Appendix A – Original CPS Documents

1. OPSS.PROV 102 - Apr 2015
    a. SSP 101F02 - Dec 2014
    b. SSP 101S04 - Jan 2017
2. OPSS.PROV 202 - Nov 2013
    a. SSP 202S01 - Feb 2018
3. OPSS.PROV 206 - Nov 2014
    a. SSP 102S05 - May 2017
    b. SSP 206F04 - Dec 2014
    c. SSP 206F06 - Sep 2017
4. OPSS.PROV 209 - Nov 2014
    a. SSP 209F01 - Dec 2014
5. OPSS.PROV 212 - Nov 2013
    a. SSP 212F01 - Jan 2014
6. OPSS.PROV 220 - Nov 2014
    a. SSP 102S07 - Mar 2018
7. OPSS.PROV 314 - Nov 2015
    a. SSP 103S05 - Aug 2019
    b. SSP 314S02 - Jan 2020
8. OPSS.PROV 331 - Nov 2015
    a. SSP 331F02 - Sep 2022
    b. SSP 331S03 - Apr 2021
9. OPSS.PROV 333 - Nov 2015
    a. SSP 333S04 - Sep 2022
10. OPSS.PROV 335 - Nov 2015
    a. SSP 335S04 - Sep 2022
    b. SSP 335S06 - Apr 2021
11. OPSS.PROV 342 - Nov 2015
12. OPSS.PROV 501 - Nov 2014
    a. SSP 105S22 - Aug 2021
13. OPSS.PROV 539 - Nov 2014
    a. SSP 105S09 - Mar 2018
14. OPSS.PROV 578 - Apr 2017

GENERAL SPECIFICATION FOR THE USE OF EXPLOSIVES

TABLE OF CONTENTS

120.01 SCOPE

This specification covers the requirements for the use of explosives.

120.01.01 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.

120.01.02 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.

120.02 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 Ministry of Transportation Publications

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

Department of Fisheries and Oceans (DFO) Publication

Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters, 1998

International Society of Explosives Engineers (ISEE)

Performance Specifications for Blasting Seismographs, 2011 Edition

120.03 DEFINITIONS

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

Blaster means a competent person knowledgeable, experienced, and trained in the handling, use, and storage of explosives and their effect on adjacent property and persons.

Blast Monitoring Consultant means a consulting engineering firm with a minimum of 5 years experience related to blasting retained by the Contractor to provide blast monitoring services. The blast monitoring consultant shall be a third party that is not owned or corporately affiliated with the Contractor responsible for the Work.

Consulting Engineering Firm means a firm or an individual that has been issued a Certificate of Authorization and a Consulting Engineer designation by the Professional Engineers Ontario.

Designated Blast Area means the area where the Contractor has notified, in writing, and provided information to all Utilities, public and private property owners, and as the area where the Contractor has made arrangements to evacuate all persons whose safety might be threatened by the blasting operation.

Fish Habitat means as defined by the Fisheries Act.

Flyrock means rock that becomes airborne as a direct result of a blast.

Peak Particle Velocity (PPV) means the maximum component velocity in millimetres per second that ground particles move as a result of energy released from explosive detonations.

Pre-Blast Survey means a detailed record, accompanied by film or video, as necessary, of the condition of private or public property, prior to the commencement of blasting operations.

120.04 DESIGN AND SUBMISSION REQUIREMENTS

120.04.01 Design Requirements

A blast design shall be prepared by an individual or firm with a minimum 5 years experience and be certified by an Engineer. The blast design shall include, as a minimum, the following:

a) Design PPV and design peak sound pressure level at 250 m radius from the area of the blast or nearest Utility, residence, structure, or facility.

b) Number, pattern, orientation, spacing, size, and depth of drill holes.

c) Collar and toe load, number and time of delays, and mass and type of charge per delay.

d) Setback distances to affected fish habitat.

e) The explosive products to be used.

f) The designated blast area.

120.04.02 Submission Requirements

The following shall be submitted to the Contract Administrator:

a) A minimum of 2 weeks prior to the use of explosives:

   i. The name and statement of experience of the firm carrying out the blasting.
   ii. The name of the blaster including a record of experience and safety training.
   iii. The name of the individual or firm responsible for the blast design, including a record of experience and statement of qualifications.
   iv. A letter from an Engineer certifying the design.
   v. The name of the blast monitoring consultant, including a record of experience and a record of qualifications.
   vi. A certificate of insurance indemnifying the Owner from all claims and damages arising from the use of explosives.

b) A minimum of 48 hours prior to the use of explosives:

   i. A letter signed by the Engineer certifying the blast design indicating the areas for which the blast design has been completed.
   ii. A letter signed by the blaster indicating receipt of the blast design and agreement that the blasting shall be according to the design.
   iii. A letter signed by the Contractor certifying that a pre-blast survey has been carried out in accordance with the Pre-Blast Survey subsection and a copy of the pre-blast survey.
   iv. A copy of the blast design, including all items shown in the Design Requirements subsection.
   v. The designated blast area.
   vi. A blasting schedule.
   vii. A list of all locations to be monitored.
   viii. Proof of calibration of all monitoring equipment.

c) Upon request, any blasting permits, approvals, and agreements required for the use of explosives or to carry out blasting operations.

120.05 MATERIALS

120.05.01 Explosives

Only explosive products approved for use in Canada shall be used.

120.06 EQUIPMENT

120.06.01 Detonation Apparatus

Detonation apparatus shall be of the type approved by the detonation system manufacturer for the type of blasting operation to be undertaken. All apparatus shall be kept in working order and shall be thoroughly inspected before and after each blasting operation.

All wiring connected to electrical detonation apparatus shall be properly insulated.

120.06.02 Monitoring Equipment

All monitoring equipment shall be capable of measuring and recording ground vibration PPV up to 200 mm/s in the vertical, transverse, and radial directions. The equipment shall have been calibrated within the last 12 months either by the manufacturer or other qualified agent. Proof of calibration shall be submitted to the Contract Administrator prior to commencement of any monitoring operations.

Monitoring equipment shall be according to ISEE Performance Specifications for Blasting Seismographs.

120.07 CONSTRUCTION

120.07.01 General

Blasting shall be carried out only during daylight hours and at a time when atmospheric conditions provide clear observation of the blast when practical from a minimum distance of 1,000 m. Blasting shall not be conducted on Sundays, statutory holidays, or during electrical storms.

Blasting shall not be carried out within 30 m of concrete placed less than 72 hours when the ambient temperature falls below 20 °C or for 36 hours when the ambient temperature is continuously greater than 20 °C, unless otherwise authorized by the Contract Administrator.

Protection of fish and fish habitat shall be according to the Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters.

120.07.02 Radio-Frequency Hazards

Prior to blasting, investigations shall be done to determine if radio-frequency hazards exist. When such hazards exist, necessary precautions shall be taken.

120.07.03 Pre-Blast Survey

A pre-blast survey shall be prepared for all buildings, Utilities, structures, water wells, and facilities likely to be affected by the blast and those within 150 m of the location where explosives are to be used. The standard inspection procedure shall include the provision of an explanatory letter to the owner or occupant and owner with a formal request for permission to carry out an inspection.

The pre-blast survey shall include, as a minimum, the following information:

a) Type of structure, including type of construction and if possible, the date when built.

b) Identification and description of existing differential settlements, including visible cracks in walls, floors, and ceilings, including a diagram, if applicable, room-by-room. All other apparent structural and cosmetic damage or defect shall also be noted. Defects shall be described, including dimensions, wherever possible.

c) Digital photographs or digital video or both, as necessary, to record areas of significant concern.

Photographs and videos shall be clear and shall accurately represent the condition of the property. Each photograph or video shall be clearly labelled with the location and date taken.

A copy of the pre-blast survey limited to a single residence or property, including copies of any photographs or videos that may form part of the report shall be provided to the owner of that residence or property, upon request.

120.07.04 Notification

120.07.04.01 General

A minimum of 15 Business Days prior to blasting, the Contractor shall provide written notice to Utilities and all owners and tenants of improved property within 500 m of the right-of-way in the vicinity of the blast. The notice shall include a blasting schedule, information about the audible blast warning system, and contact name for questions or other concerns.

The Contractor shall ensure that a competent person is available to receive, document, and deal with public inquiries before and after blasting operations.

A minimum 48 hours prior to blasting, sufficient detail regarding the blasting operations shall be provided to NAV Canada.

120.07.04.02 Utilities

Authorities of all likely affected Utilities shall be notified a minimum of 72 hours prior to blasting.

120.07.04.03 Properties

Not more than 5 Business Days and not less than 4 hours prior to each blast, the Contractor shall provide notice of the blasting schedule to all owners and tenants of buildings or facilities within 150 m of the blast.

All blasts scheduled for the following 7 Days may be included in one notice. The notice shall include information about the audible blast warning system.

When blasting operations may incur property damage or require temporary evacuation, notification shall include evacuation information and instructions. The Contractor shall take all reasonable steps to ensure that the property owner acknowledges, by their signature, that they have received the information and shall comply with any evacuation requirements. When such signature is withheld, the Contractor shall maintain records showing the date and time that the information was delivered.

120.07.05 Monitoring

120.07.05.01 General

The Contractor shall employ a blast monitoring consultant to carry out monitoring for PPV, peak sound pressure levels, and water overpressures as required. During each blast, ground vibration PPV and the peak sound pressure level shall be monitored at 250 m from the area of the blast or at the closest portion of any Utility, residence, structure, or facility. Water overpressure in affected fish habitats shall be monitored adjacent to the shore closest to the blast. The monitoring equipment shall be repositioned as required.

120.07.05.02 Ground Vibration

Ground vibration as measured by PPV shall be limited to the maximum levels shown in Table 1. Should readings from any two consecutive blasts exceed these values or any single reading exceed these values by more than 30 mm/s, the blast operation shall cease until a revised blast design, certified by the Engineer, has been submitted to the Contract Administrator.

120.07.05.03 Water Overpressure

Instantaneous pressure change as measured by water overpressure in or near fish habitat shall not exceed 100 kPa.

120.07.05.04 Trial Blasts

The Contractor shall confirm the suitability of the blast design for the ground vibration PPV limits and sound pressure levels by carrying out a minimum of three limited test blasts at locations agreed upon by the Contract Administrator and the Contractor. The trial blasts shall be carried out with appropriate blast vibration and noise level monitoring equipment. Based on the results, the initial blast design shall be revised as necessary.

120.07.06 Protective Measures

Immediately prior to the blast, the designated blast area shall be cleared of all vehicular and pedestrian traffic.

All traffic shall be stopped and prevented from entering the area until the blaster gives permission. Traffic control shall be according to the Ontario Traffic Manual, Book 7. Signs shall be posted to inform the public of blasting operations and to turn off radio transmitters. Audible blast warning devices, capable of alerting workers and the public up to a radius of 1,000 m, shall be used before and after blasting.

Blasting mats or other suitable means of controlling flyrock shall be used to limit potential hazardous effects of the blast.

120.07.06.01 Protection of Utility Lines

Where temporary rearranging and shielding of utility lines are detailed within the Contract Documents, such temporary rearranging and shielding is the minimum protection required. The Contractor shall remain responsible for any unauthorized disruptions of service and any damage to utilities arising out of the Contractor's work, notwithstanding such protection. The Utility authorities shall carry out the temporary rearranging and shielding of lines as detailed within the Contract Documents and more extensive rearranging and shielding if requested to do so by the Contractor. The cost of all such protective measures, together with the cost of restoring the lines to their original state and location, shall be at the expense of the Contractor, and shall be billed to the Contractor by the Utility authority.

Notwithstanding the preceding paragraph, the Utility authorities shall, subject to the Contractor's obligation under the Contract to assume responsibility for disruption of services and damage, consider alternative measures which the Contractor may suggest. Such alternative measures, if approved by the Utility authorities in writing, shall be provided at the Contractor's expense and billed to the Contractor by the Utility authority.

Whenever, in the opinion of the Utility authority, standby crews are necessary during blasting operations, the Contractor shall make the necessary arrangements with the Utility authority and the cost of such crews and equipment shall be billed to the Contractor by the Utility authority. These measures shall apply to those utilities located within all rock blasting areas.

120.07.07 Records

A post-blast record shall be prepared and signed by the blaster for each blast completed. The post-blast record shall report the following conditions and be made available to the Contract Administrator for site review:

a) The date, time, and location of the blast.

b) The wind direction and approximate speed at the time of the blast.

c) The general atmospheric conditions at the time of the blast.

d) The actual blast details.

e) PPV, peak sound pressure level, and water overpressure results of each blast.

A report summarizing the results of the ground vibration and peak sound pressure levels shall be submitted to the Contract Administrator at the end of each work day that blasting was carried out.

120.07.08 Damage

Upon completion of blasting or immediately following the receipt of a complaint, a site condition survey shall be performed to determine if any damage has resulted. The Contractor shall record all incidents of any damage or injury, which shall be reported immediately in writing to the Contract Administrator. All other complaints shall be reported to the Contract Administrator in writing within 24 hours of receipt. Each complaint report shall include the name and address of the complainant, time received, and description of the circumstances that led to the complaint.

120.07.09 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

120.10 BASIS OF PAYMENT

Payment at the Contract price for the appropriate tender items that requires the use of explosives shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

The cost of standby crews and equipment required by Utility authorities shall be the responsibility of the Contractor.

120.10.01 Claims

The Contractor shall be responsible for the management of all claims and payment arising from the hauling, handling, use of, and storing of explosives and all effects, directly or indirectly related to the blasting operation.

TABLE 1
Maximum Peak Particle Velocity Values

Element	Frequency Hz	Peak Particle Velocity (PPV) mm/s
Structures and Pipelines	≤ 40	20
	> 40	50
Concrete and Grout < 72 hours from placement	N/A	10

Appendix 120-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

AMENDMENT TO OPSS 120, NOVEMBER 2014

Special Provision No. 101F02 December 2014

Identification of Waterbodies for Application of DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters

120.07 CONSTRUCTION

120.07.01 General

Subsection 120.07.01 of OPSS 120 is amended by deleting the last paragraph in its entirety and replacing it with the following:

Protection of fish and fish habitat shall be according to the Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters within waterbodies specified below:

* Designer Fill-in – See Notes to Designer

NOTES TO DESIGNER:

Designer Fill-In:

* List all waterbodies that are of concern for the contract.

This SP is to be included in contracts when it is determined that the requirements to protect fish and fish habitat in the DFO Guidelines can be met. If it is determined that the DFO Guidelines cannot be met it is the responsibility of the contract designer/consultant to ensure that authorization is obtained from DFO and appropriate design measures incorporated into the contract documents.

WARRANT: When using confined explosives in or near Canadian fisheries waters and the requirements and limitations in the DFO Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters can be met.

AMENDMENT TO OPSS 120, NOVEMBER 2014 - Flyrock Incident Form - Part A

Special Provision No. 101S04 January 2017

120.07.04 Notification

Subsection 120.07.04 of OPSS 120 is amended by the addition of the following clause:

120.07.04.04 Flyrock

A completed copy of MTO form PH-CC-808, Flyrock Incident Form - Part A, shall be submitted to the Contract Administrator within 48 hours of a blast where flyrock was generated and landed outside the designated blast area.

WARRANT: All contracts.

CONSTRUCTION SPECIFICATION FOR ROCK REMOVAL BY MANUAL SCALING, MACHINE SCALING, TRIM BLASTING, OR CONTROLLED BLASTING

TABLE OF CONTENTS

202.01 SCOPE

This specification covers the requirements for removing rock by manual scaling, machine scaling, trim blasting, or controlled blasting.

202.01.01 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.

202.01.02 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.

202.02 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 206 Grading

202.03 DEFINITIONS

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

Controlled Blasting means cushion blasting, line drilling, and pre-shearing as defined in OPSS 206.

Grubbing means as defined in OPSS 206.

Mucking means as defined in OPSS 206.

Rock Cut Sounding means any non-destructive method using mechanical or electronic devices to acoustically determine areas where rock is partially or completely detached from the main rock mass.

Rock Face means as defined in OPSS 206.

Scaling means as defined in OPSS 206.

Trim Blasting means a blasting technique involving the drilling of a single row of closely-spaced holes along the excavation limits, loading them with light, well-distributed charges, completely stemmed, and simultaneously firing the charges.

Wall Control Blasting means as defined in OPSS 206.

202.04 DESIGN AND SUBMISSION REQUIREMENTS

202.04.02 Submission Requirements

A minimum of 5 Business Days prior to beginning the Work, the name and contact number of the on-site person that is responsible for the Work being carried out (i.e., foreman) and a written statement showing that the person has had at least 5 years of related work experience, including dates, and has taken all appropriate safety training shall be submitted to the Contract Administrator.

202.06 EQUIPMENT

202.06.01 Lifting Equipment

Lifting equipment shall consist of a two-person aerial lift, crane, or other equipment suitable to access the Work.

202.06.02 Drilling Equipment

Drilling equipment shall consist of a hydraulic track drill or other suitable drilling equipment acceptable to the Contract Administrator and capable of producing holes accurately and uniformly across the top of a rock cut to the depth specified in the Contract Documents.

202.06.03 Backhoe Excavator

Backhoe excavators shall have a minimum operating weight of 30,000 kg and shall be capable of operating to a minimum height of 10 m.

202.06.04 Hoe-Ram Excavator

A backhoe excavator shall be equipped with a minimum 5,200 Joule hydraulic impact hammer.

202.07 CONSTRUCTION

202.07.01 General

The work of the removal of rock by scaling or blasting or both shall include the following:

1. All equipment, including any lifting equipment, materials, and labour that is:

    a) necessary to gain access to the rock removal locations specified in the Contract Documents.

    b) required by the Owner to obtain access to any areas where:

        i. the Work is being inspected;
        ii. quantities are to be measured; or
        iii. quality assurance and acceptance procedures are being conducted.

2. All associated mucking, hauling, and management of rock material.

Removal of rock shall always be carried out in such a manner as to minimize fracturing and all other disturbance to the surrounding rock beyond the removal limits specified in the Contract Documents.

All blasting, including the use of explosives, shall be as specified in the Contract Documents.

202.07.02 Scaling

202.07.02.01 General

Scaling shall consist of the complete removal of all loose and partially-detached rock at the locations and heights specified in the Contract Documents.

Scaling shall begin at the top of the rock cut and progress to lower elevations as the work proceeds. As the scaling progresses, care shall be taken to avoid undercutting the upper sections of the scaled rock cut.

The scaling crew shall be in continuous full-time radio contact with the foreman to permit direct and immediate control.

Each day, the scaling crew shall inspect the rock cut:

a) prior to the start of work and remove any identified loose or visually unstable rock that may endanger workers.

b) prior to shutdown and remove any identified loose or visually unstable rock that may endanger the traveling public.

202.07.02.02 Manual Scaling

The work of manual scaling shall consist of the complete removal of all loose and partially-detached rock at the locations and heights specified in the Contract Documents by the manual scaling work unit and in addition to all of the other items specified in the Contact Documents, shall also include the following:

a) Rock cut sounding.

b) Scaling of the rock cut with hand tools and hand-held machine tools.

Manual scaling may include blasting with small quantities of explosives, but only when specified as an option in the Contract Documents.

As a minimum, the manual scaling work unit shall consist of the following:

a) Two labourers that are experienced in doing scaling work at the heights required in the Contract and have taken the appropriate safety training.

b) All tools and materials required for the performance of the work.

202.07.02.03 Machine Scaling

The work of machine scaling shall consist of the complete removal of all loose rock and partially-detached rock at the locations and heights specified in the Contract Documents by the machine scaling work unit and in addition to all of the other items specified in the Contact Documents, shall also include the following:

a) Grubbing.

b) Rock cut sounding.

c) Scaling of the rock cut.

As a minimum, the machine scaling work unit shall consist of the following:

a) Either a:

   i) Backhoe excavator equipped with a narrow scaling/ditching bucket and hydraulic thumbs; or
   ii) Hoe-ram excavator.

b) Backhoe and hoe-ram excavator operators with experience in machine scaling work.

c) All tools and materials required for the performance of the work.

202.07.03 Trim Blasting or Controlled Blasting

202.07.03.01 General

The work of trim blasting or controlled blasting shall consist of drilling and blasting to remove the rock specified for removal in the Contract Documents, while minimizing damage to the surrounding rock.

Any loosened or partially-detached rock shall be properly scaled, as specified in the Scaling subsection.

202.07.03.02 Trim Blasting

In addition to all of the other items specified in the Contact Documents, the work of trim blasting shall also include locating and drilling 50 mm diameter vertical holes along the perimeter of the specified trim at a maximum spacing of 750 mm or at a spacing approved by the Contract Administrator.

202.07.03.03 Controlled Blasting

In addition to all of the other items specified in the Contact Documents, the work of controlled blasting shall also include the appropriate wall control blasting techniques, as specified for rock face in OPSS 206.

202.07.04 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

When possible, excess rock material shall be managed within the right-of-way by slope flattening at locations approved by the Contract Administrator or as specified in the Contract Documents.

202.09 MEASUREMENT FOR PAYMENT

202.09.01 Actual Measurement

202.09.01.01 Rock Excavation, Manual Scaling

Measurement of rock excavation by manual scaling shall be by time in hours that the scaling crew is in effective operation.

Effective operation shall not include the time taken for the management and disposal of the materials generated by the scaling operation.

202.09.01.02 Rock Excavation, Machine Scaling

Measurement of rock excavation by machine scaling shall be the cumulative sum of the time in hours that each individual scaling unit is working on the site in effective operation.

Effective operation shall not include the time taken for the management and disposal of all materials generated by the scaling operation or for the construction of any associated ramps.

202.09.01.03 Rock Excavation, Trim Blasting

Measurement of rock excavation by trim blasting shall be by vertical length in metres of drilling required.

202.09.01.04 Rock Excavation, Controlled Blasting

Measurement of rock excavation by controlled blasting shall be by volume in cubic metres of rock measured in-place.

202.09.02 Plan Quantity Measurement

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

202.10 BASIS OF PAYMENT

202.10.01 Rock Excavation, Manual Scaling - Item
Rock Excavation, Machine Scaling - Item
Rock Excavation, Trim Blasting - Item
Rock Excavation, Controlled Blasting - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 202-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

ROCK EXCAVATION, MANUAL SCALING - Item No.

Special Provision No. 202S01 February 2018

Amendment to OPSS 202, November 2013 - Safety Plan for Manual Scaling Work

202.04 DESIGN AND SUBMISSION REQUIREMENTS

202.04.02 Submission Requirements

Subsection 202.04.02 of OPSS 202 is amended by the addition of the following:

A minimum 5 Business Days prior to beginning the manual scaling work, the following shall be submitted to the Contract Administrator:

a) Proof of training certification for all staff performing the manual scaling work.

b) A safety plan which may include the assignment of additional equipment and personnel or the use of special work methods & procedures, including site-specific communication and rescue procedures, to ensure that, in the event of an incident, all appropriate emergency personnel are immediately informed, and the Contractor is able to affect their own recovery of an injured worker suspended at height or any other member of the work unit, in a timely manner.

   A copy of the safety plan shall be kept on site both prior to and during the manual scaling work.

WARRANT: Always with this tender item.

CONSTRUCTION SPECIFICATION FOR GRADING

TABLE OF CONTENTS

206.01 SCOPE

This specification covers the requirements for grading, including earth and rock excavation and embankment construction, rock face, and the management of excavated materials.

206.01.01 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.

206.01.02 Appendices Significance and Use

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206.02 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 209 Embankments Over Swamps and Compressible Soils
OPSS 212 Earth Borrow
OPSS 501 Compacting
OPSS 802 Topsoil
OPSS 804 Seed and Cover

Ontario Provincial Standard Specifications, Materials

OPSS 1010 Aggregates - Base, Subbase, Select Subgrade and Backfill Material

Ontario Ministry of Transportation Publications

MTO Form:
PH-CC-820 Certification of Grade Elevation - Crossfall

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 into existing slopes by excavating horizontal planes. Benching also means the stepping of cut slopes at intermediate levels in deep cuts.

Berm means an extension of an embankment constructed to a lower height and designed to provide road embankment stability.

