ONTARIO PROVINCIAL STANDARD SPECIFICATION

METRIC
OPSS.MUNI 1359
NOVEMBER 2016

MATERIAL SPECIFICATION FOR UNSHRINKABLE BACKFILL

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1359.01 SCOPE

This specification covers the requirements for treated aggregate known as unshrinkable backfill, in underground service and Utility trenches, and around in-ground structures.

1359.01.01 Significance and Use of Appendices

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 as specified in the Contract Documents.

1359.01.02 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.

1359.02 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, Material

OPSS 1010	Aggregates - Base, Subbase Select Subgrade, and Backfill Material
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production

Canadian Standards Association

A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens [Part of CAN/CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
A23.2-9C	Compressive Strength of Cylindrical Concrete Specimens [Part of CAN/CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
A3001-13	Cementitious Materials for Use in Concrete [Part of CAN/CSA A3000-13 Cementitious Materials Compendium]

Ministry of Transportation, Ontario, Publications

MTO Laboratory Testing Manual:

LS-407 Method of Test for Compressive Strength of Moulded Cylinders

1359.03 DEFINITIONS

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

Reclaimed Concrete Material (RCM) means removed or processed old hydraulic cement concrete.

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

1359.04 DESIGN AND SUBMISSION REQUIREMENTS

1359.04.01 Submission Requirements

The unshrinkable backfill mix shall be designed and the unshrinkable backfill mix design data submitted using the Concrete Mix Design Submission forms as specified in the Contract Documents.

The mix design submission shall be accompanied by data on 28-Day compressive strengths of the backfill.

1359.05 MATERIALS

1359.05.01 Cementing Materials

Cementing materials shall be according to OPSS 1301.

1359.05.02 Water

Water shall be according to OPSS 1302.

1359.05.03 Aggregates

Aggregates shall be according to OPSS 1010 Granular A, and shall have a maximum aggregate size of 25 mm.

Coarse aggregate shall be crushed stone, crushed gravel, natural gravel, recycled concrete material (RCM), or a combination thereof. The typical maximum nominal size is 25 mm, or as specified in the Contract Documents. Fine aggregates shall be natural sand, crushed sand, recycled concrete aggregates, or a combination thereof. Coarse and fine aggregate shall meet the requirements in Table 1. Slag aggregate, glass and ceramics shall not be used.

1359.05.03.01 Use of Recycled 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.

The maximum passing the 75 µm shall be 5% or less of the total aggregate weight.

1359.05.03.02 Grading

The grading of the combined aggregate shall be selected to produce unshrinkable fill that meets the performance requirements of the intended application and the requirements of this Standard.

1359.05.04 Mix Requirements

Mix requirements shall be according to the following:

a) The unshrinkable backfill shall contain 25 kg/m^3 of Type GU Portland cement according to CAN/CSA A3001 and may contain additional supplementary cementing materials.

b) Slump at point of discharge shall be a minimum of 150 mm and the unshrinkable backfill shall be uniformly mixed throughout.

c) The material shall be designed so that it can flow into the excavation and fill the entire space without vibration and segregation.

c) The 28-Day compressive strength shall be a maximum of 0.40 MPa.

e) The mixture may contain foaming agents.

1359.05.05 Unshrinkable Backfill Material Placement Requirements

The material shall be placed into the excavation so that it fills the entire space without voids being created beneath horizontal projections or in other locations within the excavation.

The unshrinkable backfill material shall be completely placed within a period of 2 hours from the time of the batching.

The unshrinkable backfill material shall be protected from cold weather according to OPSS 350.

When shoring, bracing, or sheeting shall be removed, the support system shall be removed prior to or during the backfilling operation.

When placed behind abutment as backfill, layers of unshrinkable backfill material shall be placed alternately at each abutment. The layers shall not exceed 400 mm and the height of the layers shall be approximately the same. At no time shall the difference in elevation be greater than 400 mm. Each layer shall be allowed to set for a period of minimum of 4 hours before a new layer is placed.

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

1359.06 EQUIPMENT

1359.06.01 Mixing Equipment

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

1359.06.02 Transport Equipment

Unless produced on site with a volumetric mixer, unshrinkable backfill shall be transported to the site by means of ready mix trucks.

Ready mix trucks may be required to meet local environmental requirements as specified in the Contract Documents.

1359.08 QUALITY ASSURANCE

1359.08.01 Testing Requirements

Compressive strength testing shall be according to CSA-A23.2-3C, CSA-A23.2-9C, and LS-407 and with the following requirements:

a) 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 to assist in the demoulding operation.

b) The cylinders shall only be demoulded on the same day of testing for compressive strength.

c) The load indicating mechanism of the compression testing machine shall be capable of showing load changes of 100 newtons or less. The loading rate shall be 0.11 MPa/s or lower.

d) The minimum test requirement shall be one set of two test cylinders, per supplier, per day.

1359.08.02 Acceptance

Unshrinkable backfill shall be accepted when

a) the material does not deform under traffic loading, and

b) the compressive strength requirements are met.

Table 1: Requirements for fine and coarse aggregates for use in unshrinkable fill

Test	Coarse	Fine
Micro-Deval abrasion (%) (LS-618 & LS-619)	Max. 25%	Max. 30%
% passing 75 µm* (LS-601)	Max. 3%	Max. 5%
Organic Impurities	N/A	Standard colour No. 3
Sulphate content (SO4) ‡ (CSA A23.2-3B or 8B)	Max. 1.5%	Max. 1.5%
Water soluble chloride (ASTM D1411)†	Max. 0.10%	Max. 0.10%

*This requirement may be waived provided that the % passing the 80 micron sieve for the combined aggregate does not exceed 5% of the total.

†This requirement is specified if fill is to be in contact with concrete or steel pipe.

‡For unshrinkable fill in contact with permanent concrete elements, the limit of SO4. in aggregates RCA 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. RCM used in unshrinkable fill to be placed in contact with sulphate-bearing soil or ground water with sulphate shall be produced from sulphate resistant concrete.

Appendix 1359-A, November 2016

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a contract.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Concrete Mix Design Submission forms shall be used. (1359.04.01)

- May allow up to 50mm as the nominal size as the application may warrant. (1359.05.03)

- Ready mix truck may be required to have washout systems in order to meet local, environmental requirements (1359.06.02)

For shallow applications within the depth of frost penetration, differential frost heaving may occur.

The designer should ensure that the Ontario Provincial Standards General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

OPSD 509.010 Pavement Reinstatement for Utility Cuts