 350 with the exception that unshrinkable fill shall be protected from freezing after placement but need not be monitored with thermocouples nor maintained above 15° C.

578.07.03 Field Sampling and Testing

The Contractor shall be responsible for testing of slump, casting, initial storage and transportation of cylinders for compressive strength determination by the Owner.

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

- a) CCIL Certified Concrete Testing Technician, or
- b) ACI Concrete Field Testing Technician, Grade 1.

Such persons shall have a valid original card issued by the certifying agency in their possession at all times.

Unshrinkable fill shall be tested for slump according to CSA A23.2-5C when directed by the Contract Administrator. Unshrinkable fill that does not meet the slump requirement shall be adjusted to meet the slump requirement or rejected and removed from the Working Area.

For the determination of compressive strength, a set of two cylinders, 150 mm diameter 300 mm long, shall be cast each Day of production and placement, when directed by the Contract Administrator. When there is more than one supplier of unshrinkable fill, a separate set of two cylinders for each supplier shall be cast each Day of production and placement.

Cylinders shall be cast and transported according to CSA A23.2-3C except that only cardboard moulds shall be used to cast the test cylinders. A disc of wax paper matching the inside diameter of the cylinder mould shall be placed at the base of the cylinder mould prior to casting. The interior sidewalls of the cardboard mould shall be treated with a light coating of release agent.

For the first 24 hours after casting, test cylinders shall be stored within the Working Area either covered or in a shaded area.

Test information shall be recorded on MTO form PH-CC-322, a copy of which shall be submitted with each set of compressive strength cylinders.

The Contractor shall transport the cylinders to the designated quality assurance laboratory specified in the Contract Documents, for testing.

578.08 QUALITY ASSURANCE

578.08.01 Testing Requirements

Compressive strength testing shall be according to LS-407. The results of the set of two cylinders cast each Day shall be averaged to provide the test result for the Day.

578.08.02 Acceptance

Unshrinkable fill shall be accepted when:

- a) The material does not deform under traffic loading.
- b) The compressive strength requirements are met.
- c) Materials used comply with the requirements of this specification.

578.09 MEASUREMENT FOR PAYMENT

578.09.01 Actual Measurement

Measurement of unshrinkable fill shall be by volume in cubic metres.

578.09.02 Plan Quantity Measurement

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

578.10.0 BASIS OF PAYMENT

578.10.01 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.

TABLE 1
Aggregate Gradation Requirements, LS-602 (Note 1)

Sieve Designation	Percent Passing
26.5 mm	100
75 µm	0-5

Notes:

- Test samples shall be prepared by blending all aggregate components based on their individual percentages stated in the mix design.

TABLE 2
Aggregate Physical Property Requirements

Test Number	Laboratory Test	Acceptance Limit
LS-610	Organic Impurities, Organic plate number (Note 1)	3
LS-619	Micro-Deval Abrasion, fine aggregates, maximum (Note 2)	30%
LS-618	Micro-Deval Abrasion, coarse aggregates, maximum (Note 2)	25%
CSA A23.2-3B CSA A23.2-8B	Sulphate content (SO ₄), maximum (Note 3)	1.5%
ASTM D1411	Water soluble chloride maximum, (Note 4)	0.010%

Notes:

- For the natural sand component only. An aggregate that produces a colour darker than standard colour No. 3 shall be considered to have failed this requirement.
- Test samples shall be prepared by blending all aggregate components based on their individual percentages stated in the mix design. The blended aggregate shall be split on the 4.75 mm sieve and the individual coarse and fine aggregate fractions set aside for testing as required.
- For unshrinkable fill in contact with permanent concrete elements, the limit of SO₄ shall be a maximum of 0.20% unless the permanent concrete element meets the requirements of S1, S2, or S3 of CSA A23.1-14 Table 3 as appropriate.
- This requirement is specified where the unshrinkable fill will be in direct contact with concrete or steel pipe.