Bulking Factor means the ratio of the volume of rock material following excavation, placement, and compacting to the original in situ volume of the same material. The bulking factor for rock 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 as specified in the Contract Documents. Widening, flattening, or other placement of material adjacent to or on top of sideslopes beyond that specified in the Contract Documents is excluded.

Existing Rock Surface means either the rock surface that is exposed at ground level prior to the beginning of the Contract or the rock surface that is exposed after the overburden above it has been removed during the Contract.

Frontslope means the slope in a cut section between the edge of shoulder and the invert of the roadside ditch.

Grubbing means the removal of all stumps, roots, embedded logs, debris, and secondary growth.

Line Drilling means the placing of a single row of very closely-spaced holes without explosives along the rock excavation limits as specified in the Contract Documents.

Mucking means the picking up of broken rock prior to haulage.

Overbreak means any broken, displaced, or loosened rock that originates outside the designated rock excavation limits as specified in the Contract Documents, regardless of whether that rock has been excavated, displaced, or loosened due to the inherent character of the rock formation itself or due to any other cause.

Pre-Shearing means the placing of a single row of closely-spaced lightly-loaded holes along the rock excavation limits as specified in the Contract Documents that are fired simultaneously before and independently of the main excavation blast. Pre-shearing is sometimes referred to as pre-splitting.

Reclaimed Asphalt Pavement (RAP) means the processed hot mix asphalt material that is recovered by partial or full depth removal.

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

Roadside Ditch means a ditch with one of its slopes 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, that may or may not be weathered and includes boulders having a volume of 1 m^3 or greater.

Rock Face means the uniform, relatively planar, maintenance-free, vertical or near vertical rock surface between the top of the existing rock surface and the designated rock or ditch grade line that is generally characterized by noticeable drill hole traces and a minimum of blast-induced fractures beyond the rock excavation limits.

Rock Surplus means the rock excavation original tender quantity multiplied by the bulking factor, plus the volume of rock material excavated from all other items as specified in the Contract Documents, minus the rock embankment original tender quantity. Rock overbreak and rock materials resulting from scaling are specifically excluded.

Scaling means the removal of loose, broken, or overhanging rock fragments from an existing rock surface or the removal of loose, broken, or overhanging rock fragments from a rock face that remain in place after the rock has been blasted and mucked.

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 layer of soil, that is predominantly organic, too soft, or wet and otherwise unsuitable for the construction of embankments that is done prior to and usually independent of earth excavation or the placement of fill materials or both.

Tolerance means a construction working tolerance only that is considered to be:

a) Minus when it is:

   i. narrower than the Contract standard when pertaining to horizontal dimensions as measured from centreline, or
   ii. lower in elevation than the Contract standard when pertaining to vertical dimensions.

b) Plus when it is:

   i. wider than the Contract standard when pertaining to horizontal dimensions as measured from centreline, or
   ii. higher in elevation than the Contract standard when pertaining to vertical dimensions.

Wall Control Blasting means a blasting method using carefully-spaced and aligned drill holes intended to produce a relatively flat, maintenance-free, rock surface or rock face as 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 (RMMP)

For each construction stage, 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 as specified 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 the bulking factor 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 within the Contract limits to be processed into granular material or other aggregates as specified in the Contract Documents.
   v. Excavated rock to be used for other purposes in completing the Work, such as rock protection, rip rap, or river stone and the types and locations of that Work.
   vi. Excavated rock not incorporated into the Work and the locations and uses of that material.

b) A plan for the construction of rock embankments that identifies each location and volume in cubic metres where the material is going to be supplied to the corresponding station intervals as specified in the Contract Documents.

c) The locations and volume in cubic metres for the sources where rock materials are obtained for the rock supply item.

d) The location and volume in cubic metres for each source when additional rock or granular material or both are required to complete the Work.

e) The amount of rock surplus, if any, during the applicable construction stage.

The Contractor shall be solely responsible for the assumptions and the reasonableness of the RMMP.

In addition, for each construction stage, on a monthly basis, an updated RMMP shall be submitted to the Contract Administrator which shall include an ongoing tabulation of all rock materials that have been removed by the Contractor from the rock excavation or not incorporated in embankments, shown as a cumulative reduction in rock surplus.

The work of rock excavation or rock embankment shall not commence until the RMMP in accordance with the above requirements is submitted.

206.04.01.02 Trial Section for Modified Layer Compaction Method

If the Contractor wishes to request to use the modified layer compaction method as specified in the Modified Layer Compaction Method clause, a detailed plan shall then be submitted in writing to the Contract Administrator a minimum of 48 hours prior to commencing any work on the required trial section. The plan shall include full details of the placing of material and its compaction, including layer thickness; number and type of compaction units and number of passes.

206.06 EQUIPMENT

206.06.01 Tractor Bulldozer - Crawler Type for Rock Embankment Construction

Tractor bulldozer, crawler type for rock embankment construction required in the General clause of the Rock Embankments clause shall have a minimum net flywheel power of 200 kW.

206.06.02 Rollers for Shale Embankment Construction

Sheepsfoot, packall, padfoot, or tamping foot rollers required for the construction of shale embankments shall weigh a minimum of 18 tonnes and vibratory steel drum or pneumatic-tired rollers shall weigh a minimum of 9 tonnes.

206.07 CONSTRUCTION

206.07.01 General

206.07.01.01 Removal of Ice, Snow, and Frozen Ground

The Contractor shall remove and dispose of all ice, snow, and frozen material from all earth, rock, or granular surfaces prior to placing fill and from all earth, rock, or granular materials being used for backfill, embankments, or any other construction purposes.

206.07.01.02 Compaction

Earth and granular materials shall be compacted according to OPSS 501.

For compaction purposes, reclaimed asphalt pavement (RAP) or reclaimed concrete material (RCM) or both shall be treated as earth or rock when such material is respectively included in an earth embankment or a rock embankment.

206.07.01.03 Earth Borrow

When earth borrow is specified in the Contract Documents, it shall be according to OPSS 212.

206.07.01.04 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.

206.07.01.04.01 Tolerances for Earth

Upon completion, all earth grade surfaces, excluding swamp excavations, shall be shaped to the grades and cross-sections as 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 when 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 when 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 in earth cut sections:

+ 30 mm
- 0 mm

Irrespective of compliance with the above tolerances, the completed slopes shall present a uniform appearance.

206.07.01.04.02 Tolerances for Rock

Completed rock grade surfaces shall be shaped to the grades and cross-sections as specified in the Contract Documents within the following tolerances:

a) Vertical grading tolerances for the finished rock subgrade within the limits of the roadway:

For cut sections:

+ 30 mm
- 100 mm

For fill sections:

+ 30 mm
- 75 mm

Excavation below the minus tolerances may be accepted by the Contract Administrator when it is not detrimental to the work and is brought up to grade as specified in the Rock Excavation, Grading clause.

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 when 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 when the Owner deems it is not detrimental to the work or contribute to additional rock surplus.

e) Vertical grading tolerances for all ditching in rock cuts:

+ 30 mm
- 30 mm

Excavation below the minus tolerance may be accepted by the Contract Administrator when 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 a manner to avoid water saturation of embankment material and roadway foundation material and to avoid leaving undrained pockets in excavations by providing effective drainage during all stages of the work.

In excavations below subgrade and in stripping operations when 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. When pipe subdrains are required in the bases of roadway cuts, such work shall be carried out at the time that the roadside ditches are being constructed.

206.07.03 Excavation and Grading

206.07.03.01 Earth Excavation - Grading

206.07.03.01.01 General

The work shall include excavating, hauling, handling and placing, shaping, compacting, trimming of earth material, applying temporary cover, and the management of excavated and excess materials as specified in the Contract Documents.

The work shall also include the excavation and removal of pipes and culverts smaller than 200 mm in diameter and expanded polystyrene insulation when located within the limits of the earth excavation, grading work.

Suitable and non-excess earth material excavated from roadway cuts, ditching, and other associated sites shall be used in earth grading and embankment construction, unless otherwise specified in the Contract Documents.

206.07.03.01.02 Stripping

Except when swamp treatment is required, the original ground shall be stripped at the locations and to the depths specified elsewhere in the Contract Documents.

Material meeting the requirements of topsoil according to OPSS 802 that is required for re-use shall be stockpiled as specified in the Contract Documents. Other material obtained from stripping shall be managed as specified in the Management of Excavated Materials clause.

206.07.03.01.03 Excavation Below Subgrade

Unsuitable materials, other than material excavated from swamps, shall be removed below the subgrade to the lengths, widths, and depths as specified in the Contract Documents. The resulting excavation shall be backfilled with material acceptable to the Contract Administrator and compacted according to OPSS 501.

206.07.03.01.04 Swamp Excavation

Swamp excavation shall be according to OPSS 209.

206.07.03.01.05 Backfilling of Overexcavated Areas

When overexcavation occurs, the overexcavated area shall be backfilled with granular material according to OPSS 1010 and compacted according to OPSS 501 at no additional cost the Owner. With the exception of frontslopes and when boulders are encountered in the excavated slopes, backfilling shall not be permitted to obtain the required slopes for excavations.

When boulders are encountered in the excavated slopes, the boulders shall be removed at the direction of the Contract Administrator and the resulting cavity or cavities shall be backfilled with properly-compacted granular material according to OPSS 1010.

206.07.03.02 Rock Excavation - General

Except where shatter is required, drilling shall not be performed outside of or extend beyond the design excavation limits as specified in the Contract Documents.

The use of explosives for rock excavation shall be as specified in the Contract Documents.

All excavated rock, including rock materials resulting from overbreak and scaling, except the quantity of rock surplus, shall be placed in embankments.

Any excavated rock remaining after constructing the embankments shall be managed as specified in the Management of Excavated Materials clause.

206.07.03.02.01 Rock Excavation - Grading

The work shall include drilling and blasting to obtain the required rock excavation and shatter, mucking, and bringing to grade any overexcavation. Hauling shall only be part of the work when the excavated material is part of the rock surplus or is in excess of the rock embankment requirements.

When rock is to be excavated, all overlying stumps, roots, and vegetation shall be managed as excess material as specified in the Contract Documents. When earth overlies the rock to be excavated, the earth shall be removed. This work shall be performed sufficiently in advance of any blasting or rock excavation operations to allow rock cross-sections to be taken.

Scaling shall be carried out during mucking. All rock fragments or boulders either within or outside the excavated areas that are likely to slide or roll down rock cuts or are otherwise deemed to be unstable by the Contract Administrator shall be removed. 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 rock shatter or other approved material at no additional cost to the Owner.

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.

Rock scaling and the removing of all overbreak and scaled materials shall be included in the rock excavation, grading item, unless a rock face item is included in the Contract Documents.

206.07.03.02.01.01 Shale

Shale shall be excavated using methods appropriate for the site conditions. Side slopes in shale shall be as specified in the Contract Documents. Rock face and subgrade shatter are not required in shale.

206.07.03.02.02 Rock Face

The work shall include drilling and blasting using one or more wall control blasting techniques to produce the rock face required in the Contract Documents and all associated scaling, mucking, hauling and management of all overbreak and scaled rock as specified in the Management of Excavated Materials clause.

The Contractor shall decide the required spacing, diameter, and loading of all drill holes for wall control blasting in order to ensure a uniform shear face between the holes and to meet the tolerance requirements stated in the Tolerances for Rock clause for rock face. In no case shall the diameter and spacing of these holes be more than 100 mm and 0.75 m centre-to-centre, respectively,

The Contractor shall also decide the required spacing, diameter, and loading of the adjacent line of production drill holes located inside the controlled blasting limits in order to ensure that wall control blasting is able to produce the required rock face.

However, in no case shall any portion of a production drill hole be within 0.75 m of the line formed by the drill holes for wall control blasting.

206.07.03.03 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 as specified in the Contract Documents. Any such excavation shall be backfilled and compacted with material as specified in the Contract Documents, prior to closing down operations each day.

206.07.03.04 Excavation for Pavement Widening

The work shall include excavating a trench adjacent to the existing pavement to the widths and depths as specified in the Contract Documents. Excavated material shall be spread on the adjacent shoulders and slopes.

206.07.03.05 Management of Excavated Materials

Excavated materials shall be used within the Contract limits as specified in the Contract Documents.

When the Contract Administrator has deemed that the Contractor's sequence of operations, inadequate drainage measures, or handling processes or all have caused earth materials that were identified in the Contract Documents as being suitable for embankment or other construction purposes to become unsuitable for such purposes then, at no additional cost to the Owner, the Contractor shall either condition that material until it is suitable or manage it as excess material as specified in the Contract Documents and, if necessary, replace it with an equivalent volume of earth borrow. When the Contractor's operations have caused the material to become unsuitable due to excessive moisture content, conditioning may then involve re-working the material as necessary or spreading out the material in layers or both so that the material is thin enough to allow it to sufficiently dry out.

Quantities of unsuitable earth as specified in the Contract Documents and deemed suitable for use by the Contract Administrator at the time of excavation shall be used to offset borrow quantities.

Rock excavated from within the right-of-way (ROW) may be used for aggregate production up to the rock surplus quantity.

Earth or rock that is surplus to embankment requirements may be placed adjacent to the embankments by widening embankments, flattening side slopes, or constructing berms if optional cross sections or locations or both have been specified for such material in the Contract Documents or as requested by the Contractor and agreed to, in writing, by the Contract Administrator.

Surplus material may only be used within the Contract limits with the written consent of the Contract Administrator.

Surplus materials that cannot be accommodated as above and unsuitable materials shall be managed as excess material as specified in the Contract Documents.

206.07.03.06 Provision for Temporary Cover

Cover used in temporary applications shall be applied according to OPSS 804 to areas as specified in the Contract Documents.

206.07.04 Rock Supply

The work shall include any required clearing, grubbing, and stripping of the source; construction and maintenance of access roads; excavating and hauling of rock materials, regardless of whether the hauling is to the Contract limits or for rock surplus; and source rehabilitation.

The rock surplus quantity, if any, is an entitlement of the Contractor. Excavated rock may be removed for the Contractor's purposes or disposed of as the Contractor deems appropriate up to the rock surplus quantity as the staging of the work allows. All materials removed from rock excavation and not placed in rock embankment shall be deemed to be removed as part of the Contractor's rock surplus quantity.

All materials removed as part of the rock surplus quantity shall be accurately measured as specified in the Measurement of Rock Surplus clause and recorded by the Contractor at no additional cost to the Owner. Whenever such measurements are to be taken, the Contractor shall inform the Contract Administrator at least 1 Business Day in advance of such measurements.

All weighing of materials shall be as specified in the Contract Documents.

Within 7 Business Days of the Contractor taking a set of measurements, the Contractor shall:

a) Provide the Contract Administrator with a copy of those measurements and the calculations based on those measurements.

b) Advise the Contract Administrator, in writing, that the locations where the measurements were taken are ready for verification.

In the event that the Contract Administrator chooses to verify those measurements, such verification shall be undertaken within 3 Business Days of the Contract Administrator being advised that the locations are ready for verification and for those 3 Days, the Contractor shall not:

a) Place rock on or remove rock materials, as the case may be, from the measured locations; or

b) Impede the Contract Administrator in any way during the verification of those measurements.

206.07.04.01 Measurement of Rock Surplus

Rock removed as part of the rock surplus quantity shall be measured by the Contractor and verified by the Contract Administrator as specified in the Rock Supply subsection using one or more of the following 4 methods given below:

a) Weighed Aggregate Production Quantity

All locations to be used for stockpiling processed aggregates shall be identified in writing to the Contract Administrator no less than 3 Business Days prior to production.

At each stockpile location, the Contractor shall complete an accurate survey of the initial ground elevations subject to verification by the Contract Administrator prior to any materials, including materials used for a granular pad, are placed at that location.

All aggregate materials removed from each stockpile within the Contract limits shall be weighed by the Contractor for reconciliation with the rock surplus quantity by converting the mass to a bulked broken rock volume using a factor of 0.519 m^3/tonne.

Once all of the aggregates have been removed, each stockpile shall be re-surveyed by the Contractor, the measurements verified by the Contract Administrator, and the volume of material remaining determined by the Contractor.

Quantities of rock used for aggregate production and quantities of materials remaining in aggregate stockpiles shall be deducted from the rock surplus quantity.

Any materials that are added to an aggregate production stockpile within the Contract limits that do not come from rock that was excavated on the Contract shall be weighed by the Contractor and subtracted from the weighed aggregate quantity provided. If such materials are not weighed or the Contract Administrator was not given sufficient notice or opportunity by the Contractor to verify the weight of those materials, then no deduction shall be made for those materials.

b) Stockpile Volume

Excavated rock forming part of the rock surplus may be measured in stockpiles constructed by the Contractor. The Contractor shall inform the Contract Administrator, in writing, of the location where each stockpile is to be established a minimum of 3 Business Days prior to commencing any work at that stockpile location. Disposal sites shall be treated as stockpiles.

At each stockpile location, the Contractor shall complete an accurate survey of the initial ground elevations and allow the Contract Administrator to verify those measurements prior to any rock materials are placed at that location.

Once the stockpile has been completed, the stockpile shall then be resurveyed by the Contractor, the measurements verified by the Contract Administrator, and the final volume determined by the Contractor. The Contractor shall not remove any rock material from any such stockpile prior to completion of its final survey and verification by the Contract Administrator.

With the exception of excavated rock placed in rock embankment, the quantity of all other excavated rock placed within the Contract limits (e.g., for widening of pre-existing embankments, construction of access roads, crane bases, etc.) shall be measured in the same manner as the stockpiles described above. Such quantities shall be deducted from the rock surplus quantity.

At the request of the Contract Administrator, the Contractor may be required to conduct backhoe or other subsurface investigations in the Contract Administrator's presence to determine if compressible soils are present at the Contractor's proposed stockpile locations. Backfilling of such investigated areas shall be carried out using properly-compacted material acceptable to the Contract Administrator.

If the Contractor Administrator deems that compressible soils are present, the Contractor shall then re-locate the proposed stockpile or the Contractor shall install monitoring devices at the affected location. Each monitoring device shall consist of a circular 1.0 m diameter 6 mm thick steel plate with a 3.0 m length of 50 mm diameter steel pipe securely welded vertically to the centre of the plate. Whenever the level of rock placement surrounding the monitoring device is vertically within 300 mm of the top of a monitoring device, successive 3.0 m lengths of 50 mm diameter steel pipe shall be welded to the top of that device. The length of each new section shall be added to the original elevation. The Contractor shall be paid to supply and place each monitoring device as specified in the Contract Documents. Any monitoring devices damaged during placement of materials shall be replaced at no additional cost to the Owner.

The Contractor shall survey the top of each monitoring device prior to rock material placement. The Contractor shall resurvey the top of each monitoring device when the placement of rock materials is complete. Both sets of measurements shall be verified by the Contract Administrator. If the difference in elevation between the two surveys is greater than 300 mm, the initial ground elevations for this location shall then be lowered universally by the difference in monitoring device elevation. When more than one monitoring device is placed at a given location, the differences in elevations shall be averaged together.

The Contractor shall ensure that the Contract Administrator has free and unencumbered access to any location where excavated rock is being placed.

c) Weighed Broken Rock

Excavated rock forming part of the rock surplus quantity shall be weighed by the Contractor prior to exiting the Contract limits. The Contract Administrator shall be informed, in writing, at least 2 Business Days in advance that such rock materials are to be weighed as rock surplus, the specific locations where the broken rock material is to be obtained, and the locations where it is to be placed.

Excavated rock weighed as part of the rock surplus shall be converted to a bulked broken rock volume using a factor of 0.519 m^3/tonne.

d) In-situ Measure of Distinct Rock Cut

Excavated rock from distinct rock cut locations may be removed as part of the rock surplus specified in the Contractor's RMMP. A distinct rock cut location shall be one that begins with and ends at points of zero rock excavation. The excavated rock shall be used in it's entirety as rock surplus material from distinct rock cuts and shall not be split between Contract rock embankment requirements and the rock surplus quantity. This quantity shall be the quantity of the distinct rock cut in cubic meters, multiplied by the bulking factor.

206.07.05 Embankments

Only materials that are specified in the Contract Documents for use in embankments shall be used, unless approved by the Owner, in writing, prior to placement.

Materials shall not be placed over either frozen earth or ice surfaces. Ice, frozen earth, or other unsuitable materials shall not be incorporated into embankments.

RAP materials used in embankments shall be surplus to the recycling requirements of the Contract.

The Contractor shall notify the Contract Administrator, in writing, when an embankment has been completed to the dimensions that are as specified in the Contract Documents, at least 3 Business Days prior to the Contractor places any topsoil or any other material on the embankment slopes.

206.07.05.01 Earth Embankments

206.07.05.01.01 General

Material for earth embankments shall be deposited and spread in uniform layers for the full width of the embankment, except as otherwise permitted for berms. Each layer shall be compacted prior to the succeeding layer is placed. The lower portion of side hill or sloping sections shall be similarly constructed in layers and compacted until the full width surface of the specified cross-section is obtained. The embankment shall be completed thereafter with full width layers or as staged construction allows.

The construction of a core through the embankment and the subsequent completion of the embankment are prohibited, except when core construction is permitted in swamps according to OPSS 209.

Boulders, cobbles, and fragments of rock, RAP, and RCM over 150 mm in their maximum dimension shall not be placed within 300 mm of the surface of the earth grade.

Boulders, cobbles, and fragments of rock, RAP, and RCM up to 0.5 m^3 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.

Topsoil placed on earth embankments shall be according to OPSS 802.

Berms may be constructed separately, but shall be completed prior to the road embankment is built to a higher level than the berm.

Any excavation necessary for establishing compaction results throughout any embankment or any trial areas such as the one described in the Modified Layer Compaction Method clause shall be done by hand and the excavated areas shall be backfilled with the same material or material otherwise acceptable to the Contract Administrator and properly re-compacted by the Contractor.

206.07.05.01.02 Layer Compaction Method

Earth embankments shall be built using the layer compaction method, unless otherwise specified in the Contract Documents or the requirements specified in the Modified Layer Compaction Method clause have been met.

In the layer compaction method, the embankment material shall be spread out 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 as specified in the Contract Documents prior to the succeeding layer is placed.

All boulders, cobbles, fragments of rock, RAP, and RCM shall have a maximum vertical dimension after placement, not greater than the fully compacted layer depth.

When the ground cannot support construction equipment using this method then, at the discretion of the Contract Administrator, the first layer may be increased in thickness as specified in the Modified Layer Compaction Method clause.

206.07.05.01.03 Modified Layer Compaction Method

The modified layer compaction method may be used if the Contract Administrator deems that it is practical to construct an earth embankment or a portion of an earth embankment in thicker lifts than that specified in the Layer Compaction Method clause.

In this case, the embankment material shall be spread out in uniform full width layers not more than 600 mm in depth prior to compaction. Each layer shall be shaped and compacted to the line and cross-section specified prior to the succeeding layer is placed.

All boulders, cobbles, and fragments of rock shall have a maximum vertical dimension when placed not exceeding the modified layer depth. All RAP and RCM shall have a maximum vertical dimension after placement not exceeding 300 mm.

Prior to placing any material, the Contractor shall provide proof to the Contract Administrator of the ability of the proposed method to achieve the specified density by means of a trial section consisting of a single uniform lift covering a minimum area of 400 m^2 as specified in the Trial Section for Modified Layer Compaction Method clause. The location and extent of the trial section shall be acceptable to the Contract Administrator.

When it has been successfully demonstrated to the Contract Administrator that compaction can be achieved throughout the entire lift based on the acceptance requirements for a control strip specified in OPSS 501, the procedure that the Contractor used shall then be permitted for the remainder of the work to which it is applicable. Any excavation, backfilling, and re-compaction necessary for establishing the compaction results within the trial section shall be carried out by the Contractor.

If at any time, test results show that the permitted procedure is no longer producing the required degree of compaction, a new trial section shall then be constructed. In this case, the Contractor shall propose changes in the procedure to satisfy the requirements of this specification. Such changes shall be proposed in writing to the Contract Administrator prior to commencing work on the new trial area. Otherwise, the Contractor shall revert back to the layer compaction method as specified in the Layer Compaction Method clause.

206.07.05.02 Rock Embankments

206.07.05.02.01 General

The work shall include hauling, placement, and compaction of excavated rock.

Excavated rock used to construct rock embankments shall be obtained from within the Contract limits. If there is insufficient material to complete the rock embankments, the additional material shall then be provided and paid for under the rock supply item.

All rock from other items as specified in Contract Documents shall be used to construct rock embankments.

Rock embankments shall be constructed by placing embankment materials full width in successive uniform layers.

For rock embankments other than shale, the layers shall not exceed 1.5 m thickness prior to compaction. Material in each layer shall be fully compacted prior to the succeeding layer is placed. Each rock fill layer shall be compacted with a tractor bulldozer, crawler type as specified in the Tractor Bulldozer - Crawler Type for Rock Embankment Construction subsection. The minimum number of complete passes shall be 6 and the maximum number of passes shall be 8. A complete pass shall be defined as 100% coverage of the layer surface. The maximum speed of the equipment during each pass shall be 3.2 km/h.

For all rock embankments, materials shall be placed in their 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.

Rock fragments exceeding a maximum of 1.0 m in any dimension shall be well distributed throughout the embankment. Rock fragments up to a maximum of 3.0 m in any dimension 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 shall be sufficiently spaced to allow free access of the specified equipment to compact the intervening fill.

Placement and compaction in layers is not required when rock is placed under water. In this case, end dumping may be used. However, end dumping shall only be used to an elevation of 1.0 m above the water level that is present at the time of placement. After that, the rock embankment shall be constructed using the equipment and method specified in the paragraphs above. The materials shall be well distributed to form a solid embankment constructed to full width as the work progresses or as staged construction allows.

When a 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 so that mud waves generated by the rock placement are able to move away from the embankment. Mud waves shall be displaced or removed to prevent their entrapment below or within the embankment.

End dumping from the top of the embankments may also be carried out at locations as specified in the Contract Documents when narrow and relatively shallow widening of an existing embankment is required for the shoulder portion of the highway.

The top surface of the embankment shall be chinked with rock fragments and spalls to form the subgrade prior to the placement of the roadway subbase in order to minimize voids and prevent migration of the subbase material into the rock fill.

Care shall be taken to avoid large boulders and rock fragments protruding above the average embankment surface within a distance of 3 m beyond the edge of shoulder.

With the written approval of the Contract Administrator, dumping of surplus rock over the sides of rock embankments by the Contractor is permitted as follows:

a) After the rock embankments have been completed to the grades and tolerances specified in the Contract Documents and all such measurements have been verified by the Contract Administrator.

b) Only in areas that do not affect features that are located within the right-of-way (e.g., ditches, culverts, and signs) or the right-of-way limits and shall not detrimentally affect stability or drainage or cause other potentially negative impacts.

c) At the direction of the Owner.

206.07.05.02.02 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. When a harder, more durable rock (e.g., limestone) is present as an integral part of a shale formation, no pieces shall be placed in the embankment that after placement are greater than 150 mm measured vertically or greater than 600 mm measured parallel to the embankment layers, respectively.

Compaction of each layer shall be in two stages using equipment specified in the Rollers for Shale Embankment Construction subsection. In the first stage, a minimum of 2 passes shall be made with a static sheepsfoot, packall, padfoot, or tamping foot type roller. In the second stage, a minimum of 2 passes shall be made with a vibratory steel drum or pneumatic-tired roller. The maximum speed of rollers shall not exceed 5 km/hr.

206.07.06 Rock Backfill to Structure

When rock backfill to structures is specified, the rock backfill shall only be comprised of rock fragments no larger than 250 mm in their greatest dimension and free of all debris, earth, topsoil, wood, chemical, or other contamination.

Rock backfill shall be placed in a manner that the structure is not damaged. Dumping of rock backfill against a structure shall not be permitted.

206.07.07 Quality Control

206.07.07.01 Grade Checks

The Contractor shall be responsible for carrying out all quality control (QC) grade checks to ensure that horizontal and vertical grading tolerances are met.

A competent survey crew shall carry out grade checks on all finished earth and rock grade surfaces. QC of earth and rock grade surfaces shall be based on horizontal and vertical grading tolerances as specified in the Tolerances for Earth and Tolerances for Rock clauses, respectively. The grade shall be certified at the stations and offsets shown in the grading templates or where grading templates are not available, at the frequency requirements specified for the layout elsewhere in the Contract Documents.

206.07.07.01.01 Submission of Grade Checks

The Contractor shall submit all grade checks relating to horizontal and vertical grading tolerances, including all non-compliances, to the Contract Administrator within 2 Business Days following completion of the grade.

When grading templates are available, the Contractor shall sign and certify on the grading template that the components of the work indicated on that template have been correctly constructed to the specified line and grade tolerances. If a template is not available, then the Contractor shall complete, sign, and submit MTO form PH-CC-820 to the Contract Administrator.

206.07.07.02 Compaction Quality Control

The Contractor shall use Method B according to OPSS 501 for quality control of compaction.

206.07.08 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

206.08 QUALITY ASSURANCE

206.08.01 Grade Checks

The Owner may conduct random QA grade checks to verify horizontal and vertical grading tolerances.

Provided that the Owner's grade checks conform to those determined by the Contractor, no action shall be taken. If discrepancies between QA and QC grade checks occur, the Owner may then conduct additional QA grade checks at the Owner’s discretion.

If the finished grade or cross-section is found to be outside the specification limits specified in the Tolerances - General clause, then:

a) The Contract Administrator shall notify the Contractor.

b) The Contractor shall be charged for each station where the finished grade is outside of the specification limits, at the rate specified in the Finished Grade Checks Outside Specification Limits subsection.

c) The Contractor shall then bring the earth or rock grade surface to within the specified tolerances for grade, at no additional cost to the Owner.

206.09 MEASUREMENT FOR PAYMENT

206.09.01 Actual Measurement

206.09.01.01 Earth Excavation, Grading

Measurement for earth excavation, grading shall be the in-place volume of earth in cubic metres computed from field measurements of cross-sections taken both prior to grubbing and upon completion of the work.

When benching is required to key-in new fills into existing slopes, the quantity of materials that are excavated as part of that operation shall not be included in the measurement for payment.

206.09.01.01.01 Overbuilding, Earth

When the Contract requires earth borrow, the quantity of material placed beyond the earth grading tolerances shall be deducted from the measured quantity of earth borrow on a cubic metre for cubic metre basis, with no correction for changes in the 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 the existing pavement when 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 the in-place volume in cubic metres computed from field measurements of cross-sections bounded by the original rock line after the earth overburden has been removed and the theoretical rock face and the bottom excavation limits designated in the Contract Documents. Where shatter is specified, the bottom of the cut shall be 300 mm below the designated rock grade.

The quantity of rock excavation shall also include:

a) All shatter that is specified in the Contract Documents.

b) Any rock that is excavated beyond the limits that are as specified in the Contract Documents at the Contract Administrator's written instructions.

206.09.01.03.02 Overbuilding, Rock

When the Contract has a rock supply item, the quantity of excavated rock placed beyond the rock grading tolerance at the top of subgrade and beyond the angle of repose for rock fills shall be deducted from the rock surplus quantity on a cubic metre for cubic metre basis with no correction for changes in density of the material.

206.09.01.03.03 Boulders

Measurement of each boulder classified as rock shall be by volume in cubic metres computed on the basis of the product of the actual rock measurement of the 3 maximum rectilinear dimensions in metres of the boulder.

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 Supply

The quantity of rock supply shall be determined in cubic metres either at the end of a distinct stage or at the end of the Contract.

The quantity shall be determined as one of the following:

a) The rock surplus quantity less the quantities of rock materials removed as part of the rock surplus and measured as specified in the Measurement of Rock Surplus clause.

b) The quantity of rock materials determined by the Contract Administrator required to complete the embankments.

c) The total of both a) and b).

At the discretion of the Contract Administrator, earlier access to the rock supply item may be granted; however, the quantities shall be reconciled at the end of the stage or Contract.

The rock supply quantity shall be measured in-situ by the Contractor in neat lines at the source. The in-situ volume shall be the rock supply quantity divided by the bulking factor.

For rock materials supplied under the rock supply item for the completion of rock embankments, any rock materials remaining at the rock supply source after rock embankment construction has been completed or otherwise used on the Contract as specified in the Management of Excavated Materials clause, shall be paid for as specified in the Rock Supply subsection under the Basis of Payment section.

The Contract Administrator shall be informed in writing 2 Business Days prior to commencing drilling operations at the rock supply source or 2 Business Days prior to removing rock from the rock pile or both. The Contract Administrator reserves the right to verify any measurements at any source. The Contractor shall give the Contract Administrator complete access to all such sources.

206.09.01.06 Rock Embankment

Measurement of rock embankment shall be by volume in cubic metres of rock embankments. Adjustments to the Plan Quantity shall be limited to those supported with topographic survey information.

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.

Payment for earth grade checks, including provision of all labour, Equipment, and Material to conduct quality control testing shall be included in the Contract price as part of the work of earth excavation, grading.

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.

When the Contract Administrator directs that material excavated under this item is to be handled other than as specified in the Excavation for Pavement Widening clause, then such material shall be managed in accordance with the Contract Documents and treated as a Change in the Work.

Material used to backfill the excavation shall be paid for at the Contract price for the tender item of the type of material used.

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 embankment shall be included in the rock excavation, grading item.

When excavated rock is to be used for any other Contract item work (e.g., rock embankment, granular materials, or rip-rap), the hauling costs are deemed to be included in payment for the work associated with the appropriate tender item. However, when excavated rock is not to be used for any other Contract item work, the hauling costs are then deemed to be included in payment for the work under the rock excavation, grading item.

Payment for rock grade checks, including provision of all labour, Equipment, and Material to conduct quality control testing, shall be included in the Contract price as part of the work of rock excavation, grading.

When 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.

On completion of drilling and blasting, a progress payment of 50% of this tender item shall be made.

On completion of mucking, a progress payment of an additional 25% of this tender item shall be made.

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.

206.10.05 Rock Supply - 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, and all costs for fees and royalties.

When 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.

The unit price tendered for this item is excluded from the provisions specified in the Contract Documents for renegotiation of unit prices.

For rock materials supplied under the rock supply item for completion of rock embankments as specified in the Contract Documents, any rock materials remaining at the rock supply source after completion of all rock excavation and rock embankment construction shall be paid at 50% of the tender unit rate for rock supply.

As specified in part b) of the Measurement of Rock Surplus clause, the Contractor shall be paid $400.00 for each monitoring device used to monitor compressible soils, regardless of the number of additional pipe sections that are required.

206.10.06 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.

206.10.07 Backfill for Overexcavation

Payment shall not be made for backfill of any overexcavation in excess of the specified tolerances.

206.10.08 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.

206.10.09 Finished Grade Checks Outside Specification Limits

As specified in the Grade Checks subsection of the Quality Assurance section, for each station where the QA grade check of the finished grade is outside of specification limits, the Contractor shall be charged $250.00.

Appendix 206-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

AMENDMENT TO OPSS 206, NOVEMBER 2014

Special Provision No. 102S05 May 2017

206.02 REFERENCES

Section 206.02 of OPSS 206 is amended by the addition of the following to **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

206.06 EQUIPMENT

Section 206.06 of OPSS 206 is amended by the addition of the following subsections:

206.06.03 Nuclear Moisture and Density Gauge

Nuclear moisture and density gauges shall meet the requirements of the Nuclear Moisture and Density Gauge subsection of OPSS 501.

206.06.04 Hydraulic Excavator - Crawler Mounted for Rock Embankment Construction

Hydraulic excavator, crawler mounted for rock embankment construction required in the General clause of the Rock Embankments clause shall have a minimum operating weight of 32,000 kg.

206.06.07 CONSTRUCTION

206.07.05.01.03 Modified Layer Compaction Method

Clause 206.07.05.01.03 of OPSS 206 is amended by deleting the fifth and sixth paragraphs in their entirety and replacing them with the following:

Prior to the construction of the trial section, the maximum dry density (MDD) of the material to be compacted shall be determined according to LS-706 from a minimum of 3 independent samples of the material.

Acceptance of the trial section shall be based on compaction testing within the trial section lift. For testing within the lift, the trial section shall be a single lot with 4 sublots of equal area. At a random location within each sublot, a level surface shall be prepared at a depth that permits the probe of a nuclear moisture and density gauge to extend to the bottom of the lift. Field wet density and moisture content shall be determined at each random location using the gauge and the dry density value calculated for each sublot.

If the quality index for the lot, calculated according to the Quality Index clause of OPSS 501, is equal to or greater than 1.47, the trial section shall be accepted. If the quality index for the lot is less than 1.47, the method of construction of the trial section shall not be accepted. The target density for the purpose of the quality index calculation shall be the average of the 3 MDD values determined according to LS-706.

If the trial section has been accepted, field wet density and moisture content testing shall be carried out at 10 random locations on the trial section surface using a nuclear moisture and density gauge. The average dry

density from the 10 locations shall be calculated and used as the target density for acceptance, according to OPSS 501, for further placement of the material by the modified layer compaction method.

The same procedure used for the construction of the accepted trial section, including compaction equipment, vibration characteristics, and number of passes, shall be used for the further placement and compaction of the same material by the modified layer compaction method.

A new trial section shall be required for the material when one or more of the following apply:

a) A new target density is required according to the Target Density clause of OPSS 501.

b) The Contractor wants to change the accepted modified layer compaction method procedure.

c) An accepted modified layer compaction method procedure is no longer producing the required degree of compaction.

When requested by the Contract Administrator, compacted material shall be removed to verify the thickness and/or complete compaction testing on a levelled surface within any compacted lift.

All excavation, backfilling, and re-compaction necessary for thickness verification and compaction testing within the trial section lift and as requested by the Contract Administrator at other locations shall be completed to the satisfaction of the Contract Administrator at no additional cost to the Owner.

206.07.05.02 Rock Embankments

206.07.05.02.01 General

Clause 206.07.05.02.01 of OPSS 206 is amended by deleting the fifth and sixth paragraphs in their entirety and replacing them with the following:

For rock embankments, other than shale, the layers shall not exceed 1.5 m thickness prior to compaction. The material in each layer shall be fully compacted before the succeeding layer is placed. Each rock fill layer shall be compacted with a tractor bulldozer, crawler type, as specified in the Tractor Bulldozer - Crawler Type for Rock Embankment Construction subsection. In confined areas or in any other areas where the Contract Administrator agrees that a tractor bulldozer , crawler type, cannot be reasonably used, then each rock fill layer may be compacted using a hydraulic excavator , crawler mounted, as specified in the Hydraulic Excavator - Crawler Mounted for Rock Embankment Construction subsection. The minimum number of complete passes shall be six and the maximum number of passes shall be eight for either type of equipment. A complete pass shall be defined as 100% coverage of the layer surface. The maximum speed of the equipment during each pass shall be 3.2 km/h.

For all rock embankments, materials shall be placed in their final position by blading when using a tractor bulldozer, crawler type for or by raking and chinking when using a hydraulic excavator, crawler mounted or a combination of both types of equipment, providing that the total number of complete passes over the same area specified in the paragraph given above is achieved. 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.

WARRANT: Always with OPSS 206, Grading.

ROCK EXCAVATION, GRADING – Item No.

Special Provision No. 206F04 December 2014

Amendment to OPSS 206, November 2014

Bulking Factor for Shale

206.03 DEFINITIONS

Section 206.03 of OPSS 206 is amended by deleting the definition for **Bulking Factor** in its entirety and replacing it with the following:

Bulking Factor means the ratio of the volume of rock material following excavation, placement, and compacting to the original in-situ volume of the same material. The bulking factor for rock shall be 1.35, except for shale. For rock excavation quantities identified as shatter, the bulking factor shall be 0.35. For shale, the bulking factor shall be [* Designer Fill-in, See Notes to Designer].

206.07.04.01 Measurement of Rock Surplus

Clause 206.07.04.01 of OPSS 206 is amended by deleting the third paragraph in point a) in its entirety and replacing it with the following:

All aggregate materials removed from each stockpile within the Contract limits shall be weighed by the Contractor for reconciliation with the rock surplus quantity by converting the mass to a bulked broken rock volume using a factor of 0.519 m^3/tonne, except for shale. For shale, the conversion factor shall be [**Designer Fill-in, See Notes to Designer] m^3/tonne.

Clause 206.07.04.01 of OPSS 206 is further amended by deleting the second paragraph in point c) in its entirety and replacing it with the following:

Excavated rock weighed as part of the rock surplus shall be converted to a bulked broken rock volume using a factor of 0.519 m^3/tonne, except for shale. For shale, the conversion factor shall be [** Designer Fill-in, See Notes to Designer] m^3/tonne.

NOTES TO DESIGNER:

Designer Fill-ins:

* Insert the bulking factor for shale recommended by the Geotechnical Section.
** Insert the converting volume factor in m^3/tonne recommended by the Geotechnical Section.

WARRANT: Always with this item when shale is excavated as part of the Rock Excavation, Grading item.

EARTH EXCAVATION, GRADING - Item No.

Special Provision No. 206F06 September 2017

Amendment to OPSS 206, November 2014

206.07.03.01 Earth Excavation - Grading

206.07.03.01.01 General

Clause 206.07.03.01.01 of OPSS 206 is amended by the addition of the following paragraph:

The work shall also include the excavation of pavement, treated base, concrete base, prime, surface treatment, and mulch pavements, including any buried layers of these materials, at the following locations:

* Designer Fill-In, See Notes to Designer

206.09.01.01 Earth Excavation, Grading

Clause 206.09.01.01 of OPSS 206 is amended by the addition of the following paragraph:

Where the work of earth excavation, grading includes the removal of pavement, treated base, concrete base, prime, surface treatment, and mulch pavements, including any buried layers of these materials, the measurement for payment of earth excavation, grading shall include the volume of these materials.

NOTES TO DESIGNER:

Designer Fill-In:

* Fill in the locations where the 2nd paragraph of CDED B206-1.8.6, Part B. applies, and pavement removal is to be included in the quantities for both this item and the appropriate removal of pavement item(s).

WARRANT: Include with this item when there are areas of pavement reconstruction and the pavement is included in the earth excavation quantity for these areas.

CONSTRUCTION SPECIFICATION FOR EMBANKMENTS OVER SWAMPS AND COMPRESSIBLE SOILS

TABLE OF CONTENTS

209.01 SCOPE

This specification covers the requirements for the construction of embankments over swamps and compressible soils using the excavation, floatation, or displacement method.

209.01.01 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.

209.01.02 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.

209.02 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 201	Clearing, Close Cut Clearing, Grubbing, and Removal of Surface and Piled Boulders
OPSS 206	Grading
OPSS 212	Earth Borrow

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1860	Geotextiles

209.03 DEFINITIONS

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

Displacement Method means to build the embankment directly on the swamp such that the underlying swamp material is displaced away from the embankment fill.

Earth means earth as defined in OPSS 206.

Floatation Method means to build the embankment directly on the swamp minimizing the displacement of the swamp material.

Rock means rock as defined in OPSS 206.

Swamp Material means the material within the swamp excavation, floatation, or displacement limits, except rock, masonry, natural wood, and manufactured products. Wood that has decomposed and breaks down readily upon handling shall be considered swamp material.

Swamp Wave means the swamp material that is displaced as a result of placement of embankment material.

209.05 MATERIALS

209.05.01 Embankment Material

Embankment material shall consist of earth, rock, select subgrade material, or other material specified in the Contract Documents.

209.05.01.01 Earth Borrow

Earth borrow shall be according to OPSS 212.

209.05.01.02 Select Subgrade Material

Select subgrade material shall be according to OPSS 1010.

209.05.02 Geotextiles

Geotextiles shall be according to OPSS 1860 and be of the type, class, and filtration opening size (FOS) range specified in the Contract Documents.

209.06 EQUIPMENT

209.06.01 Rented Swamp Excavator

The type of swamp excavator equipment shall be as specified in the Contract Documents.

The minimum size and requirements shall be a 26,500 kg crawler mounted hydraulic backhoe with a minimum 12 m reach and a 1 m^3 bucket or a 40,000 kg crawler mounted dragline with a 1.15 m^3 bucket. The bucket shall be suitable for swamp excavation.

209.06.02 Spreading, Levelling, and Compacting Equipment

When the floatation method is used, spreading, levelling, and compacting equipment shall be restricted to a gross weight that is not detrimental to the structural integrity of the root mat.

209.07 CONSTRUCTION

209.07.01 General

The work of embankment construction shall be carried out using one or more of the following methods specified in the Contract Documents:

a) Excavation Method

b) Floatation Method

c) Displacement Method

209.07.02 Clearing and Close Cut Clearing

Prior to beginning embankment construction, the required clearing and close cut clearing shall be completed according to OPSS 201.

209.07.03 Excavation Method

The work shall include the excavation of all material, except rock, from within the limits specified in the Contract Documents and the handling, placing, shaping, trimming, and hauling of excavated material.

Excavation shall be to the full width and full depth in one operation prior to backfilling.

Excavated material shall be placed clear of the sides of the embankment limits and any drainage facilities. The operations of excavating and backfilling shall be carried out simultaneously.

209.07.03.01 Embankment Construction and Backfill

Backfill shall be placed according to OPSS 206. However, when wet conditions exist, backfill material other than rock may be placed up to 600 mm above water level without compaction.

Embankment material placed subsequent to the backfill material shall be placed according to OPSS 206.

209.07.04 Floatation Method

The work shall consist of controlled placement of embankment material, removal of surcharges specified in the Contract Documents from above the subgrade, and hauling and incorporating of the surcharge material into the work according to OPSS 206.

209.07.04.01 Swamp Waves

Swamp waves shall not be excavated or otherwise disturbed.

209.07.04.02 Embankment Construction

The embankment shall be constructed according to OPSS 206, except that vibratory compaction equipment shall not be used within 1.0 m of the original surface of the swamp.

Each layer shall be built using an outside to inside sequence by keeping the outer one-third portions of the layer at least 30 m ahead of the centre portion.

209.07.04.03 Geotextile

When geotextile is to be placed, the area specified in the Contract Documents for geotextile shall be close cut cleared and cleared of objects that may damage the geotextile. Close cut clearing shall be carried out in such a manner as not to damage the structural integrity of the root mat.

The placement operation shall be such that the geotextile is not exposed to daylight for more than 72 hours.

Adjacent sections of the geotextile shall be overlapped a minimum of 1.0 m or shall be sewn together according to OPSS 1860.

Should the geotextile be damaged, it shall be repaired by placing a piece of geotextile large enough to cover the damaged section meeting the above requirements for overlapping.

If the geotextile is damaged due to the Contractor's operation during embankment construction, the embankment material shall be removed from the geotextile.

209.07.05 Displacement Method

The work shall consist of controlled placement of the embankment material, excavation of swamp waves and displaced material, removal of surcharges specified in the Contract Documents, and hauling and incorporating of this material into the work according to OPSS 206.

209.07.05.01 Embankment Construction

The embankment shall be built in such a manner as to displace as much of the material underlying the embankment as possible. An inside to outside construction sequence shall be used, keeping the inside one-third portion 30 m ahead of the outside portions.

When a stable platform has been established, embankment material placed 300 mm above original ground shall be placed according to OPSS 206.

209.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

Manufactured products shall not be used in the right-of-way.

Excavated swamp material shall be used as much as possible within the right-of-way adjacent to an embankment and conforming to standard right-of-way offset. This shall be done by widening embankments, flattening side slopes, and constructing modified cross-sections as specified in the Contract Documents. Such material shall be trimmed to provide smooth contours and to provide drainage.

The volume of excavated material to be used within the Contract limits or designated areas shall be as specified in the Contract Documents.

209.09 MEASUREMENT FOR PAYMENT

209.09.01 Actual Measurement

209.09.01.01 Excavation

Measurement shall be by volume in cubic metres by the method of average end areas. The quantity for payment shall be the lesser of the following:

a) Actual excavation.

b) Excavation to the length, width, and depth as specified in the Contract Documents.

209.09.01.02 Rental of Swamp Excavation Equipment

Measurement shall be by time in hours that the equipment is actually engaged in the work.

When the excavated material has been placed in a location that will not interfere with subsequent excavation, measurement shall not be made for the handling required in grading, levelling, and trimming of such material.

209.09.01.03 Select Subgrade Material

Measurement shall be by mass in tonnes or by volume in cubic metres as specified in the Contract Documents.

209.09.01.03.01 Cubic Metre Measurement

When measurement of select subgrade material is in cubic metres, one of the following methods, as specified in the Contract Documents, shall be used to calculate the volume of the material:

a) End Area Method

Volume of material shall be measured in their original location and computed in cubic metres by the method of average end areas.

Original cross-sections shall be taken after the area has been cleared, grubbed, and stripped of unsuitable surface material. These operations shall be completed a minimum of 3 Working Days in advance of excavation to allow for the required cross-sectioning.

b) Truck Box Method

Material shall be measured in cubic metres, loose, by predetermined truck box capacities. The predetermined capacity of each truck shall be that computed from its box dimensions.

Each truck shall be uniquely and readily identifiable.

209.09.01.04 Geotextile

Measurement shall be by area, in place, in square metres, with no allowance for overlaps.

209.09.02 Plan Quantity Measurement

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

209.10 BASIS OF PAYMENT

209.10.01 Excavation

Payment for swamp excavation shall be at the Contract price for the tender item Earth Excavation, Grading, according to OPSS 206.

Payment shall not be made for the removal of materials that slide or slough inside the excavation limits.

209.10.02 Rental of Swamp Excavation Equipment, Dragline - Item
Rental of Swamp Excavation Equipment, Hydraulic Backhoe - Item

Payment at the Contract price for the above tender items shall be full compensation for furnishing and operating the minimum size equipment specified, including mats when necessary, for the excavation and for the management of the material adjacent to the excavation.

When the Contract Administrator approves the use of larger equipment, the Contract price per hour shall be adjusted by adding to the Contract price the difference between the rate set out in the Contract Documents for the minimum size equipment specified and the rate set out in the Contract Documents for the larger equipment to be employed.

209.10.03 Floatation and Displacement Method

Payment shall not be made for swamp material displaced by floatation or displacement.

209.10.04 Select Subgrade Material - Item
Geotextile - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Repairs to geotextile damaged by the Contractor's operation shall be at no additional cost to the Owner.

209.10.05 Management of Swamp Material Excavated by Equipment Rental

All costs associated with the management of material are deemed to be included in the Contract unit price for rental of equipment.

Material resulting from the operation of the above equipment shall be managed as specified in the Contract Documents.

Appendix 209-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

RENTAL OF SWAMP EXCAVATION EQUIPMENT, DRAGLINE - Item No.
RENTAL OF SWAMP EXCAVATION EQUIPMENT, HYDRAULIC BACKHOE - Item No.
GEOTEXTILE FOR SWAMP TREATMENT - Item No.

Special Provision No. 209F01 December 2014

Amendment to OPSS 209, November 2014

209.03 DEFINITIONS

Section 209.03 of OPSS 209 is amended by the addition of the following definition:

Hydraulic Backhoe Reach means the distance from the bottom of the tracks to the tip of the bucket teeth when measured vertically with the bucket at the lowest point of the bucket swing path.

209.06 EQUIPMENT

209.06.01 Rented Swamp Excavator

Subsection 209.06.01 of OPSS 209 is deleted in its entirety and replaced by the following:

The type of swamp excavator equipment shall be as specified in the Contract Documents.

All buckets shall be suitable for swamp excavation.

Dragline minimum operating weight shall be determined using the manufacturer's standard operating dragline configuration, boom length, counterweights and manufacturer's specified bucket.

The minimum size and requirements of the excavator(s) shall be:

* Designer Fill-in - See Notes to Designer

209.07 CONSTRUCTION

209.07.03 Excavation Method

Subsection 209.07.03 of OPSS 209 is deleted in its entirety and replaced with the following:

The work shall include the excavation of all material, except rock from within the limits specified in the Contract Documents and the handling, placing, shaping, trimming and hauling of excavated material.

Excavation shall be to the full width and full depth. The excavation and backfilling shall be a controlled operation and carried out simultaneously.

Excavated material shall be placed clear of the sides of the embankment limits and any drainage facilities.

209.07.06 Management of Excess Material

Subsection 209.07.06, of OPSS 209 is deleted in its entirety and replaced with the following:

209.07.06 Management of Excavated Swamp Material

Management of excess material shall be according the Contract Documents. Material resulting from the operation of the swamp excavation equipment shall be managed as follows:

** Designer Fill-in - See Notes to Designer

Manufactured products are not to be used in the right-of-way.

Excavated swamp material shall be used as much as possible within the right-of-way adjacent to an embankment and conforming to standard right-of-way offset. This shall be done by widening embankments, flattening side slopes, and constructing modified cross-sections as specified in the Contract Documents. Such material shall be trimmed to provide smooth contours and to provide drainage.

The volume of excavated material to be used within the Contract limits or designated areas shall be as specified in the Contract Documents.

209.09 MEASUREMENT FOR PAYMENT

209.09.01.02 Rental of Swamp Excavation Equipment

Clause 209.09.01.02 of OPSS 209 is amended by deleting the first sentence and replacing it with the following:

Measurement shall be by time in hours that the equipment is in effective operation. The equipment shall not be considered in effective operation when there are no trucks ready for loading, when hauling is required.

209.09.01.04 Geotextile

Clause 209.09.01.04 of OPSS 209 is amended by deleting the title and replacing it with the following:

Geotextile for Swamp Treatment.

209.10 BASIS OF PAYMENT

Subsection 209.10.02of OPSS 209 is deleted in its entirety and replaced with the following:

209.10.02 Rental of Swamp Excavation Equipment, Dragline – Item
Rental of Swamp Excavation Equipment, Hydraulic Backhoe – Item

Payment at the Contract price for the above items shall be full compensation for furnishing and operating the minimum size equipment specified, including mats when necessary, for the excavation.

Payment for drainage of water in swamps prior to excavation is included in these tender items unless otherwise specified elsewhere in the Contract Documents.

When the Contract Administrator approves the use of larger equipment, the Contract price per hour will be adjusted by adding to the Contract price the difference between the rate set out in the Contract Documents for the minimum size equipment specified and the rate set out in the Contract Documents for the larger equipment to be employed. Where the standard operating weight for the equipment falls between increments and listed categories shown in the Contract Documents the lower rate shall apply. No interpolation between

categories of standard operating weights will be made to determine payments. When larger equipment is approved for use, the estimated hours of swamp excavation equipment rental will be adjusted down by the Contract Administrator.

Payment shall be made only for the time in which the equipment is in effective operation.

209.10.04 Select Subgrade Material – Item
Geotextile – Item

Subsection 209.10.04 of OPSS 209 is amended by deleting the title and replacing it with the following:

Select Subgrade Material – Item
Geotextile for Swamp Treatment – Item

209.10.05 Management of Swamp Material Excavated by Equipment Rental

Subsection 209.10.05 of OPSS 209 is deleted in its entirety and replaced with the following:

All costs associated with the management of material, except trucking, are deemed to be included in the Contract unit price for rental of swamp excavation equipment.

NOTES TO DESIGNER:

Designer Fill-In:

* State the required excavation equipment minimum type, minimum size, minimum reach (when applicable) and minimum bucket size.

Refer to CDED section B209 for more information on equipment configurations and contacts that may provide assistance with equipment selection. Typical configurations are as follows:

- 40,000 kg crawler mounted dragline with a 1.15 m^3 bucket, for side casting and trucking;
- 75,000 kg crawler mounted dragline with a 2.3 m^3 bucket, for side casting;
- 75,000 kg crawler mounted dragline with a 1.5 m^3 bucket, for trucking;
- 26,500 kg crawler mounted hydraulic backhoe with a 1.5 m^3 bucket, for side casting and trucking;
- 26,500 kg crawler mounted hydraulic backhoe with a minimum 12 m reach and a 1.5 m^3 bucket, for side casting and trucking;
- 32,000 kg crawler mounted hydraulic backhoe with a minimum 14 m reach and a 1.0 m^3 bucket, for side casting and trucking.

** State the material management locations, quantities (m3) at each location and requirements i.e.: 1. adjacent to operation, 2. at slope flattening locations as indicated elsewhere in the contract, 3. specific location, etc.

A chart in the Contract Documents may be needed to show the information if there are a large number of swamps and various management strategies.

WARRANT: Always with these tender items.

CONSTRUCTION SPECIFICATION FOR EARTH BORROW

TABLE OF CONTENTS

212.01 SCOPE

This specification covers the requirements for earth borrow.

212.01.01 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.

212.01.02 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.

212.02 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 201 Clearing, Close Cut Clearing, Grubbing, and Removal of Surface and Piled Boulders
OPSS 206 Grading
OPSS 401 Trenching, Backfilling, and Compacting

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-702 Determination of Particle Size Analysis of Soils

MTO Form:
PH-D-10 Aggregate Sample Data Sheet

212.03 DEFINITIONS

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

Access Road means a private road built or an existing road used by the Contractor to gain access to the Work or to a source of material.

Borrow means earth material acquired from outside the right-of-way to complete the Work.

Haul Road means any public road, excluding the road under Contract, that forms part of a material haul route.

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that materials received from the Contractor meet the specified requirements.

Referee Testing means testing of a material attribute for the purpose of resolving acceptance issues at the request of the Contractor or the Owner.

212.04 DESIGN AND SUBMISSION REQUIREMENTS

212.04.01 Submission Requirements

A minimum of 14 Days prior to borrow material being used in the Work, the Contractor shall provide a list of intended borrow sources and the tonnage that is expected to be used from each source to the Contract Administrator.

A minimum of 48 hours prior to the placement of borrow in the Work, the following shall be submitted to the Contract Administrator:

a) Written proof for the right to occupy and operate each borrow source, including all appropriate permits.

b) Identification and description of any frost-susceptible materials that the Contractor intends to use as borrow and a detailed plan describing where the Contractor intends to use it.

212.05 MATERIALS

212.05.01 Earth Borrow

Earth borrow shall consist of earth as defined in OPSS 206 and shall be free from organic and foreign material.

Earth borrow with at least 50% of its particles by mass between 5 and 75 μm in size, as determined using LS-702, shall be considered frost-susceptible.

212.07 CONSTRUCTION

212.07.01 General

The work required for borrow shall include clearing, grubbing, and stripping of a borrow source according to OPSS 201 and 206; construction and maintenance of access roads; maintenance and restoration of haul roads; excavating, hauling, placing, and compacting borrow; and borrow source rehabilitation.

The construction of embankments and backfill areas with borrow shall be according to OPSS 206 and OPSS 401, respectively.

Frost-susceptible material shall not be placed in the following areas:

a) Within the zone between the frost penetration depth specified elsewhere in the Contract Documents and the final grade that will be established within the roadway upon completion of construction.

b) In any other areas, specified elsewhere in the Contract Documents.

When borrow is stockpiled prior to use, material from different sources shall be stockpiled separately from each other.

212.07.02 Owner's Properties

Unless otherwise specified, material shall not be supplied from the Owner's properties.

212.07.03 Clearing, Grubbing, and Stripping

Borrow sources shall be cleared, grubbed, and stripped of any unsuitable materials. These operations shall be completed a minimum of 3 Working Days in advance of any excavation where cross-sections are required.

Stripped material shall be piled sufficiently back from the face of the pit or quarry to prevent the contamination of the face material. The stripped material shall be piled such that the distance from the face being worked to the stripped material shall be:

a) For pits, at least equal to the depth of the face or 5 m, whichever is the greater distance.

b) For quarries, at least 5 m.

212.07.04 Haul Roads

Inspection of all haul roads prior to construction use shall be undertaken jointly by the Contract Administrator, the Contractor, and the owner of the haul road.

All required restoration work shall be performed when haul roads are damaged due to hauling operations.

Acceptable material shall be chosen and properly placed on the haul road to:

a) Provide safe passage and control of traffic at all times; and

b) Repair that road to the pre-contract condition upon completion of the hauling operations both to the satisfaction of the Contract Administrator and the owner of the road.

212.07.05 Borrow Source Rehabilitation

The borrow source shall be rehabilitated to comply with all applicable federal, provincial, and municipal requirements.

212.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

212.08 QUALITY ASSURANCE

212.08.01 General

The Contract Administrator reserves the right to visually inspect borrow and reject any borrow material that does not meet the requirements specified herein and elsewhere in the Contract Documents.

All samples shall be obtained and delivered to the QA laboratory according to the Contract Documents. The data to be included with all samples shall be according to the requirements of the MTO form PH-D-10.

212.08.02 Acceptance of Earth Borrow

At the discretion of the Owner, the Quality Assurance (QA) laboratory designated by the Owner may carry out QA testing for the purposes of ensuring that earth borrow being placed above the frost penetration depth in the areas listed in the General subsection of the Construction section is not frost-susceptible.

For earth borrow material being placed within the frost penetration depth in the areas specified above, lots may be established at the discretion of the Contract Administrator, in accordance with the schedule shown in Table 1. In addition, any single lot or series of lots may be terminated and a new lot or series of lots re-established, at the discretion of the Contract Administrator.

A minimum of one randomly-obtained duplicate sample shall be obtained from each lot. Additional samples may also be taken at the discretion of the Contract Administrator. In the event that the Contractor is unavailable to take a designated sample for a lot, then no further earth materials from that lot shall be placed above the frost penetration depth until the designated sample is taken.

The Contract Administrator shall document and seal each sample container according to the Contract Documents.

For each duplicate sample, one sample shall be tested for QA purposes and the remaining sample shall be retained for referee testing, if necessary.

If a sample is found to contain more than 50% of its particles by mass between 5 and 75 μm when tested in accordance with LS-702, the Contract Administrator shall then notify the Contractor, in writing, within 2 Business Days of receiving the results, that any material within that lot represented by that sample including any material already within the Work or in stockpiles is frost susceptible and not acceptable for use above the frost penetration depth, wherever specified in the Contract Documents.

In addition, any of the material within that lot which has already been placed within the areas listed in the General subsection of the Construction section shall be removed at no additional cost to the Owner.

212.08.02.01 Referee Testing

The Contractor may invoke referee testing for any lot by submitting a written request to the Contract Administrator within 2 Business Days following notification from the Contract Administrator that the sampled material has been determined to be frost-susceptible.

The retained duplicate QA sample shall be used for referee testing. However, if a referee sample is not available, the Contractor shall then be responsible for obtaining a new sample from a location to be decided on by the Contract Administrator, at no additional cost to the Owner.

Referee testing shall be carried out, as specified herein and elsewhere in the Contract Documents.

All referee test results for a lot shall replace the respective QA tests for acceptance of the applicable lot and the referee results shall be binding on both the Owner and the Contractor.

212.09 MEASUREMENT FOR PAYMENT

212.09.01 Actual Measurement

212.09.01.01 Earth Borrow

Measurement of earth borrow shall be by volume in compacted cubic metres, excluding the volume of any boulders that cannot be accommodated in the Work.

Earth borrow shall be measured at the Contract site using the method of average end areas and surveyed cross-sections taken both prior to and after the placement of the material in the Work.

However, for borrow quantities that are less than 1,000 m^3, in areas where surveying may be impractical such as where borrow is being placed in areas of standing water, or where materials that are not designated as borrow are being placed and compacted in the same area and at the same time as borrow, then the truck box method may be used, at the discretion of the Contract Administrator.

In this case, each truck carrying borrow shall be readily-identifiable and the loose volume that it contains shall be calculated based on an estimated percentage of the truck box capacity which has been pre-determined from measurements taken by the Contract Administrator. The Contract Administrator shall then determine the compacted in-place volume of the borrow by dividing the estimated volume of the material within the truck box by an appropriate bulking factor determined by the Owner.

212.10 BASIS OF PAYMENT

212.10.01 Earth Borrow - 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.

Removal and replacement of localized soft spots identified by the Contract Administrator or removal of unacceptable material or both shall be at no additional cost to the Owner.

The Owner shall be responsible for the cost of referee testing, provided that the referee test results show that the material meets the applicable specifications. Otherwise, the Contractor shall be responsible for the costs.

212.10.02 Haul Roads

Payment at the Contract price for the appropriate tender items used to perform maintenance and restoration of haul roads shall be full compensation for all labour, Equipment, and Material to maintain and restore haul roads.

When the Contract does not include the appropriate tender items, prices shall be negotiated.

212.10.03 Access Roads

No separate or additional payment shall be made for the cost of construction and maintenance of access roads.

TABLE 1
Lot Schedule for Sampling and Testing Earth Borrow
Placed Above the Frost Penetration Depth

Expected Quantity from Each Source m^3	**Lot Size**
< 10,000	One lot
> 10,000 (Note 1)	10,000 m^3 lots up to 50,000 m^3 and 50,000 m^3 lots thereafter

Notes:

1. When the quantity of borrow is insufficient for a complete lot and is:

   a) less than one-half the quantity of a complete lot, then that quantity shall be added to the previous lot; or

   b) greater than or equal to one-half the quantity of a complete lot, then that quantity shall form its own lot.

Appendix 212-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

EARTH BORROW - Item No

Special Provision No. 212F01 January 2014

Amendment to OPSS 212, November 2013

212.05 MATERIALS

212.05.01 Earth Borrow

Subsection 212.05.01 of OPSS 212 is amended by the addition of the following clause:

212.05.01.01 Fly Ash

Fly ash materials shall be accepted as earth borrow.

Ontario Power Generation shall be contacted to arrange acquisition of the fly ash material from the following source(s):

* Designer Fill-in – See Notes to Designer

212.07 CONSTRUCTION

212.07.01 General

Subsection 212.07.01 of OPSS 212 is amended by the addition of the following clause:

212.07.01.01 Earth Borrow with Fly Ash

Fly ash shall be placed according to earth borrow construction requirements and the following:

a) Fly ash shall not be mixed with earth material.

b) Fly ash shall be placed on a drainage bed constructed to the full width of the embankment and to a depth of ** Designer Fill-in – See Notes to Designer

c) The drainage bed shall be constructed of the following material:
*** Designer Fill-in – See Notes to Designer

d) Fly ash shall be covered with a minimum cover of earth of **** Designer Fill-in – See Notes to Designer

212.10 BASIS OF PAYMENT

212.10.01 Earth Borrow - Item

Subsection 212.10.01 of OPSS 212 is amended by the addition of the following:

Granular material used to construct a drainage bed under fly ash shall be paid for at the Contract price for the appropriate granular item.

NOTES TO DESIGNER:

Designer Fill-ins:

* Identify the source of fly ash.
** Identify depth of drainage bed.
*** Identify material for drainage bed. (Usually an appropriate product tendered in the contract and as recommended by Geotechnical).
**** Identify depth of earth cover.

WARRANT: For use with this tender item on contracts within 50 km of a fly ash source.

CONSTRUCTION SPECIFICATION FOR WICK DRAIN INSTALLATION

TABLE OF CONTENTS

220.01 SCOPE

This specification covers the requirements for the supply and installation of wick drains, including granular blanket.

220.01.01 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.

220.01.02 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.

220.02 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 206	Grading
OPSS 501	Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

Canadian General Standards Board (CGSB)

CAN/CGSB 148.1 No.10-94	Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size

ASTM International

D 638-10	Standard Test Method for Tensile Properties of Plastics
D 3776/D 3776M-09ae2	Standard Test Methods for Mass per Unit Area (Weight) of Fabric
D 4491-99a(2009)	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
D 4533-11	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
D 4632-08	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
D 4716-08	Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
D 4833-07	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
D 5199-12	Standard Test Method for Measuring the Nominal Thickness of Geosynthetics

220.03 DEFINITIONS

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

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in accordance with the requirements of the Contract Documents.

Geotechnical Instrumentation means equipment used to monitor the progress of settlement, displacement, and pore water pressure measurements and includes such equipment as piezometers, settlement cells, standpipes, settlement profilers, inclinometers, and settlement rods.

Granular Blanket means a layer of free draining granular material used to provide drainage of excess pore pressures due to soil consolidation.

Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

Recognized Specialist Subcontractor means a subcontractor retained by the Contractor that has proven satisfactory experience in work of this type and magnitude and has completed a minimum of five wick drain installation projects in the last five years.

220.04 DESIGN AND SUBMISSION REQUIREMENTS

220.04.01 Submission Requirements

220.04.01.01 Qualifications

Prior to the commencement of the Work, the qualifications of the recognized specialist subcontractor shall be submitted to the Contract Administrator.

At least one month prior to commencing the installation of wick drains, the qualifications of the QVE undertaking the certification of the work shall be submitted to the Contract Administrator.

220.04.01.02 Materials

At least 3 weeks prior to the installation of wick drains, the Contractor shall submit to the Contract Administrator the following:

a) A minimum one metre sample of the wick drain.

b) The manufacturer's technical specifications indicating that the materials meet the requirements shown in Table 1.

c) A certificate for each production lot supplied indicating that the wick drain supplied was produced and tested according to the requirements shown in Table 1.

The Contractor shall have test results available for the aggregates to be used in the work. At the request of the Contract Administrator, the Contractor shall make available or submit quality control test results. When more than one aggregate source is used for supplying material, test data from each source shall be submitted separately.

220.04.01.03 Installation Procedures

At least 3 weeks prior to the installation of wick drains, the Contractor shall submit to the Contract Administrator the details of the sequence and method of installation outlining the following:

a) Size, type, weight, maximum pushing force, and configuration of the installation rig.

b) Dimensions of the mandrel to be used.

c) Details of wick drain anchorage.

d) Detailed description of proposed installation procedures.

e) Alternative methods for overcoming obstructions.

f) Methods for splicing wick drains.

220.04.01.04 Certificates of Conformance

The following certificates of conformance shall be signed and sealed by the QVE and shall be submitted to the Contract Administrator:

a) At least 3 weeks prior to the installation of wick drains, a certificate of conformance stating that the equipment, materials, and procedures are capable of achieving successful wick drain installation according to the requirements of the Contract Documents.

b) Upon completion of the wick drain installation and prior to the placement of any overlying material, a final certificate of conformance stating that the work has been carried out according to the submitted installation procedures and the requirements of the Contract Documents.

220.05 MATERIALS

220.05.01 Wick Drains

Wick drains shall be prefabricated and shall consist of a continuous plastic drainage core wrapped in a non-woven geotextile. The geotextile, core, and composite wick drain shall meet the requirements shown in Table 1.

All wick drains shall be free of defects, rips, holes, and flaws.

220.05.02 Granular Blanket

The granular blanket shall be Granular B, Type I, Type II, or Type III, according to OPSS 1010, except that 100% shall pass the 37.5 mm sieve.

220.06 EQUIPMENT

The equipment used to install wick drains shall be of the type that minimizes the disturbance to the drainage blanket or the native subsoil during the installation operation.

Falling weight impact hammers shall not be permitted.

220.07 CONSTRUCTION

220.07.01 Operational Constraints

When a site is designated as an environmentally sensitive area, jetting techniques shall not be permitted.

Wick drains shall be installed subsequent to the construction of the granular blanket and prior to the installation of monitoring instruments and placement of any overlying material. Wick drains shall be protected by a minimum of 2 m of earth fill or 4 m of rock fill before the ground freezes. Wick drains shall not be installed in frozen ground.

Installation of the wick drains shall be coordinated with the placement of geotechnical instrumentation as specified in the Contract Documents. Wick drains shall be installed in a manner that does not disturb geotechnical instrumentation already in place. Geotechnical instrumentation damaged as a result of Contractor's activities shall be replaced by the Contractor.

220.07.02 Transportation and Storage

During transportation and storage, the wick drain materials shall be protected from damage.

The storage area shall be so that the wick drain materials are protected from sunlight, dirt, dust, mud, debris, and all other detrimental substances.

220.07.03 Granular Blanket

The granular blanket shall be placed subsequent to the excavation of unsuitable material and any backfilling specified in the Contract Documents.

The granular blanket shall be placed and compacted to the limits and grades specified in the Contract Documents.

The granular blanket shall be placed according to the earth embankment requirements of OPSS 206 and compacted to a minimum 90% of its maximum dry density measured according to OPSS 501.

When the granular blanket is placed under water, it shall be placed by end dumping.

220.07.04 Trial Wick Drains

Prior to the installation of wick drains within the areas designated in the Contract Documents, the Contractor shall demonstrate that the proposed materials, equipment, and installation method produce a satisfactory wick drain installation in accordance with these specifications. The Contractor shall install a minimum of 10 trial wick drains at permanent installation locations designated by the Contractor Administrator.

Provided the trial wick drains are installed to the satisfaction of the Contract Administrator, they shall be incorporated as part of the permanent installation.

The QVE shall monitor the wick drain installation on a full-time basis. If at any time the QVE considers that the method of installation does not produce a wick drain that satisfies the contract requirements, the method or equipment or both, as necessary, shall be altered to comply with the requirements of the Contract Documents.

220.07.05 Installation

220.07.05.01 General

Wick drains shall be installed to the depths specified in the Contract Documents.

Wick drains shall be installed using a mandrel advanced through the granular blanket and the underlying soil. The mandrel shall protect the wick drain material from damage during installation and shall be withdrawn after the installation of the wick drain. The mandrel shall be provided with an anchor plate to prevent soil from entering the bottom of the mandrel during installation and to anchor the bottom of the wick drain at the required depth at the time of mandrel removal. The projected cross-sectional area of the mandrel and anchor combination shall not exceed 7,700 mm^2.

Augering or vibratory equipment may be used within the granular blanket and underlying soils to facilitate the installation of wick drains. The use of augering or vibratory equipment shall not extend more than 1 m into the soil to be consolidated.

220.07.05.02 Layout

Wick drains shall be located and staked out by the Contractor. The spacing of the wick drains shall not vary more than 150 mm from the spacing specified in the Contract Documents.

220.07.05.03 Vertical Alignment

Wick drains shall be installed vertically, within a tolerance of not more than 10 mm per 500 mm. The Contractor shall maintain a suitable method of verifying the vertical alignment of the mandrel and of determining the depth of the wick drain at all times.

220.07.05.04 Splices

Splices in the wick drain shall be made so as to ensure continuity and to prevent reduction in the wick drain discharge capacity. Splices shall be a minimum of 150 mm in length.

220.07.05.05 Cut-Off

The wick drain shall be cut at the surface of the granular blanket so that at least a 150 mm length protrudes above the top of the granular blanket at each wick drain location.

220.07.05.06 Obstructions

Where obstructions are encountered below the working surface that cannot be penetrated by the wick drain installation equipment, the Contractor shall complete the wick drain from the elevation of the obstruction to the working surface and notify the Contract Administrator. At the direction of the Contract Administrator, the Contractor shall attempt to install a new wick drain within a 500 mm radius of the obstructed wick drain. A maximum of two attempts shall be made as directed by the Contract Administrator.

220.07.06 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

220.08 QUALITY ASSURANCE

220.08.01 Certificate

Certificates for each production lot indicating that the wick drain supplied was produced and tested according to the requirements of this specification shall be provided by the manufacturer for all wick drains delivered to the Contract.

220.08.02 Rejected Drains

Wick drains that are damaged or that do not meet the requirements of this specification shall be rejected and replaced. Replacement wick drains shall be installed within a 500 mm radius from the location of the rejected wick drain, as directed by the Contract Administrator.

220.09 MEASUREMENT FOR PAYMENT

220.09.01 Actual Measurement

220.09.01.01 Wick Drains

Measurement shall be by length in metres for all accepted wick drains, including the protruding portion up to 150 mm per installation.

Properly installed obstructed wick drains and replacement wick drains shall be measured for payment.

220.09.02 Plan Quantity Measurement

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

220.10 BASIS OF PAYMENT

220.10.01 Wick Drains - 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.

Geotechnical instrumentation damaged as a result of the Contractor's activities shall be replaced at no additional cost to the Owner.

Payment shall not be made for rejected wick drains or delays or expenses incurred by the Contractor as a result of improper or unacceptable material or installation.

All labour, Equipment and Material required for the granular blanket shall be paid for with the appropriate road base or subbase item, Granular B Type I, Granular B Type II, Granular B Type III, as specified.

TABLE 1
Wick Drain Property Requirements

Component	Property		Test Method	Unit	Requirement
Core	Physical	Material	--	--	Polypropylene, Studded or Grooved
		Thickness	ASTM D 5199	mm	≥ 2
		Mass	ASTM D 3776	g/m	≥ 40
	Mechanical	Tensile Strength	ASTM D 638	N	≥ 800
Geotextile	Physical	Material	--	--	Polypropylene, Non-Woven
		Mass	ASTM D 5261	g/m^2	≥ 110
	Mechanical	Grab Tensile Strength	ASTM D 4632	N	≥ 600
		Puncture Strength	ASTM D 4833	N	≥ 200
		Trapezoidal Tear	ASTM D 4533	N	≥ 250
		Filtration Opening Size (FOS)	CAN/CGSB 148.1, Method No. 10	µm	≥ 40
		Permittivity	ASTM D 4491	s^{-1}	≥ 0.5
Composite Wick Drain	Physical	Width	--	mm	≥ 100
		Thickness	ASTM D 5199	mm	≥ 3
	Mechanical	Discharge Capacity @ 10 kPa	ASTM D 4716	m^3/s	≥ 1.2×10^{-4}
		Discharge Capacity @ 240 kPa	ASTM D 4716	m^3/s	≥ 1.0×10^{-4}

Appendix 220-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

AMENDMENT TO OPSS 220, NOVEMBER 2014

Special Provision No. 102S07 March 2018

220.03 DEFINITIONS

Section 220.03 of OPSS 220 is amended by the deletion of the definitions for **Certificate of Conformance** and **Quality Verification Engineer**.

220.04 DESIGN AND SUBMISSION REQUIREMENTS

220.04.01 Submission Requirements

220.04.01.01 Qualifications

Clause 220.04.01.01 of OPSS 220 is deleted in its entirety and replaced with the following:

Prior to the commencement of the Work, the qualifications of the recognized specialist subcontractor shall be submitted to the Contract Administrator.

220.04.01.04 Certificates of Conformance

Clause 220.04.01.04 of OPSS 220 is deleted in its entirety.

220.07 CONSTRUCTION

220.07.04 Trial Wick Drains

Subsection 220.07.04 of OPSS 220 is deleted in its entirety and replaced with the following:

Prior to the installation of wick drains within the areas designated in the Contract Documents, the Contractor's Engineer shall demonstrate that the proposed materials, equipment, and installation method produce a satisfactory wick drain installation in accordance with these specifications. The Contractor's Engineer shall install a minimum of 10 trial wick drains at permanent installation locations designated by the Contractor.

Provided the trial wick drains are installed to the satisfaction of the Contract Administrator, they shall be incorporated as part of the permanent installation.

The Contractor's Engineer shall monitor the wick drain installation on a full-time basis. If at any time the Contractor's Engineer considers that the method of installation does not produce a wick drain that satisfies the Contract requirements, the method or equipment or both, as necessary, shall be altered to comply with the requirements of the Contract Documents.

Section 220.07 of OPSS 220 is amended by the addition of the following subsection:

220.07.07 Inspection after Wick Drain Installation

A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the wick drain installation and prior to the placement of any overlying material.

WARRANT: Always with OPSS 220, Construction Specification for Wick Drain Installation.

CONSTRUCTION SPECIFICATION FOR UNTREATED SUBBASE, BASE, SURFACE, SHOULDER, SELECTED SUBGRADE, AND STOCKPILING

TABLE OF CONTENTS

314.01 SCOPE

This specification covers the requirements for the construction of Subbase, Base, roadway surface, Shoulder, and edge ramping for bituminous pavements, selected subgrade and stockpiling at specified sites.

314.01.01 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.

314.01.02 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.

314.02 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 201	Clearing, Close Cut Clearing, Grubbing, and Removal of Surface and Piled Boulders
OPSS 350	Concrete Pavement and Concrete Base
OPSS 501	Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1001	Aggregates - General
OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

314.03 DEFINITIONS

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

Selected Subgrade means a granular material meeting the requirements of Select Subgrade Material (SSM), as specified in OPSS 1010, which is used to replace unsuitable native soils or raise the existing grade or both, in order to meet the final subgrade grading requirements, specified in the Contract Documents.

Tolerance means a construction working tolerance only that is considered to be:

a) Minus when it is:

   i. narrower than the Contract standard when pertaining to horizontal dimensions as measured from centreline, or
   ii. lower in elevation than the Contract standard when pertaining to vertical dimensions.

b) Plus when it is:

   i. wider than the Contract standard when pertaining to horizontal dimensions as measured from centreline, or
   ii. higher in elevation than the Contract standard when pertaining to vertical dimensions.

314.05 MATERIALS

314.05.01 Aggregates

Aggregates used for Base, Subbase and selected subgrade applications shall be according to OPSS 1010.

314.05.02 Water

Water shall be free of any contaminants that could adversely affect the environment or the placement and compaction of materials for Base, Subbase and selected subgrade applications.

314.06 EQUIPMENT

314.06.01 Water

Equipment used for applying water to granular materials in order to meet compaction requirements for Base, Subbase and selected subgrade applications shall be equipped with variable flow control to uniformly and completely wet the material without causing the material to be eroded away. The equipment operator shall also have the capability to monitor and change the flow while the equipment is moving.

314.07 CONSTRUCTION

314.07.01 Subbase, Base, Surface, and Selected Subgrade

All materials shall be kept free from clay and other types of deleterious material. Construction operations shall not disturb underlying work.

All materials shall be placed in uniform lifts without segregation.

Except as provided under the Modified Layer Compaction Method clause:

a) Granular B, Type II shall be placed in accordance with the compaction methods specified in the Granular B, Type II clause such that the thickness of the compacted layer is not greater than 150 mm.

b) All other materials shall be placed such that the thickness of the compacted layer is not greater than 150 mm.

In all cases, each lift shall be bladed to a smooth surface according to the required cross-section and maintained until placement of a subsequent lift, when applicable.

Prior to closing down operations for each Day, the Subbase material shall be bladed and compacted and, if necessary, covered with sufficient Base material to carry traffic.

The Base shall be maintained to the tolerances in grade and cross-section and to the specified density until Contract Completion or, if the Contract includes paving, until the Base surface is paved.

314.07.02 Winter Grading

Any areas where materials used for Subbase, Base, selected subgrade or other fill applications are being placed shall be free of ice and snow. Frozen material shall not be incorporated into the Work. Materials used for Subbase, Base, selected subgrade or other fill applications shall not be placed over frozen ground. However, one lift of material may be placed over frozen ground, as long as the final grading and compaction of that lift is done after the underlying material has thawed.

314.07.03 Edge Ramping of Bituminous Pavement

A ramp of the specified material shall be built along the outside edges of each bituminous pavement construction course. Such ramps shall be at a height level with the pavement course and fall away from its edge at a slope not steeper than 4H:1V. Care shall be taken to prevent any ramping material from being spilled or pushed onto the pavement. Any material that is spilled shall be removed immediately without damage to the pavement and the surface thoroughly cleaned with the use of a power broom or other suitable means.

Prior to paving any section, only sufficient material to construct the ramps shall be placed on the Shoulders. No other Shoulder material shall be placed until the conditions, as detailed in the Shoulders subsection, have been attained.

Edge ramps shall be completed prior to opening adjacent pavement to traffic.

314.07.04 Shoulders

Material used for shouldering shall be placed and compacted at locations and to the line, grade, and cross-section specified in the Contract Documents.

Prior to commencing Shoulder construction, all debris and deleterious material shall be removed from the Shoulder area.

Shouldering operations shall commence as soon as, but not before, the following pavement conditions are met:

a) Bituminous Pavements

Placement of material for shouldering operations shall not commence along any section of pavement, until at least 6 hours have elapsed from the time of completion of the final bituminous pavement course in that section. In addition, for pavement sections that are already open to traffic, all shouldering operations shall be completed within 24 hours of their commencement. In all cases where a pavement section is not yet open to traffic, the shouldering shall be completed prior to opening that pavement section to traffic.

b) Concrete Pavement and Concrete Base

Shouldering operations shall commence according to OPSS 350. Shouldering shall be completed prior to opening the concrete base or concrete pavement to traffic.

All Shoulder construction material shall be conveyed from the transport vehicle onto the Shoulder area. End dumping of Shoulder construction material directly on to the adjacent pavement surface or directly on to the Shoulder shall not be permitted. The material shall be uniformly distributed within the specified Shoulder limits without segregation. Grading and shaping operations shall confine all material to within the specified Shoulder limits without overspill.

Any Shoulder construction material deposited, dragged, or inadvertently placed on the pavement surface shall be removed immediately and the pavement surface shall be thoroughly cleaned with the use of a power broom or other suitable means.

314.07.05 Compaction

314.07.05.01 General

Each lift of material shall be compacted as specified below prior to the placement of the next lift.

The rate of placing material shall be controlled by the adequacy of the compaction obtained.

314.07.05.02 Compaction Requirements

314.07.05.02.01 Granular B, Type II

Material shall not be dumped into position, but shall be deposited on and pushed over the end of the lift being constructed by means of bulldozers or other approved equipment.

The placement of the first lift of material over wet or weak subgrade shall be monitored and the placement and compaction procedure modified as required, with the approval of the Contract Administrator, to minimize subgrade disturbance. Localized, unusually wet or weak subgrade areas shall be identified to the Contract Administrator for possible treatment.

In restricted zones, as specified in OPSS 501, Granular B, Type II shall be compacted using hand-operated vibratory equipment with a minimum operating mass of 400 kg and a maximum power output between 5.0 and 9.9 kW. Where confined areas are less than the minimum width and where such equipment can be used safely, then smaller vibratory hand-operated tampers shall be used. One hundred percent compaction coverage with a minimum of four passes shall be provided in all cases.

In non-restricted zones, Granular B, Type II shall be compacted using single drum, vibratory, smooth steel drum rollers, with a minimum operating mass of 5,000 kilograms and minimum operating dynamic force of 75 kN. One hundred percent roller pass coverage with a minimum number of four passes shall be provided. Each roller pass shall overlap the coverage of the preceding pass by a minimum of 0.5 m.

314.07.05.02.02 All Other Granular Materials

The compaction requirements shall be according to OPSS 501.

314.07.05.03 Modified Layer Compaction Method

Material may be placed in layers thicker than permitted under the Subbase, Base, Surface, and selected subgrade subsection, subject to the following provisions:

a) All materials, with the exception of Granular B, Type II shall be placed in uniform layers such that each layer shall have a depth of not more than 300 mm after compaction.

b) Granular B, Type II shall be placed in uniform layers with a compacted depth not to exceed the values shown in Table 1 for various sizes of single drum, vibratory, smooth wheel drum rollers. Both the minimum operating mass and the minimum operating dynamic force requirements shown in Table 1 shall be met for the roller used. One hundred percent roller pass coverage with a minimum number of four passes shall be provided. Each roller pass shall overlap the coverage of the preceding pass by a minimum of 0.5 m.

c) Prior to placing material in layers as described in a) or b) above depending on the type of granular material used, the ability of the proposed method to achieve satisfactory compaction shall be demonstrated to the satisfaction of the Contract Administrator by means of a two-lane trial area. The trial area location shall be approved by the Contract Administrator. At least 48 hours prior to any work commencing on the trial area, full details of the proposed placing and compacting system or systems, including the rate of placing, depth of layer, number and type of compaction units, and number of passes shall be submitted to the Contract Administrator. The areas designated to evaluate each system shall be of sufficient length to be representative of the proposed method and shall normally be approximately 150 m in length. Approval will follow within one Business Day after satisfactory completion of the compaction trial area.

d) When the Contract Administrator, approves a system of placing and compacting, the system shall be used for the remainder of the work to which it is applicable, except that:

   i. Should it be necessary at any time to change the system or any part of it, including the source of material or the rate of placing the material, approval to change the system shall be obtained from the Contract Administrator, who may require a further trial area.
   ii. If, at any time, tests show that a previously-approved system is no longer producing the required degree of compaction, changes shall be made as necessary to satisfy the requirements of this specification.

314.07.06 Tolerances

The surface of the uppermost layer of granular material and each granular course shall be bladed, shaped, and compacted to produce the grade and cross-section specified in the Contract Documents, within the tolerances shown in Table 2.

In the event of a conflict between meeting horizontal grading tolerances and meeting vertical grading tolerances, the vertical grading tolerances shall take precedence.

314.07.07 Stockpiling of Granular Material

Sites for stockpile construction, specified in the Contract Documents, shall be cleared and grubbed, regardless of stockpile height, according to OPSS 201. Organic soil underlying the stockpile location shall be removed and the site cleaned up prior to stockpile construction. Stockpiles shall be constructed, including the supply and placement of a pad upon which the materials are to be stockpiled, according to OPSS 1001.

314.07.08 Grade Checks

The Contract Administrator shall be notified within 12 hours when each Subbase or Base course has been completed, including Shoulders, and prior to the next course being placed.

The Contractor shall be responsible for carrying out all grade checks to ensure that horizontal and vertical grading tolerances are met.

Grade checks shall be carried out on all finished granular surfaces. Grade checks of granular grading surfaces shall be based on horizontal and vertical grading tolerances, as specified in the Tolerances subsection. The grade shall be certified at the stations and offsets shown in the grading templates, or when grading templates are not available, at the frequency requirements shown for the layout specified elsewhere in the Contract Documents.

314.07.09 Submission of Grade Checks

All grade checks concerning 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.

When grading templates are available, the Contractor shall sign and certify on the grading template that the components of the work indicated on that template have been correctly constructed to the specified line and grade tolerances. If a template is not available, then the Contractor shall complete, sign, and submit MTO form PH-CC-820 to the Contract Administrator.

314.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

314.08 QUALITY ASSURANCE

314.08.01 General

The Owner may conduct random QA grade checks to verify that the grade and cross-section are within the specified tolerances.

314.08.02 Acceptance

If the Contract Administrator chooses not to take QA grade checks or if the QA grade checks conform to those determined by the Contractor, the work shall then be accepted.

However, if any discrepancies between the QA and the Contractor's grade checks are found, then, at the discretion of the Owner, additional QA grade checks may be carried out in any other location.

If the finished grade or cross-section or both are not within the tolerances specified in the Tolerances subsection, then:

a) The Contract Administrator shall notify the Contractor and advise where the tolerances have not been met, including overbuilding of the width of a granular course.

b) The Contractor shall be charged for each station where the tolerances have not been met, at the rate specified in the Basis of Payment section.

c) The Contractor shall bring the granular surface to within the specified tolerances for grade, at no additional cost to the Owner.

314.09 MEASUREMENT FOR PAYMENT

314.09.01 Actual Measurement

314.09.01.01 Granular A, B Type I, B Type II, B Type III, M and O
Granular A, B Type I, B Type II, B Type III, M, and O Stockpiled
Granular A, B Type I, B Type II, B Type III, M, and O from Stockpile
Select Subgrade Material, Compacted

314.09.01.01.01 Tonne

When payment is by the tonne:

a) When the Contractor supplies Granular A and M composed of air-cooled iron blast-furnace slag or nickel slag, the payment quantities shall be determined by applying the following factors:

   i. The total measured mass of air-cooled iron blast-furnace slag incorporated into the work shall be multiplied by a factor of 1.116.
   ii. The total measured mass of nickel slag incorporated into the work shall be multiplied by a factor of 0.85.

b) When Granular B is composed of slag, the payment quantities shall be determined by comparing the density of the material to the average density of granular material as set by the Owner for that specific area and applying the conversion factors that have been determined to the weighed tonnes.

c) When granular material is composed of slag, it is necessary to determine the amount of overrun or underrun. Such overrun and underrun shall be the difference between the tender quantity and the payment quantity as determined by applying the foregoing factors to the weighed tonnes.

314.09.01.01.02 Cubic Metre

When payment is by cubic metre, one of the following methods shall be used as determined by the Contract Administrator:

a) End Area Method

   i. At Source

   The volume of material shall be measured at the source in its original location and computed in cubic metres by the method of average end areas.

   Cross-sections shall be taken after the source has been cleared, grubbed, and stripped of all unsuitable surface material.

   The volume of boulders removed from borrow pits that cannot be accommodated in embankments or any other areas acceptable to the Owner, shall be deducted.

   ii. In Place

   When the measurement for payment of material in its original location is impractical, the measurement for payment shall be made of material measured in place with no allowance for shrinkage and computed in cubic metres by the method of average end areas.

b) Truck Box Method

The truck box method shall only be used when the Contract Administrator deems that the quantities are too small or the end area method is impractical for other reasons.

In this case, measurement for payment shall be based on the total volume in cubic metres of loose granular material, calculated by the Contract Administrator, from estimated percentages of the pre-determined capacity of each truck box determined from measurements of its dimensions.

Each truck that the Contractor intends to use shall be uniquely and readily identifiable to the satisfaction of the Contract Administrator.

314.09.01.01.03 Square Metre

When payment is by square metre, the area shall be based on that shown in the Contract Documents.

314.09.02 Plan Quantity Measurement

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

314.10 BASIS OF PAYMENT

314.10.01

Granular A - Item
Granular A, Stockpiled - Item
Granular A, from Stockpile - Item

Granular B Type I - Item
Granular B Type I, Stockpiled - Item
Granular B Type I, from Stockpile - Item

Granular B Type II - Item
Granular B Type II, Stockpiled - Item
Granular B Type II, from Stockpile - Item

Granular B Type III - Item
Granular B Type III, Stockpiled - Item
Granular B Type III, from Stockpile - Item

Granular M - Item
Granular M, Stockpiled - Item
Granular M, from Stockpile - Item

Granular O - Item
Granular O, Stockpiled - Item
Granular O, from Stockpile - Item

Select Subgrade Material, Compacted - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

As specified in the Acceptance subsection, $250.00 shall be deducted from payment for each station where the QA grade check of the finished grade is found to be outside of the specification limit.

Any additional grading carried out to correct grades that are not within the tolerances specified in the Tolerances subsection shall be carried out at no additional cost to the Owner.

Where a finished granular course exceeds the horizontal tolerances specified in the Tolerances subsection and the material outside that tolerance has been left in place, the Owner shall deduct from payment the theoretical quantity of material placed outside of that tolerance, based on a conversion factor of 2.0 t/m^3, regardless of the type of granular material used.

TABLE 1
Modified Layer Compaction Thickness for Granular B, Type II
Single Drum, Vibratory, Smooth Wheel Drum Roller

Minimum Operating Mass kg	Minimum Operating Dynamic Force kN	Maximum Layer Depth After Compaction mm
5,000	75	300
8,000	150	450
12,000	250	600
15,000	350	750

TABLE 2
Allowable Tolerances for Finished Granular Surfaces

Tolerances From Specified Grade and Cross - Section	Finished Granular Courses mm	Finished Granular Surfaces Immediately Beneath Bituminous Courses, Sidewalks, and Curb and Gutter mm		Finished Granular Surfaces Immediately Beneath Concrete Courses, Sidewalks, and Curb and Gutter mm
		When the Finished Grade is Controlled by Fixed Components Such as Existing Pavements and Curbs	All Others	
Vertical	+ 30 - 30	+ 10 - 10	+ 30 - 30	+ 10 - 10
Horizontal	+ 30 - 0	+ 10 - 0	+ 30 - 0	+ 10 - 0
Surface Deviation (Note 1)	15	10		10

Notes:

1. The maximum gap between a granular surface and the underside of a 3 m rigid metal straightedge, placed anywhere and in any direction on that surface.

Appendix 314-A, November 2015
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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

AMENDMENT TO OPSS 314, NOVEMBER 2015

Special Provision No. 103S05 August 2019

314.02 REFERENCES

Section 314.02 of OPSS 314 is amended by the addition of the following:

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

314.07 CONSTRUCTION

314.07.02 Winter Grading

Clause 314.07.02 of OPSS 314 is deleted in its entirety and replaced with the following:

Any areas where materials used for Subbase, Base, selected subgrade or other fill applications are being placed shall be free of ice and snow. Frozen material shall not be incorporated into the Work. Materials used for Subbase, Base, selected subgrade or other fill applications shall not be placed over frozen ground.

314.07.04 Shoulders

Subsection 314.07.04 of OPSS 314 is amended by the addition of the following to the fourth paragraph:

The material shall be placed in lifts not greater than 300 mm in thickness prior to compaction.

314.07.05 Compaction

314.07.05.02 Compaction Requirements

314.07.05.02.01 Granular B, Type II

Clause 314.07.05.02.01 of OPSS 314 is deleted in its entirety and replaced with the following:

Granular B Type II shall be placed and compacted at a moisture content which is no more than 0.5 % above and no more than 1.5% below its optimum moisture content according to LS-706.

The material shall not be dumped into position but shall be deposited on and pushed over the end of the lift being constructed by means of bulldozers or other equipment approved by the Contract Administrator.

The placement of the first lift of material over wet or weak subgrade shall be monitored and the placement and compaction procedure modified as required, with the approval of the Contract Administrator, to minimize subgrade disturbance. Localized, unusually wet or weak subgrade areas shall be identified to the Contract Administrator for possible treatment.

In restricted zones as specified in OPSS 501, Granular B, Type II shall be compacted using hand-operated vibratory equipment with a minimum operating mass of 400 kg and a maximum power output between 5.0

and 9.9 kW. Where confined areas are less than the minimum width and where such equipment cannot be used safely, then smaller vibratory hand-operated tampers shall be used. One hundred percent compaction coverage with a minimum of four passes shall be provided in all cases.

In non-restricted zones, Granular B, Type II shall be compacted using single drum, vibratory, smooth steel drum rollers, with a minimum operating mass of 5,000 kilograms and minimum operating dynamic force of 75 kN. One hundred percent roller pass coverage with a minimum number of four passes shall be provided. Each roller pass shall overlap the coverage of the preceding pass by a minimum of 0.5 m.

Regardless of the minimum number of passes being specified, additional passes may be required, at the discretion of the Contract Administrator.

Clause 314.07.05.02 of OPSS 314 is amended by the addition of the following clauses:

314.07.05.02.03 Shoulders

Where granular material is being placed around guiderail and sign posts at the shoulders, it shall be compacted using hand-operated vibratory equipment according to OPSS 501.

314.07.05.02.03.01 Lift Thicknesses Less than 100 mm

If the lift thickness for grade correction at the shoulders is less than 100 mm, compaction testing using a nuclear gauge may be waived at the discretion of the Contract Administrator.

Where compaction testing using a nuclear gauge is waived, the granular material being used shall be placed and compacted at a moisture content which is no more than 0.5 % above and no more than 1.5% below its optimum moisture content according to LS-706.

Where the shoulder is wide enough, the granular material shall be compacted using a single drum, vibratory, smooth steel drum roller, with a minimum operating mass of 5,000 kilograms and a minimum operating dynamic force of 75 kN. Where narrower shoulders prevent such equipment from being effectively used, the granular material shall be compacted using hand-operated vibratory compaction equipment with a minimum operating mass of 400 kg and a maximum power output between 5.0 and 9.9 kW.

In either case, wherever compaction testing using a nuclear gauge is waived, a minimum of four passes shall be completed and where possible, each pass shall overlap the coverage of the preceding pass by a minimum of 0.5 m.

Regardless of the minimum number of passes being specified, additional passes may be required, at the discretion of the Contract Administrator.

WARRANT: Always with OPSS 314, Construction Specification for Untreated Subbase, Base, Surface, Shoulder, Selected Subgrade, and Stockpiling.

RAP SHOULDERING - Item No.

Special Provision No. 314S02 January 2020

Amendment to OPSS 314, November 2015

314.02 REFERENCES

Section 314.02 of OPSS 314 is amended by the addition of the following:

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-282 Method of Test for Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures.

314.05 MATERIALS

Section 314.05 of OPSS 314 is amended by the addition of the following subsection:

314.05.03 RAP Shouldering

RAP obtained from Contract milling operations may be used for shouldering, as long as the RAP, at the time of use, has:

a) 100% by mass passing the 26.5 mm sieve and no more than 75% by mass passing the 4.75 mm sieve; and

b) No visible contamination, as determined by the Contract Administrator.

RAP obtained from any other sources will not be acceptable for shouldering without written consent from the Owner.

314.07 CONSTRUCTION

314.07.04 Shoulders

Clause 314.07.04 of OPSS 314 is amended by the addition of the following clause:

314.07.04.01 RAP Shouldering

RAP shouldering shall be according to and at the locations specified in the Contract Documents.

314.07.05 Compaction

314.07.05.02 Compaction Requirements

Clause 314.07.05.02 of OPSS 314 is amended by the addition of the following clause:

314.07.05.02.04 RAP Shouldering

314.07.05.02.04.01 Compaction Acceptance Based on LS-706

Where 100% RAP is being placed for shouldering, RAP shall be compacted, according to OPSS 501, with the following changes and clarifications:

1. The RAP shall be considered to be a granular material;

2. All lots shall be no more than 500 m long and have 4 sublots;

3. Target densities shall be established, based on LS-706, according to the last paragraph of the Target Density clause in OPSS 501; and

4. The moisture content readings obtained from a nuclear gauge shall be adjusted by deducting the AC- bias of the gauge for the purpose of calculating the field dry density. The AC-bias of the gauge shall be determined, at the start of the compaction work for the Contract, using the difference between the average moisture content readings measured using the nuclear gauge, at a minimum of 6 random locations and the field moisture content of samples of the RAP taken at the same locations. The moisture content of the RAP samples shall be determined according to the Determination of Moisture Content section of LS-282. A new AC-bias shall be generated whenever a different nuclear gauge is employed for the compaction work carried out on the Contract.

314.07.05.02.04.02 Compaction Acceptance Based on Specified Compaction Methods

Compaction acceptance, as described in the Compaction Acceptance Based on LS-706 clause, given above, may be waived at Regional discretion.

In this case, the RAP shouldering shall be placed and compacted at a moisture content which is no less than 2% lower than and no more than 1.0% greater than its optimum moisture content, as determined according to LS-706 and the Determination of Moisture Content section of LS-282 for the moisture content of the RAP. However, if the moisture content of the compacted RAP is being measured using a nuclear gauge, then those measurements must be adjusted for the AC-bias of the gauge, as described in part 4 of the list given in the Compaction Acceptance Based on LS-706 clause given above.

Where the shoulder is wide enough, the RAP shouldering shall be compacted using a single drum, vibratory, smooth steel drum roller, with a minimum operating mass of 5,000 kilograms and a minimum operating dynamic force of 75 kN. Where narrower shoulders or guide rails prevent such equipment from being effectively used, then the RAP shall be compacted using hand-operated or excavator-mounted vibratory compaction equipment. Hand-operated equipment shall have a minimum operating mass of 400 kg and a maximum power output between 5.0 and 9.9 kW.

In all cases, a minimum of four passes shall be completed and where possible, each pass shall overlap the coverage of the preceding pass by a minimum of 0.5 m.

Regardless of the minimum number of passes being specified, additional passes may be required, at the discretion of the Contract Administrator.

314.09 MEASUREMENT FOR PAYMENT

314.09.01 Actual Measurement

Clause 314.09.01.01 of OPSS 314 is amended by the addition of the following:

314.09.01.01 RAP Shouldering

314.10 BASIS OF PAYMENT

Subsection 314.10.01 of OPSS 314 is amended by the addition of the following:

314.10.01 RAP Shouldering - Item

WARRANT: Always with this tender item.

CONSTRUCTION SPECIFICATION FOR FULL DEPTH RECLAMATION WITH EXPANDED ASPHALT STABILIZATION

TABLE OF CONTENTS

331.01 SCOPE

This specification covers the requirements for in-place full-depth reclamation of the existing hot mix asphalt (HMA) pavement and underlying granular base; shaping and compacting the unstabilized material; if required, adding and blending corrective aggregates or active filler or both; adding and mixing expanded asphalt; and shaping and compacting the expanded asphalt mix.

331.01.01 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.

331.01.02 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.

331.02 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 301	Restoring Unpaved Roadway Surfaces
OPSS 313	Hot Mix Asphalt - End Result
OPSS 501	Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1010	Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1101	Performance Graded Asphalt Cement
OPSS 1301	Cementing Materials

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-200	Penetration of Bituminous Materials
LS-282	Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-297	Determination of Indirect Tensile Strength of Expanded Asphalt Mixes
LS-602	Sieve Analysis of Aggregates
LS-625	Sampling of Granular Materials
SP-027	Manual for Assessment of Surface Defects of In-Place Recycled Pavement Mats

Ontario Traffic Manual (OTM):
OTM Book 7 - Temporary Conditions

American Association of State Highway and Transportation Officials (AASHTO)

T40-02 Sampling Bituminous Materials

Wirtgen GmbH Publication

Wirtgen Cold Recycling Technology manual, 1st edition, 2012

331.03 DEFINITIONS

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

Active Filler means substances that chemically alter the mix properties.

Corrective Aggregate means virgin aggregate or reclaimed asphalt pavement (RAP) or both added to the reclaimed materials to meet the expanded asphalt mix requirements.

Expanded Asphalt means heated asphalt cement expanded from its normal volume by the addition of water.

Expanded Asphalt Mix (EAM) means the mixture of reclaimed materials; corrective aggregate or active filler or both, if required; and expanded asphalt.

Expanded Asphalt Mix (EAM) Mat means a pavement course which comprises Expanded Asphalt Mix.

Hot Mix Asphalt (HMA) means as defined in OPSS 313

Performance Graded Asphalt Cement (PGAC) means as defined in OPSS 313.

Quality Assurance (QA) means as defined in OPSS 313.

Reclaimed Asphalt Pavement (RAP) means as defined in OPSS 313.

Reclaimed Material means the mixture of reclaimed existing asphalt pavement and granular base.

Unstabilized Material means the mixture of reclaimed existing asphalt pavement and granular base; and corrective aggregate or active filler or both, if required.

331.04 DESIGN AND SUBMISSION REQUIREMENTS

331.04.01 Design Requirements

For mix design purposes, prior to commencing the work the Contractor shall obtain samples representative of the material that is produced during in-place full-depth reclamation. These samples shall be used to establish the design rate of expanded asphalt as a per cent by mass of the unstabilized material and to establish the necessity for corrective aggregate and/or active filler. The dry tensile strength shall be a minimum of 225 kPa and the wet tensile strength shall be a minimum of 100 kPa.

For bidding purpose only, the design rate of the expanded asphalt shall be as specified in the Contract Documents.

The mix design shall be carried out according to the Wirtgen Cold Recycling Technology manual using briquettes produced according to LS-297. The mix design shall be completed by a laboratory with Canadian Council of Independent Laboratories (CCIL) Type A certification or equivalent equipped to carry out expanded asphalt mix designs. When the existing pavement significantly changes composition, a separate mix design shall be completed.

Each mix design shall include the following:

a) Information on the grade, manufacturer, and supplier of the PGAC.

b) The percent by mass of expanded asphalt in the mix, referred to as the design rate, and all calculations performed to determine the design rate of expanded asphalt.

c) The recommended PGAC temperature for foaming, the half-life, the expansion ratio and the percent of water added for foaming.

d) The optimum moisture content and the mix design bulk relative density.

e) The dry tensile strength, the wet tensile strength, and the tensile strength ratio.

f) The amount of water to be added to the mix.

g) Maximum field rate adjustment allowed to the design rate without adverse effects to mix properties.

h) Recovered penetration for the binder of the existing pavement according to LS-200.

i) Type, source, gradation and quantity of corrective aggregate, if required.

j) Type, source and quantity of active filler, if required.

331.04.02 Submission Requirements

A copy of the mix design shall be submitted to the Contract Administrator a minimum of 7 Business Days prior to the start of EAM operations. Within 4 Business Days after receiving the mix design, the Contract Administrator shall provide written confirmation of receipt of the submitted mix design documents or of any non-conformance to the contract requirements.

Confirmation of receipt of the mix design documents does not constitute any guarantee that the mix can be produced or constructed or both to Contract requirements, and does not relieve the Contractor of the responsibility for ensuring the specified quality of Materials and workmanship.

A new mix design shall be submitted when the expanded asphalt design rate is adjusted by 0.3% or greater. Separate or new mix designs shall be submitted if the composition or layer thicknesses of the existing pavement changes significantly. Where more than one mix design is required, the area for which each mix design is to be used shall be clearly identified.

331.05 MATERIALS

331.05.01 Performance Graded Asphalt Cement

PGAC shall be according to OPSS 1101. The Additional Testing Requirements and Acceptance Criteria for PG Grades table shall not apply. PGAC shall be selected with performance properties meeting the design maximum pavement temperature of 52 °C and the minimum pavement temperature of -28 °C at a minimum, and the selected PGAC shall have suitable expansion characteristics.

331.05.02 Corrective Aggregates

If required by the mix design, corrective aggregate shall be incorporated into the reclaimed material at the application rate determined in the mix design. Corrective aggregate shall meet the physical property requirements of OPSS 1010 for Granular A.

331.05.03 Active Filler

If required by the mix design, active filler shall be incorporated into the reclaimed material at the application rate determined in the mix design.

When used as active filler, Portland cement shall be according to OPSS 1301. Not more than 1% by mass of Portland cement shall be added to the mix.

331.05.04 Water

Water shall be clean and free from oil, acid, alkali, organic matter or other deleterious substances.

331.05.05 Expanded Asphalt Mix

The EAM shall be 100% passing the 37.5 mm sieve, and 95% to 100% passing the 26.5 mm sieve, and shall be measured based on air dried gradation according to coarse sieving operation of LS-602.

331.06 EQUIPMENT

331.06.01 Full-Depth Reclamation and Stabilization Equipment

The reclaimer-stabilizer shall be capable of reclaiming the existing asphalt pavement and underlying granular base to the depths specified in the Contract Documents, incorporating corrective aggregate or active filler or both into the mix, adding expanded asphalt in a controlled manner, and producing a uniform mix.

The reclaimer-stabilizer shall be fitted with an automatic sensor system to accurately maintain a preset depth of cut within a tolerance of 10 mm and shall have a minimum 2.0 m wide cutting drum.

The reclaimer-stabilizer shall have an asphalt cement expansion system capable of producing optimum expansion and an injection system capable of injecting and blending expanded asphalt uniformly throughout the unstabilized material. In order to mix the unstabilized material with the expanded asphalt, the reclaimer-stabilizer shall include the following features:

a) A system to control and regulate the application of expanded asphalt in relation to travel speed and mass of material within a tolerance of ± 3.0% by volume of asphalt cement.

b) A system to monitor and control all aspects of the mixing process, including percent expanded asphalt, rate of application, and percent water for optimum compaction.

c) A system of nozzles that provides uniform application of the expanded asphalt across the full width of treatment. The application system shall be adjustable for varying widths of treatment.

The aggregate delivery vehicle shall have a system for controlled application of the corrective aggregate.

331.06.02 Placing Equipment

A mechanical paver capable of spreading the mix evenly in front of the screed in one continuous pass to the specified cross-fall and grade shall be used to place the EAM. The paver shall be equipped with distributing augers for the full width to be paved. The paver shall have a vibratory screed capable of vibrating the full width of mix placed.

331.06.03 Pilot Vehicle

The pilot vehicle used to control traffic shall be according to OTM, Book 7.

331.07 CONSTRUCTION

331.07.01 Operational Constraints

In-place full depth reclamation including mixing, shaping and compacting to final grade shall be completed across the full pavement width prior to closing down operations each day.

The existing shoulders shall be shaped and compacted to match the adjacent lane prior to closing down operations each day.

Expanded asphalt stabilization shall not proceed during periods of rain or when the surface is in a saturated condition.

Traffic, including construction traffic, shall be kept off the freshly placed EAM until such time as it is able to carry traffic without damage. The Contractor shall be responsible for repair of damaged EAM.

The HMA course(s) shall not be placed on the EAM until the following requirements have been met:

a) The EAM has been allowed to cure for a minimum of 3 Days.

b) It has been demonstrated that the EAM meets all the requirements of this specification.

c) All defective areas in the EAM have been repaired to the satisfaction of the Contract Administrator.

331.07.02 In-Place Full-Depth Reclamation

The existing asphalt pavement and underlying granular base shall be reclaimed to the depths and widths specified in the Contract Documents.

The graded surface of the reclaimed material, including existing shoulders shall be according to the surface tolerance requirements of OPSS 301. Reclaimed material exceeding 50 mm in size shall be removed from the work. The material shall be compacted according to OPSS 501.

331.07.03 Expanded Asphalt Trial Section

Prior to carrying out expanded asphalt stabilization, the Contractor shall demonstrate to the Contract Administrator the ability to successfully carry out expanded asphalt stabilization according to this specification by placing a trial section within the Contract limits.

In lieu of a trial section, the Contract Administrator may accept evidence that the Contractor has demonstrated the ability to successfully mix, handle, place, and compact EAM with the same equipment, placing crew, and methodology to meet the Contract requirements for placing EAM on another Contract within the last 12 months.

The trial section shall be a minimum of 3,500 m² or the equivalent of one tanker load of asphalt cement. The Contractor shall propose the location of the trial section to the Contract Administrator for approval. A minimum of 48 hours notice shall be given to the Contract Administrator prior to placing the trial section.

The Contract Administrator shall allow the Contractor to continue the expanded asphalt stabilization work based on an acceptable visual assessment of the trial section according to the requirements of the Grading and Compacting the Expanded Asphalt Mix subsection. When EAM is rejected by visual assessment, the Contractor shall repeat additional trial sections until the EAM meets the requirements of the Surface Appearance subsection.

The Contractor shall be responsible for the repair, removal, or replacement of an unacceptable trial section according to the Repairing and Re-Evaluating subsection.

331.07.04 Expanded Asphalt Stabilization

Expanded asphalt stabilization shall be to the depth and limits detailed in the Contract Documents. The overlap between successive passes of the reclaimer-stabilizer shall be a minimum of 100 mm and a maximum of 150 mm.

If required, corrective aggregate or active filler or both shall be added to the roadway prior to stabilizing.

In areas that are inaccessible to the reclaimer-stabilizer equipment, existing asphalt pavement shall be removed and replaced with a minimum 100 mm of binder course hot mix placed flush with the adjacent EAM surface.

331.07.05 Compacting the Expanded Asphalt Mix

The surface of the EAM shall be uniform in texture and free of surface defects.

Granular material shall be compacted according to OPSS 501.

The compacted surface of the EAM shall be according to the surface tolerances as specified in this specification.

331.07.06 Traffic Control with Moving Vehicles

Traffic shall be controlled with moving vehicles according to OTM, Book 7.

The moving vehicles shall guide one-way traffic through or around construction. The maximum speed of the moving vehicles shall be 30 km/h. Traffic control with moving vehicles shall be maintained until such time as the expanded asphalt stabilization is able to carry traffic without damage.

331.08 QUALITY ASSURANCE

331.08.01 General

Acceptance of the EAM shall be based on the following criteria:

a) Surface Appearance

b) Asphalt Cement Content

c) Tensile Strength of EAM

d) Thickness

e) Surface Tolerance

f) Compaction

g) EAM Gradation

h) Corrective Aggregates, if required.

Work that does not meet the acceptance criteria shall be repaired according to the Repairing and Re-Evaluating subsection.

331.08.02 Sampling

331.08.02.01 Lot Size

A lot size shall be a maximum of 50,000 m² of expanded asphalt stabilization divided into 10 sublots of equal size. The lot size may be adjusted at the discretion of the Contract Administrator and after discussion with the Contractor, prior to starting the work and when changes occur in the mix design or in the sequence of expanded asphalt stabilization. The maximum sublot size shall be 5,000 m². The minimum number of sublots in a lot shall be three.

331.08.02.02 Performance Graded Asphalt Cement

Samples of PGAC to be used in the mix shall be taken from the storage tank at the terminal according to the Tank Tap Method specified in AASHTO T40-02 and the terminal's health and safety plan in the presence of the Contract Administration at a frequency of three sets of samples per Contract for PGAC providing to three different lots. Each set of samples shall be a minimum of 2 full one-litre portions. The Contractor's health and safety plan and procedure for sampling shall be reviewed at the pre-pave meeting.

Sample containers supplied by the Contractor shall be triple tight steel containers or suitable containers that can be sealed to prevent leakage or contamination.

331.08.02.03 Corrective Aggregate

Where the quantity of corrective aggregate is greater than 5,000 tonnes, two 25 kg samples shall be taken in the presence of the Contract Administrator for each 25,000 tonnes of material produced, and whenever material is produced from a new source or new bench in a quarry, or whenever a significant change in production of materials occurs.

QA samples shall be taken in accordance with procedures given in LS-625 and at the time and location determined by the Contract Administrator.

331.08.02.05 Expanded Asphalt Mix

For the purpose of accepting the asphalt cement content, samples of unstabilized material and EAM shall be taken at a minimum frequency of one set of samples per sublot. To obtain a set of samples, one 15 kg sample of unstabilized material shall be obtained immediately following in-place full depth reclamation and, from the same approximate location, a second 15 kg sample of EAM immediately following stabilization. The maximum sampling depth shall be 100 mm. The second sample may be obtained after placement and prior to compaction.

For the purpose of determining the EAM gradation, another 30 kg sample of EAM shall be taken from each of three randomly selected sublots for every lot.

The samples shall be packaged in non-absorptive materials to protect sample integrity and sealed in waterproof containers. The samples shall be transported in a manner that avoids stacking and extreme temperatures.

331.08.03 Acceptance Criteria

331.08.03.01 Surface Appearance

Surface appearance shall be assessed by the Contract Administrator based on SP-027 manual after the EAM mat has been opened to traffic. The finished EAM surface shall have a uniformly smooth texture and be free from surface defects of ravelling, deformation, flushing, and rutting prior to placement of the HMA overlay.

331.08.03.02 Asphalt Cement Content

For each sublot, the sample of unstabilized material taken immediately following in-place full depth reclamation and the sample of EAM taken immediately after stabilization, shall be tested for total asphalt cement content according to LS-282. The total asphalt cement content of the EAM includes existing aged asphalt cement and new asphalt cement. The per cent by mass of new asphalt cement added to the unstabilized material shall be determined from the two samples at each location by subtracting the total asphalt cement content of the unstabilized material from the total asphalt cement content of the EAM.

The average new asphalt cement content of a lot shall not be less than 0.4% or more than 0.6% of the established mix design.

331.08.03.03 Tensile Strength

Samples of EAM shall also be tested for dry tensile strength and wet tensile strength according to LS-297.

Dry tensile strength requirements for the lot are met when the following are satisfied:

a) The mean dry tensile strength of the lot is equal to or greater than 225 kPa; and

b) No individual sublot dry tensile strength is less than 200 kPa.

Wet tensile strength requirements for the lot are met when the following are satisfied:

a) The mean wet tensile strength of the lot is equal to or greater than 100 kPa; and

b) No individual sublot wet tensile strength is less than 75 kPa.

EAM that does not meet the above dry tensile strength and wet tensile strength requirements shall be deemed rejectable.

331.08.03.04 Thickness

Thickness of the EAM shall be measured by the Contract Administrator at a minimum frequency of one thickness measurement per sublot. Measurements shall be taken by excavating along the edge of the stabilized pass with a shovel and measuring the depth of stabilization from the bottom of the EAM to the surface of the adjacent unstabilized material. Thickness requirements for the lot are met when the following are satisfied:

a) At least 90% of all thickness measurements are equal to or greater than the specified thickness minus 20 mm, and

b) No individual thickness measurement for the lot is less than the specified thickness minus 30 mm.

331.08.03.05 Surface Tolerance

The surface tolerance of any EAM surface shall be such that when tested with a 3 m straight edge placed anywhere on the EAM surface, including the edge of the EAM, in any direction on the surface, there shall not be a gap between the bottom of the straight edge and the surface of the EAM greater than 10 mm according to OPSS 301.

331.08.03.06 Compaction

Compaction measurements shall be taken by the Contract Administrator according to OPSS 501 for granular materials and at a minimum frequency of one QA measurement per sublot. Compaction requirements of the EAM placed for the lot are met when the following are satisfied:

a) The lot average of all compaction measurements is greater than or equal to 97% of the target density; and

b) No individual compaction measurement for the sublot is less than 95% of the target density.

331.08.03.07 Expanded Asphalt Mix Gradation

If the EAM does not meet the gradation requirements, the Contractor shall submit an action plan of mediation to the Contract Administrator for approval within 2 Business Days after the delivery of the QA testing results.

331.08.03.08 Corrective Aggregate

QA testing shall be carried out to ensure that corrective aggregate to be used in the work is according to the physical property requirements of Granular A according to OPSS 1010.

331.08.04 Repairing and Re-Evaluating

331.08.04.01 General

With the exception of repairs for surface tolerance, the minimum width of repair shall be the full lane width.

For repairs due to the surface appearance defects, the minimum repair length shall be sufficient for the repair to be carried out by the reclaimer-stabilizer equipment. For other repairs based on the lot and sublot acceptance, the minimum length shall be according to the Repairing and Re-Evaluating clause of OPSS 313. All repairs shall be made using the same equipment as was used during initial production and placement.

All repairs will be re-evaluated and retested according to Acceptance Criteria subsection.

331.08.04.02 Surface Appearance

Unacceptable EAM due to the surface appearance defects, including any area damaged or contaminated by traffic, by water added by Contractors during compaction, or by nature, shall be reprocessed by the reclaimer-stabilizer. If required, additional expanded asphalt shall be added during reprocessing.

Alternatively, the Contractor shall remove and replace damaged or otherwise unacceptable EAM with the same hot mix type to be used in the overlying hot mix lift to a minimum depth of 50 mm according to OPSS 313.

331.08.04.03 Asphalt Cement Content

For sublots with insufficient asphalt cement content, the EAM mat shall be reprocessed by the reclaimer-stabilizer with addition of asphalt cement during reprocessing. For sublots with excessive asphalt cement content, the EAM mat shall be reprocessed by the reclaimer-stabilizer with addition of corrective aggregates during reprocessing. The unacceptable sublots are repaired until the corresponding lot mean is within the acceptance tolerance.

331.08.04.04 Tensile Strength

The rejectable sublots shall be reprocessed by the reclaimer-stabilizer, if required, with addition of asphalt cement during reprocessing until the corresponding lot mean is above the acceptance criterion. Alternatively, the EAM mat shall be removed to a minimum depth of 50 mm and replaced by an appropriate HMA approved by the Contract Administrator.

331.08.04.05 Thickness

For sublots with insufficient thickness, the Contractor shall determine the limits of the unacceptance EAM based on additional measurement. The pavement segments with insufficient thickness shall be overlaid with binder course or surface course with additional thickness so as to compensate for the insufficient thickness as found in EAM layer.

331.08.04.06 Surface Tolerance

To meet the specified surface tolerance, all deficient areas shall be re-profiled by milling or padded with the same hot mix type to be used in the overlying hot mix lift.

331.08.04.07 Compaction

Mixes that cannot be compacted to the specified density shall be removed to a minimum depth of 50 mm and replaced by HMA approved by the Contract Administrator.

331.09 MEASUREMENT FOR PAYMENT

331.09.01 Actual Measurement

331.09.01.01 Full-Depth Reclamation with Expanded Asphalt Stabilization

Measurement of full-depth reclamation with expanded asphalt stabilization shall be by horizontal area in square metres.

331.09.02 Plan Quantity Measurement

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

331.10 BASIS OF PAYMENT

331.10.01 Full-Depth Reclamation with Expanded Asphalt Stabilization - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

The addition of corrective aggregate, active filler or other additives, including any expanded asphalt that is required due to the additives, shall be at no extra cost to the Owner.

HMA required to replace unacceptable EAM shall be at no extra cost to the Owner.

PGAC shall be included in the Full-Depth Reclamation with Expanded Asphalt Stabilization item.

Repair of unacceptable EAM shall be carried out at no extra cost to the Owner.

The additional expanded asphalt, if required, added during reprocessing of unacceptable EAM shall be carried out at no extra cost to the Owner.

Repair of areas of EAM damaged by traffic shall be completed at no extra cost to the Owner.

Repair, removal, or replacement of an unacceptable trial section shall be completed at no extra cost to the Owner.

Appendix 331-A, November 2015
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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

FULL-DEPTH RECLAMATION WITH EXPANDED ASPHALT STABILIZATION - Item No.

Special Provision No. 331F02 September 2022

Amendment to OPSS 331, November 2015

331.02 REFERENCES

Section 331.02 of OPSS 331 is amended by the deletion of the following:

Ministry of Transportation Publications:
LS-200 Penetration of Bituminous Materials

American Association of State Highway and Transportation Officials (AASHTO):
T 40-02 Sampling Bituminous Materials

Wirtgen GmbH Publication:
Wirtgen Cold Recycling Technology manual, 1st edition, 2012

Section 331.02 of OPSS 331 is amended with the addition of the following:

Ministry of Transportation Publications:
LS-806 Practice for Mix Design of Full-Depth Reclamation Mixtures with Expanded Asphalt

American Association of State Highway and Transportation Officials (AASHTO):
R 66-16 Sampling of Asphalt Materials

ASTM Publications:
D5/D5M-20 Standard Test Method for Penetration of Bituminous Materials
D2041/D241M-19 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures

331.04 DESIGN AND SUBMISSION REQUIREMENTS

331.04.01 Design Requirement

The first paragraph of Subsection 331.04.01 of OPSS 331 is amended by deleting the last sentence in its entirety and replacing it with the following:

The dry tensile strength shall be a minimum of 225 kPa and the tensile strength ratio shall be a minimum of 50%.

The third paragraph of Subsection 331.04.01 of OPSS 331 is amended by deleting the first sentence in its entirety and replacing it with the following:

The mix design shall be carried out according to the LS-806.

The last paragraph of Subsection 331.04.01 of OPSS 331 is amended by deleting point d) and h) in its entirety and replacing it with the following:

d) The optimum moisture content, the mix design bulk relative density, and the air void for the EAM. Air void shall be according to ASTM D2041, Supplemental Procedure for Asphalt Mixtures Containing Porous Aggregate.

h) Recovered penetration for the binder of the existing pavement according to ASTM D5M.

Subsection 331.04.01 of OPSS 331 is amended by the addition of the following:

The design rate of the expanded asphalt shall be as specified in Table 1, which is for bidding purpose only. The Contractor shall prepare a mix design to determine the design rate for the Contract.

Table 1
Design Rate of the Expanded Asphalt at Various Locations

Location in Contract	Pulverizing Depth (mm)	Average Depth of HMA Layer (mm)	Foaming Depth (mm)	Design Rate of the Expanded Asphalt (%)

[* Designer Fill-Ins for Table 1, See Notes to Designer]

331.05 MATERIALS

331.05.01 Performance Graded Asphalt Cement

The second sentence of Subsection 331.05.01 of OPSS 331 is deleted in its entirety and replaced with the following:

The Additional Testing Requirements and Categories for PGAC table in OPSS 1101 shall not apply.

331.05.03 Active Filler

The second paragraph of Subsection 331.05.03 of OPSS 331 is deleted in its entirety and replaced with the following:

When any of the strength requirements as specified in Section 331.04.01 is not met, active filler such as Portland cement, hydrated lime, and/or quick lime can be considered to be added into the EAM. Portland cement shall be according to OPSS 1301. The maximum cement content to added asphalt content ratio shall be 1:2.5 or the maximum quantity of Portland cement is limited to 1.5 % by dry mass of the combined RAP and granular materials, whichever is less.

When the plasticity index of the EAM is less than 10, the maximum quantity of hydrated lime, or quick lime is limited to 1.5 % by dry mass of the combined RAP and granular materials. When the plasticity index is larger than 10, the EAM shall be pre-treated with an amount of hydrated lime based on the result of the initial consumption of lime (ICL) test as per LS-806.

331.05.05 Expanded Asphalt Mix

Subsection 331.05.05 of OPSS 331 is deleted in its entirety and replaced with the following:

331.05.05 Reclaimed Material

The gradation requirement for reclaimed material shall be 100% passing the 37.5 mm sieve, and 95% to 100% passing the 26.5 mm sieve. The gradation shall be measured based on unextracted washed gradation according to the procedures in LS-602, with full range of gradation sizes provided for information purposes only.

331.06 EQUIPMENT

331.06.03 Pilot Vehicle

Subsection 331.06.03 of OPSS 331 is deleted in its entirety.

331.07 CONSTRUCTION

331.07.04 Expanded Asphalt Stabilization

Subsection 331.07.04 of OPSS 331 is amended with the addition of the following clause:

331.07.04.01 Longitudinal Joints

For achieving continuity and integrity in the paved area, the minimum overlap between two successive lanes in longitudinal joints shall be 150 mm. In addition, the face of the joints shall be inspected between the milling unit and paving unit to make sure it is free of excessive loose material, or any build-up dust generated by the milling machine.

331.07.04.02 Mixing

The expanded asphalt shall be added at the design rate. Expanded asphalt expansion ratio and half-life shall be checked using the test nozzle on the recycling unit or mixer for each load of asphalt delivered to the site, where appropriate. The rate of addition of expanded asphalt shall be field adjusted as required to within 0.30% of the design rate and mixed to produce a uniformly coated mix that can be compacted to the specified density.

331.07.06 Traffic Control with Moving Vehicles

Subsection 331.07.06 of OPSS 331 is deleted in its entirety and replaced with the following:

331.07.06 Traffic Control with Pilot Vehicles

Traffic shall be controlled with pilot vehicles according to OTM, Book 7.

The pilot vehicles shall guide one-way traffic through or around construction. The maximum speed of the moving vehicles shall be 30 km/h. Traffic control with moving vehicles shall be maintained until the EAM mat is able to carry traffic without damage.

331.08 QUALITY ASSURANCE

331.08.01 General

Under subsection 331.08.01, bullet point g) is deleted in its entirety and replaced by the following:

g) Reclaimed Material Gradation.

331.08.02 Sampling

Subsection 331.08.02 of OPSS 331 is amended by the addition of the following clause:

331.08.02.06 Reclaimed Material Gradation

For the purpose of determining the reclaimed material gradation, 30 kg of reclaimed material samples shall be taken from each of five randomly selected sublots for every lot.

331.08.02.02 Performance Graded Asphalt Cement

Clause 331.08.02.02 of OPSS 331 is amended by deleting its first sentence and replaced by the following:

Samples of PGAC to be used in the mix shall be taken from the storage tank at the terminal according to the Tank Tap Method specified in AASHTO R66 and the terminal's health and safety plan in the presence of the Contract Administration at a frequency of three sets of samples per Contract for PGAC providing to three different lots.

331.08.02.05 Expanded Asphalt Mix

Clause 331.08.02.05 of OPSS 331 is amended by deleting its second paragraph.

331.08.03 Acceptance Criteria

331.08.03.03 Tensile Strength

Clause 331.08.03.03 of OPSS 331 is amended by addition of the following clause:

331.08.03.03.01 Referee Testing

A written request may be made to the Contract Administrator for referee testing within 3 Business Days of receiving a rejectable tensile strength test result. Referee testing shall be carried out by a laboratory designated by the Owner from a roster maintained for this purpose.

The referee testing shall be conducted by taken slab samples at random locations within the sublot as directed by the Contract Administrator. The total of six slab sample shall be dry cut 150 mm x 150 mm and removed intact from the EAM mat. The tensile strength test shall follow either the Method A or Method B procedure, as per LS-297.

The results of the referee test shall be used for acceptance determination and shall be binding on both parties. If the referee testing results in rejection of the tensile strength, the referee testing shall be at no addition cost to the Owner. If the referee testing results in the material passing all test criteria, the referee testing charge shall be paid by the Owner.

331.10 BASIS OF PAYMENT

Section 331.10 of OPSS 331 is amended by the addition of the following subsection:

331.10.02 Traffic Control with Pilot Vehicles

Traffic control with pilot vehicles shall be included under the Temporary Traffic Control Signs item.

NOTES TO DESIGNER:

* Designer Fill-Ins for Table 1

In the first column, insert the location of EAM with various pulverizing depths, foaming depths, and design rate of the expanded asphalt. This could be a highway number, or a particular feature of the contract, such as chainage.

In the second column, insert the pulverizing depth, i.e., the total reclaimed depth.

In the third column, insert the average thickness of the HMA layer for the location.

In the fourth column, insert the proposed foaming depth, i.e., the depth to which expanded asphalt is added.

In the fifth column, insert the design rate of the expanded asphalt according to the design rate of the pre-engineering mix design as prepared by the Owner, or calculated by the formula as defined in the Contract Design, Estimating and Documentation (CDED) manual.

WARRANT: Always with this tender item.

FULL-DEPTH RECLAMATION WITH EXPANDED ASPHALT STABILIZATION - Item No.

Special Provision No. 331S03 April 2021

Amendment to OPSS 331, November 2015 - Reduced Tensile Strength Requirement for Low Volume Road

331.01 SCOPE

Section 331.01 of OPSS 331 is amended by the addition of the following:

This also includes the reduced tensile strength requirements for the design and testing of expanded asphalt mix (EAM) for low volume roads where the design life equivalent single axle load (ESAL) is less than one million.

331.04 DESIGN AND SUBMISSION REQUIREMENTS

331.04.01 Design Requirements

The last sentence of the first paragraph of Subsection 331.04.01 of OPSS 331 is deleted in its entirety and replacing by the following:

The dry tensile strength shall be a minimum of 175 kPa and the tensile strength ratio shall be a minimum of 50%.

331.08 QUALITY ASSURANCE

331.08.03 Acceptance Criteria

331.08.03.03 Tensile Strength

Clause 331.08.03.03 of OPSS 331 is deleted in its entirety and replaced by the following:

Samples of EAM shall be tested for acceptance purposes according to LS-297.

Dry tensile strength requirements for the lot are met when the following are satisfied:

a) The mean dry tensile strength of the lot is equal to or greater than 175 kPa; and

b) no individual sublot dry tensile strength is less than 150 kPa.

Wet tensile strength requirements for the lot are met when the following are satisfied:

a) The mean wet tensile strength of the lot is equal to or greater than 75 kPa; and

b) no individual sublot wet tensile strength is less than 55 kPa.

EAM that does not meet the above dry tensile strength and wet tensile strength requirements shall be deemed rejectable.

WARRANT: With this tender item in consultation with the Regional Geotechnical Section.

CONSTRUCTION SPECIFICATION FOR COLD IN-PLACE RECYCLING

TABLE OF CONTENTS

333.01 SCOPE

This specification covers the requirements for cold in-place recycling of existing hot mix asphalt (HMA) pavement, sizing, adding active filler if required, adding and mixing emulsified asphalt, and spreading and compacting the cold in-place recycled (CIR) mix.

333.01.01 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.

333.01.02 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.

333.02 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 313 Hot Mix Asphalt - End Result

Ontario Provincial Standard Specifications, Material

OPSS 1103 Emulsified Asphalt
OPSS 1301 Cementing Materials

Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-200 Penetration of Bituminous Materials
LS-291 Quantitative Extraction of Asphalt Cement and Mechanical Analysis of Extracted Aggregate from Bituminous Paving Mixtures - Ontario Procedure
LS-300 Preparation of Marshall Specimens for Cold In-Place Recycled Mixtures
LS-306 Bulk Relative Density of Compacted Bituminous Mixtures Using Paraffin Coated Specimens
LS-602 Sieve Analysis of Aggregates

Ontario Traffic Manual (OTM):
OTM Book 7 - Temporary Conditions

SP-027 Manual for Assessment of Surface Defects of In-Place Recycled Pavement Mats

ASTM International

D6752/D 6752M-11 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method

333.03 DEFINITIONS

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

Active Filler means substances added to the reclaimed existing asphalt pavement that chemically alter the mix properties.

Cold In-Place Recycled (CIR) Mix means the in-place mixture of existing reclaimed HMA pavement, emulsified asphalt, and water.

Hot Mix Asphalt (HMA) means as defined in OPSS 313

Quality Assurance (QA) means as defined in OPSS 313.

Reclaimed Asphalt Pavement (RAP) means as defined in OPSS 313.

Target Density means the average bulk relative density for the lot established according to LS-300 by the QA testing laboratory, and used to determine the per cent compaction.

333.04 DESIGN AND SUBMISSION REQUIREMENTS

333.04.01 Design Requirements

For mix design purposes, prior to commencing the work, the Contractor shall obtain samples representative of the material that is produced during the milling operation. These samples shall be used to establish the design rate of emulsified asphalt as a percent by mass of the RAP. The design rate of the emulsified asphalt shall be a minimum of 1.2%.

The mix design shall be completed by a laboratory with Canadian Council of Independent Laboratories (CCIL) Type A certification or equivalent equipped to carry out CIR mix design. Where the existing pavement significantly changes composition, a separate mix design shall be completed.

Each mix design shall include the following:

a) Information on the type, manufacturer, and supplier of the emulsified asphalt.

b) The percent by mass of emulsified asphalt in the CIR, referred to as the design rate, and all calculations performed to determine the design rate of emulsified asphalt.

c) The optimum moisture content and the mix design bulk relative density.

d) The amount of water to be added to the mix.

e) Maximum field rate adjustment allowed to the design rate without adverse effects to the mix properties.

f) Recovered penetration for the binder of the existing pavement according to LS 200.

g) Type, source and quantity of active filler, if required.

333.04.02 Submission Requirements

A copy of the mix design shall be submitted to the Contract Administrator a minimum of 7 Business Days prior to the start of CIR operations. Within 4 Business Days after receiving the mix design, the Contract Administrator shall provide written confirmation of receipt of the submitted mix design documents or of any non-conformance to the contract requirements.

Confirmation of receipt of the mix design documents does not constitute any guarantee that the mix can be produced or constructed or both to Contract requirements, and does not relieve the Contractor of the responsibility for ensuring the specified quality of Materials and workmanship.

A new mix design shall be submitted when the emulsified asphalt design rate is adjusted by greater than 0.20%. Separate or new mix designs shall be submitted if the composition or layer thicknesses of the existing pavement changes significantly. Where more than one mix design is required, the area for which each mix design is to be used shall be clearly identified.

333.05 MATERIALS

333.05.01 Reclaimed Asphalt Pavement

RAP material shall be 100% passing the 37.5 mm sieve, and 95% to 100% passing the 26.5 mm sieve after processing, and shall be measured based on air dried gradation according to the coarse sieving operation of LS-602.

333.05.02 Emulsified Asphalt

Emulsified asphalt shall be polymer modified mixing grade according to OPSS 1103 and be compatible with the process and materials used.

333.05.03 Water

Water shall be clean and free from oil, acid, alkali, organic matter, or other deleterious substances.

333.05.04 Active Filler

When active filler is required, it shall be incorporated into the existing reclaimed asphalt pavement at the application rate specified in the mix design.

When used as active filler, Portland cement shall be according to OPSS 1301. Not more than 1% by mass of Portland cement shall be added to the mix.

333.06 EQUIPMENT

333.06.01 Recycling Train

The recycling train shall include the following:

a) A self-propelled cold milling unit with a cutting drum capable of reclaiming a full lane width of asphalt pavement to the depth specified in the Contract Documents in one pass.

b) A screening and sizing unit capable of processing the RAP.

c) An aggregate feed system that measures and regulates the mass of RAP being added into the mixing unit prior to the addition of the emulsified asphalt. The scale shall be calibrated to the manufacturer's tolerance prior to the start of the work and when requested by the Contract Administrator.

d) An emulsified asphalt control system equipped with a flow meter calibrated in litres per tonne and a total delivery meter calibrated in litres to continuously maintain the required amount of emulsified asphalt added to within 0.2% by mass of the reclaimed material feed.

e) A means of monitoring and controlling the addition of water.

f) A mixing unit capable of producing a uniform and thoroughly blended CIR mix.

333.06.02 Placing Equipment

A mechanical paver capable of spreading the mix evenly in front of the screed in one continuous pass to the specified crossfall and grade shall be used to place the CIR mix. The paver shall be equipped with distributing augers for the full width to be paved. The paver shall have a vibratory screed capable of vibrating the full width of mix placed.

333.06.03 Compaction Equipment

Compaction equipment shall be selected to achieve the required compaction.

333.06.04 Drying Unit

A drying unit specifically designed to provide radiant heat to the CIR mat may be used. Open flame heating shall not be used. The entire heater assembly shall be capable of readily adjusting the intensity of heat on the pavement surface.

333.06.05 Straight Edge

The straight edge shall be 3 m in length, metal, and have a level recessed in its upper edge parallel to the lower edge.

333.06.06 Pilot Vehicle

Pilot vehicles used to control traffic shall be according to OTM, Book 7.

333.07 CONSTRUCTION

333.07.01 General

HMA pavement in areas inaccessible to the reclaiming equipment shall be removed and replaced with acceptable binder course HMA. The HMA shall be placed to the CIR depth specified in the Contract Documents in compacted lift thicknesses between 40 and 75 mm in depth.

The overlap between successive passes of the recycling train shall be a minimum 100 mm.

333.07.02 Operational Constraints

The work shall not be carried out when the ambient temperature is less than 10 °C or when the overnight low is forecast to be less than 2 °C. Cold in-place recycled mix shall not be placed after September 1st without the written approval from the Contract Administrator. The work shall be carried out when the roadway is clean and free of standing water. The work shall not proceed during periods of rain or when the surface is in a saturated condition.

All traffic, including construction traffic, shall be kept off the freshly placed CIR mat until it is able to carry traffic without damage. Any damage to the CIR mat shall be repaired.

The wearing surface shall not be placed on the CIR mat until the following requirements have been met:

a) The CIR mat has been opened to traffic and allowed to cure for a minimum of 14 Days.

b) The specified moisture content has been achieved according to the Acceptance Criteria section.

c) The specified density has been achieved according to the Compaction subsection.

d) All defective areas in the CIR mat have been repaired to the satisfaction of the Contract Administrator.

The wearing surface shall be placed within 30 Days of placing the CIR mat. The 30 Day requirement may be waived by the Contract Administrator if the CIR mix does not meet the requirements of this specification and is subject to repair.

333.07.03 Cold In-Place Recycling Trial Section

Prior to carrying out CIR, the ability to successfully carry out CIR according to this specification shall be demonstrated to the Contract Administrator by placing a trial section within the Contract limits.

In lieu of a trial section, the Contract Administrator may accept evidence that the ability to successfully mix, handle, place, and compact CIR with the same equipment, placing crew, and methodology to meet the Contract requirements for placing CIR has been demonstrated on any Contract within the last 12 months.

The trial section shall be one lane width and 500 m in length. The location of the trial section shall be proposed to the Contract Administrator for approval. A minimum of 48 hours notice shall be given to the Contract Administrator prior to placing the trial section.

The Contract Administrator shall allow the CIR work to continue based on an acceptable visual assessment of the trial according to the requirements of the Surface Appearance subsection. When the CIR is rejected by visual assessment, the trial section shall be repaired or removed and replaced until the CIR meets the requirements of the Surface Appearance subsection.

333.07.04 Surface Preparation

When specified in the Contract Documents, milling prior to CIR work shall be carried out to achieve the specified crossfall and grade.

All deleterious and loose milled material shall be removed from the milled surfaces, and longitudinal and transverse joints after reclaiming operations are completed and before placing CIR mix.

Existing crack sealant shall be removed and disposed of prior to CIR reclaiming operations.

333.07.05 Mixing

The emulsified asphalt shall be added at the design rate. The rate of addition of emulsified asphalt shall be field adjusted as required to within 0.20% of the design rate and mixed to produce a uniformly coated CIR mix that can be compacted to the specified density. The emulsified asphalt added shall not be less than 1.2%.

Water may be added in a controlled manner to facilitate uniform mixing.

333.07.06 Compaction

The CIR mix shall be compacted according to the requirements of the Acceptance Criteria for Compaction subsection.

333.07.07 Surface Appearance

The compacted CIR mat shall be smooth and constructed to the crossfall and grade specified in the Contract Documents. The surface of the CIR mat shall be of uniform texture and free of segregation, raveling, rutting, longitudinal streaks, flushing, fat spots, oil spills, roller marks, and other defects.

333.07.08 Drying

Prior to the placement of the wearing surface, the Contractor may elect to use a drying unit. Overheating or burning of the CIR shall not be allowed.

333.07.09 Traffic Control with Moving Vehicles

Traffic shall be controlled with moving vehicles according to OTM, Book 7.

The moving vehicles shall guide one-way traffic through or around construction. The maximum speed of the moving vehicles shall be 30 km/h. Traffic control with moving vehicles shall be maintained until such time as the CIR mat is able to carry traffic without damage.

333.07.10 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

333.08 QUALITY ASSURANCE

333.08.01 General

Acceptance of the CIR mix shall be based on the following criteria:

a) Surface Appearance

b) Surface Tolerance

c) Moisture Content

d) Compaction

e) RAP Gradation

Work that does not meet the acceptance criteria shall be repaired according to the Repairing and Re-Evaluating subsection.

333.08.02 Sampling

333.08.02.01 Lot Size

The Contract Administrator shall determine the size and location of the lots and sublots after discussion with the Contractor and before CIR production starts. A lot shall typically represent 25,000 m² with 5 equal sublots of 5,000 m² in size.

333.08.02.02 Cold In-Place Recycling Material

Samples of CIR material shall be packaged in non-absorptive materials to protect sample integrity and sealed in waterproof containers. Samples shall be transported in a manner that avoids stacking and extreme temperatures.

333.08.02.02.01 Slabs

At least 4 Business Days prior to the planned overlay of the CIR mat, 2 slab samples of the CIR material shall be obtained from each sublot. The two slab samples shall be located side-by-side and taken at random locations as directed by the Contract Administrator. Each slab sample shall be dry cut 150 mm x 150 mm and removed intact from the CIR mat.

One slab sample shall be used to test for bulk relative density and the other slab sample shall be used to test for moisture content. The result of the moisture content will be used for both the moisture acceptance, and moisture adjustment for compaction calculation according to LS-306.

Additional slab samples for QA acceptance tests shall only be taken after the Contractor has carried out remedial work to improve moisture content and/or compaction in the rejected sublot. The Contractor shall be charged the cost of additional tests.

333.08.02.02.02 Loose Mix Samples

For the purpose of determining the RAP gradation, 30 kg of loose CIR mix samples shall be taken from each of two randomly selected sublots for every lot.

333.08.02.03 Reclaimed Material

At the start of production of each new lot or whenever the existing pavement material significantly changes composition, one 15 kg sample of material reclaimed from the roadway shall be obtained prior to adding emulsion for the purpose of determining the target density for compaction. Samples shall be taken at random locations as directed by the Contract Administrator.

333.08.02.04 Emulsified Asphalt

Samples of emulsified asphalt used in the mix shall be taken at the job site from the tankers according to the Contractor's health and safety plan at a frequency of three sets of samples per Contract randomly taken from three different lots. Each sample shall be taken either from a sampling spigot on the transfer line, if available, or from the end of the transfer line after a minimum of 4,000 kg has been drawn from the tanker. Each set of samples shall be a minimum of 2 full four-litre containers. The Contractor's health and safety plan and procedure for sampling shall be reviewed at the pre-pave meeting.

The sample containers supplied by the Contractor shall be new triple tight epoxy lined pails or suitable leak-proof plastic containers. The sample labels shall be obtained from the Contract Administrator.

333.08.03 Acceptance Criteria

333.08.03.01 Surface Appearance

Surface appearance shall be assessed by the Contract Administrator based on visual surveys after the CIR mat has been opened to traffic. The finished CIR surface shall have a uniformly smooth texture and shall meet the surface appearance requirements of ravelling, segregation and rutting as specified in Table 1 prior to placement of HMA overlay.

333.08.03.02 Surface Tolerance

The surface tolerance of any CIR surface shall be such that when tested with a 3 m straight edge placed anywhere on the CIR surface, except across the crown, and in any direction on the surface, there shall not be a gap between the bottom of the straight edge and the surface of the CIR greater than 6 mm.

333.08.03.03 Moisture Content

The QA laboratory shall test one sample from each sublot to determine the moisture content of CIR mix according to LS-291, and the test result of the moisture content shall be rounded to one decimal place according to LS-100. The test result for each sublot shall be used to compute the lot mean for moisture content of CIR mix.

The moisture content of CIR mix acceptance shall be based on the mean moisture content of the lot and the moisture content of the individual sublots. The lot is acceptable if the lot mean moisture content is equal to or less than 2% with no individual sublot's moisture content greater than 3%. The lot is rejectable if the lot mean moisture content of CIR mix is greater than 3%. Any sublot with its moisture content greater than 3% shall be deemed rejectable.

If the lot mean moisture content of CIR mix is less than 3% and greater than 2%, the Contractor may elect to accept a payment reduction or repair for the lot. The payment reduction shall be calculated according to Table 2. If the Contractor elects to repair the lot in lieu of a payment reduction, the lot shall be repaired according to the Repairing and Re-Evaluating subsection.

333.08.03.04 Compaction

The compaction of the CIR mix shall be calculated for each sublot from the bulk relative density determined from slab samples according to LS-306 or ASTM D-6752, and the target density for the lot as follows:

Compaction = (bulk relative density of slab sample / target density) x 100%

where the target density to be used for acceptance purposes shall be calculated for each lot from material reclaimed from the roadway prior to adding emulsion. The target density shall be established according to LS-300.

Each lot of CIR mix shall be compacted to a minimum mean of 96.0% of the target density established for the mix, with no individual sublot's bulk relative density result falling below 95.0% of the target density. CIR that is not compacted to the required density shall be deemed rejectable.

333.08.03.05 Reclaimed Asphalt Pavement Gradation

If the RAP does not meet the gradation requirements, the Contractor shall submit an action plan of remediation to the Contract Administrator for approval within 2 Business Days after the delivery of the QA testing results.

333.08.04 Repairing and Re-Evaluating

CIR mix that is rejectable based on the Acceptance Criteria subsection shall be repaired according to the requirements specified in Table 1.

Repairs shall be for the full lane width. For repairs due to surface appearance defects, the minimum repair length shall be sufficient for the repair to be carried out by the recycling train, or by the paving equipment, whichever is applicable. For other repairs based on the lot and sublot acceptance, the minimum length shall be according to the Repairing and Re-Evaluating clause of OPSS 313 and to the depth specified in Table 1.

The HMA required to repair unacceptable CIR shall be placed in compacted lift thicknesses between 40 and 75 mm. The HMA mix type and design used for repairs shall be approved by the Contract Administrator and shall meet the acceptance requirements for the HMA specified elsewhere in the Contract Documents.

All repairs will be re-evaluated and retested according to the Acceptance Criteria subsection.

When repairs are made to rejectable sublots or those sublots that the Contractor elects to repair due to the non-conformance of the moisture content requirements, the lot shall be re-evaluated and re-decisioned for payment reduction. The original lot shall be divided into two reconfigured lots in the following way: All acceptable sublots (with moisture content equal to or less than 2%) shall be grouped as one lot and shall receive the full Contract price. The remaining sublots shall be grouped as another lot and shall use the retest results of the repaired sublots to calculate the mean lot moisture content, and shall be accepted either at the full Contract price, or subjected to a payment reduction, or deemed rejectable.

333.09 MEASUREMENT FOR PAYMENT

333.09.01 Actual Measurement

333.09.01.01 Cold In-Place Recycled Mix

Measurement of CIR mix placed shall be by area in square metres.

333.09.02 Plan Quantity Measurement

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

333.10 BASIS OF PAYMENT

333.10.01 Cold In-Place Recycled Mix - 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.

The addition of active filler or other additives to the mix, including any emulsion that is required due to the additives, shall be at no extra cost to the Owner.

HMA required to replace unacceptable CIR material shall be at no extra cost to the Owner.

Emulsified asphalt shall be included in the Cold In-Place Recycled Mix item.

Repair of an unacceptable CIR mat shall be carried out at no extra cost to the Owner.

HMA placed in areas inaccessible to the reclaiming equipment shall be included in the Cold In-Place Recycled Mix item.

Repair of areas of CIR damaged by traffic shall be completed at no extra cost to the Owner.

Repair, removal, or replacement of an unacceptable trial section shall be completed at no extra cost to the Owner.

333.10.02 Payment Reduction for Moisture Content

When test results show that the moisture content payment factor for the lot is less than 1.000 and the Contractor is not required to or does not elect to repair the lot, the payment reduction for the lot shall be as follows:

(1.000 – Payment Factor) x item price x lot quantity

For purposes of payment reduction, the term item price means the Contract price of the applicable tender item.

For purposes of re-decision after repairs, the lot quantity is the area of the reconfigured lot.

TABLE 1
Acceptance Criteria and Repair Requirements for CIR Mix

Acceptance Criteria	Defect Type	Severity / Criteria	Acceptable / Rejectable	Repair Requirements
Surface Appearance	Ravelling/Coarse Aggregate Loss (Note 1)	Very Slight to Slight	Acceptable	No action required.
		Moderate to Severe	Rejectable	Mill 50 mm and replace with an acceptable binder course HMA (Note 2).
		Very Severe	Rejectable	Remove CIR to full depth and replace with an acceptable binder course HMA (Note 2).
	Segregation (Note 1)	Slight to Medium	Acceptable	No action required.
		Severe	Rejectable	Mill 50 mm and replace with an acceptable binder course HMA (Note 2).
	Rutting (Note 1)	Very Slight to Slight	Acceptable	No action required.
		Moderate to Severe	Rejectable	Mill 50 mm and replace with an acceptable binder course HMA (Note 2).
		Very Severe	Rejectable	Remove CIR to full depth and replace with an acceptable binder course HMA (Note 2).
Surface Tolerance	Non-conformance for surface tolerance as per the Surface Tolerance subsection of the Acceptance Criteria.	> 6 mm based on 3 m straight edge measurement	Rejectable	All deficient areas shall be re-profiled by milling or padded with the same hot mix type to be used in the overlying hot mix lift.
Moisture Content	Non-conformance for moisture Content as per the Moisture Content subsection of the Acceptance Criteria.	> 3% for Moisture Content of Lot or Individual Sublot	Rejectable	For rejected sublots, or sublots within the corresponding rejected lot: 1) Use drying unit as specified in the Drying Unit subsection to dry the CIR mat, or 2) Reprocess with a recycling train (Note 2), or 3) Remove CIR material to full depth and replace with an acceptable binder course HMA.
Compaction	Non-conformance for compaction as per the Compaction subsection of the Acceptance Criteria.	< 96% for Compaction of Lot; and < 95% for Compaction of Individual Sublot	Rejectable	For rejected sublots, or sublots within the corresponding rejected lot: 1) Recompact the CIR mat, if required, with reheating process, or 2) Reprocess with a recycling train (Note 2), or 3) Remove CIR material to full depth and replace with an acceptable binder course HMA.

Notes:
1) Defect and severity definitions according to SP-027.
2) Reprocessing with a recycling train may be considered as a repair method, upon submission of a proposal by the Contractor and approved by the Contract Administrator.

TABLE 2
Moisture Content of CIR Mix Payment Factors

Moisture Content Payment Factors Acceptance Criteria	Classification	Payment Factor, PFT
MC ≤ 2%	Acceptable	1.000
2% < MC ≤ 3%	Payment Reduction	1 – TODRF x (MC - 2)/10
MC > 3%	Rejectable	N/A
Where: MC = the mean of the lot sample of moisture content of CIR Mix in percent calculated to one decimal place according to LS-100. PFT = the payment factor for moisture content calculated to three decimal places according to LS-100. TODRF = Tender Opening Date Reduction Factor according to Table 3.		

TABLE 3
Tender Opening Date Reduction Factor

Year of Tender Opening	Tender Opening Date Reduction Factor
2015	0.65
2016	0.8
2017	1.0

Appendix 333-A, November 2015
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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

COLD IN-PLACE RECYCLED MIX - Item No.

Special Provision No. 333S04 September 2022

Amendment to OPSS 333, November 2015

333.02 REFERENCES

Section 333.02 of OPSS 333 is amended by the deletion of the following under **Ministry of Transportation Publications**:

LS-200 Penetration of Bituminous Materials
LS-291 Quantitative Extraction of Asphalt Cement and Mechanical Analysis of Extracted Aggregate from Bituminous Paving Mixtures - Ontario Procedure

Section 333.02 of OPSS 333 is amended by the addition of the following under **Ministry of Transportation Publications**:

LS-282 Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-804 Practice for Mix Design of Cold Recycled Mixtures with Emulsified Asphalt

Compaction Measurement of Cold In-Place Recycled Pavements Using Nuclear Moisture and Density Gauges

Section 333.02 of OPSS 333 is amended by the addition of the following:

AASHTO Publication

PP 86-17 Standard Practice for Emulsified Asphalt Content of Cold Recycled Mixture Designs

ASTM Publication

D5/D5M-20 Standard Test Method for Penetration of Bituminous Materials

333.04 DESIGN AND SUBMISSION REQUIREMENTS

333.04.01 Design Requirements

The last paragraph of Subsection 333.04.01 of OPSS 333 is deleted in its entirety and replaced by the following:

Each mix design shall include the following:

a) Information on the type, manufacturer, and supplier of the emulsified asphalt.

b) The percent by mass of emulsified asphalt in the CIR, referred to as the design rate, and all calculations performed to determine the design rate of emulsified asphalt.

c) Emulsion information to confirm the particle charges (anionic or cationic) and cohesion properties of the emulsified asphalt and RAP to ensure material compatibility. Emulsified asphalt residue content and penetration shall be provided.

d) The optimum fluid content, the mix design bulk relative density, and the air void for the CIR mix.

e) The amount of water to be added to the mix.

f) Maximum field rate adjustment allowed to the design rate without adverse effects to the mix properties.

g) Recovered penetration for the binder of the existing pavement according to ASTM D5M.

h) Type, source and quantity of active filler, if required.

The mix design shall be according to LS-804 and satisfy either the Marshall Stability or Indirect Tensile Strength requirements.

If Indirect Tensile Strength test is being used as the CIR mix design requirement, the mix design shall meet the following requirements:

Dry Indirect Tensile Strength	Minimum 225 kPa; and
Tensile Strength Ratio	Minimum 50%

If Marshall Stability test is being used as the CIR mix design requirement, the mix design shall meet the following requirements:

Unsoaked Marshall Stability	Minimum 5,560 N; and
Retained Marshall Stability	Minimum 60%

Regardless which mix design method was selected, the Unsoaked Marshall Stability, Retained Marshall Stability, Dry Indirect Tensile Strength and Tensile Strength Ratio shall be provided as part of the submission. The primary design method shall provide the full set of testing data, and for information purposes only, the secondary design method shall provide the testing data for one-point design only.

The Contractor can elect to perform additional testing by following AASHTO PP 86, for information only.

333.04.02 Submission Requirements

Subsection 333.04.02 of OPSS 333 is deleted in its entirety and replaced by the following:

A copy of the mix design document shall be submitted to the Contract Administrator a minimum of seven Business Days prior to the start of the CIR production.

Proposals for the use of alternative emulsified asphalt material listed under OPSS 1103 shall be submitted in writing to the Contract Administrator a minimum of seven Business Days prior to the intended use of the alternate product. The Owner may consider the use of other emulsified asphalt on trial basis, based on the documentation provided.

Within four Business Days after receiving the mix design, the Contract Administrator shall provide written confirmation of receipt of the submitted mix design and alternative emulsified asphalt material documents or of any non-conformance to the contract requirements.

Confirmation of receipt of the mix design documents does not constitute any guarantee that the mix can be produced or constructed or both to Contract requirements and does not relieve the Contractor of the responsibility for ensuring the specified quality of Materials and workmanship.

A new mix design shall be submitted when the emulsified asphalt design rate is adjusted by greater than 0.20%. Separate or new mix designs shall be submitted if the composition or layer thicknesses of the existing pavement changes significantly. Where more than one mix design is required, the area for which each mix design is to be used shall be clearly identified.

333.05 MATERIALS

333.05.01 Reclaimed Asphalt Pavement

Subsection 333.05.01 of OPSS 333 is deleted in its entirety and replaced by the following:

The gradation requirement for RAP shall be 100% passing the 37.5 mm sieve, and 95% to 100% passing the 26.5 mm sieve. The gradation shall be measured based on unextracted washed gradation according to the procedures in LS-602, with full range of gradation sizes provided for information purposes only.

333.05.02 Emulsified Asphalt

Subsection 333.05.02 of OPSS 333 is deleted in its entirety and replaced by the following:

Emulsified asphalt shall be according to OPSS 1103 and be compatible with the process and materials used.

The Owner may consider the use of other emulsified asphalt on trial basis, based on the documentation provided.

333.05.04 Active Filler

The second paragraph of Subsection 333.05.04 of OPSS 333 is deleted in its entirety and replaced by the following:

When any of the strength requirements as specified in Subsection 333.04.01 Design Requirements are not met, active filler such as Portland cement, hydrated lime, or quick lime may be added into the CIR mix. Portland cement shall be according to OPSS 1301, and its quantity is limited to one-third the quantity of residual asphalt of emulsion by mass. The maximum quantity of hydrated lime, or quick lime is limited to 1.0% by dry mass of RAP.

333.06 EQUIPMENT

333.06.03 Compaction Equipment

Subsection 333.06.03 of OPSS 333 is amended by the addition of the following sentence:

Compaction equipment for control strips shall have a minimum static weight of 11,000 kg.

333.06.04 Drying Unit

Subsection 333.06.04 of OPSS 333 is deleted in its entirety.

333.06.06 Pilot Vehicle

Subsection 333.06.06 of OPSS 333 is deleted in its entirety.

333.07 CONSTRUCTION

333.07.06 Compaction

Subsection 333.07.06 of OPSS 333 is deleted in its entirety and replaced by the following:

333.07.06.01 Compaction Testing Target Density

Compaction acceptance shall be according to the Acceptance Criteria for Compaction clause and shall be based on the target density. A control strip for the determination of the target density shall be constructed at the start of CIR mix production. The control strip shall be constructed according to Compaction Measurement of Cold In-Place Recycled Pavements Using Nuclear Moisture and Density Gauges. Levelling sand may be used to provide a flat surface for the nuclear moisture and density gauge when open coarse texture CIR mix is encountered. A minimum notice of two Business Days shall be given to the Contract Administrator prior to the construction of the control strip.

The Owner shall be provided access to complete the following tests according to the Compaction Testing clause:

a) Compaction testing of the control strip.

b) Establishment of the target density.

c) Compaction acceptance testing.

Compaction acceptance testing shall be performed once compaction has been completed on the CIR mat. Compaction acceptance shall be achieved prior to opening to traffic.

333.07.06.02 Target Density

A new control strip shall be constructed, and a new target density established for every 100,000 m² of CIR mix production and whenever any one of the following situations arises:

a) A different mix design is applied to the pavement section.

b) The existing pavement material significantly changes in surface roughness, gradation, composition, or layer thickness as determined by the Contract Administrator.

c) A different nuclear moisture and density gauge is to be used for the sublot testing.

The new target density shall apply to the calculations according to the Acceptance Criteria subsection for all sublots constructed after the establishment of a new target density.

333.07.07 Surface Appearance

Subsection 333.07.07 of OPSS 333 is deleted in its entirety and replaced by the following:

The compacted CIR mat shall be smooth and constructed to the crossfall and grade as specified in the Contract Documents. The surface of the CIR mat shall be of uniform texture and free of severe segregation and longitudinal streaks, moderate to severe raveling, rutting and flushing, and free of fat spots, oil spills, roller marks, and other defects.

333.07.08 Drying

Subsection 333.07.08 of OPSS 333 is deleted in its entirety.

333.07.09 Traffic Control with Moving Vehicles

Subsection 333.07.09 of OPSS 333 is deleted in its entirety and replaced by the following:

333.07.09 Traffic Control with Pilot Vehicles

Traffic shall be controlled with pilot vehicles according to OTM, Book 7.

The pilot vehicles shall guide one-way traffic through or around construction. The maximum speed of the moving vehicles shall be 30 km/h. Traffic control with moving vehicles shall be maintained until the CIR mat is able to carry traffic without damage.

Section 333.07 of OPSS 333 is amended by the addition of the following subsection:

333.07.11 Longitudinal Joints

For achieving continuity and integrity in the paved area, the minimum overlap between two successive lanes in longitudinal joints shall be 150 mm. In addition, the face of the joints shall be inspected between the milling unit and paving unit to make sure it is free of excessive loose material, or any built-up dust generated by the milling machine.

333.08 QUALITY ASSURANCE

333.08.02 Sampling

333.08.02.02 Cold In-Place Recycling Material

333.08.02.02.01 Slabs

The first and second paragraphs of Clause 333.08.02.02.01 of OPSS 333 are deleted in their entirety and replaced by the following:

At least four Business Days prior to the planned overlay of the CIR mat, three slab samples of the CIR material shall be obtained from each sublot. The three slab samples shall be located side-by-side and taken at random locations as directed by the Contract Administrator. Each slab sample shall be dry cut 150 mm × 150 mm and removed intact from the CIR mat.

One slab sample shall be used to test for bulk relative density, one slab sample shall be used to test for moisture content, and another sample is retained for referee. The result of the moisture content will be used for both the moisture acceptance, and moisture adjustment for compaction calculation according to LS-306.

333.08.02.02.02 Loose Mix Samples

Clause 333.08.02.02.02 of OPSS 333 is deleted in its entirety and replaced by the following:

333.08.02.02.02 RAP Gradation

For the purpose of determining the RAP gradation, 30 kg of RAP samples prior to application of emulsion shall be taken from each of five randomly selected sublots for every lot.

Subsection 333.08.02.02 of OPSS 333 is amended by the addition of the following clauses:

333.08.02.02.03 Sampling for Indirect Tensile Strength and Marshall Stability

Two 15 kg samples of the CIR shall be obtained from each sublot, taken at random locations as directed by the Contract Administrator. One of the 15 kg sample shall be used to test for dry tensile strength and wet tensile strength according to LS-297, for information only. The other 15 kg sample shall be used to test for Marshall Stability according to AASHTO PP 86, for information only.

333.08.02.03 Reclaimed Material

Subsection 333.08.02.03 of OPSS 333 is deleted in its entirety.

333.08.03 Acceptance Criteria

333.08.03.03 Moisture Content

The first paragraph of Clause 333.08.03.03 of OPSS 333 is deleted in its entirety and replaced by the following:

The QA laboratory shall test one sample from each sublot to determine the moisture content of CIR mix according to LS-282, and the test result of the moisture content shall be rounded to one decimal place according to LS-100. The test result for each sublot shall be used to compute the lot mean for moisture content of CIR mix.

Clause 333.08.03.03 of OPSS 333 is amended by the addition of the following clause:

333.08.03.03.01 Referee Testing

A written request may be made to the Contract Administrator for referee testing within 3 Business Days of receiving a rejectable moisture test result. Referee testing shall be carried out by a laboratory designated by the Owner from a roster maintained for this purpose.

The results of the referee test shall be used for acceptance determination and shall be binding on both parties. If the referee testing results in rejection of the moisture content, the referee testing shall be at no addition cost to the Owner. If the referee testing results in the material passing all test criteria, the referee testing charge shall be paid by the Owner.

333.08.03.04 Compaction

Clause 333.08.03.04 of OPSS 333 is deleted in its entirety and replaced by the following:

333.08.03.04.01 Compaction Testing

Quality assurance for the compaction of CIR mix shall consist of taking five random field wet density and moisture content measurements from each sublot of compacted CIR mix and using them to calculate the Quality Index (Qi) according to Compaction Measurement of Cold In-Place Recycling Pavements Using Nuclear Moisture and Density Gauges.

333.08.03.04.02 Acceptance Criteria for Compaction

When Qi for a sublot is equal to or greater than 1.49, the sublot shall be accepted; otherwise, the sublot shall be rejected for compaction

333.08.03.04.03 Rejected Sublots

If a sublot is rejected for compaction, the sublot shall be recompacted, with adjustment to the moisture content if required, until satisfactory compaction is achieved. The recompacted sublot shall be retested and the compaction re-evaluated according to the Acceptance Criteria subsection.

333.10 BASIS OF PAYMENT

Section 333.10 of OPSS 333 is amended by the addition of the following subsection:

333.10.03 Traffic Control with Pilot Vehicles

Traffic control with pilot vehicles shall be included under the Temporary Traffic Control Signs item.

Table 1 of OPSS 333 is amended by deleting the following under Moisture Content Acceptance Criteria, Repair Requirements:

1) Use of drying unit as specified in the Drying Unit subsection to dry the CIR mat, or

WARRANT: Always with this tender item.

CONSTRUCTION SPECIFICATION FOR COMPACTING

TABLE OF CONTENTS

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 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.

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 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 206 Grading
OPSS 401 Trenching, Backfilling, and Compacting

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 free of contaminants that could adversely affect fill material or the environment.

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.

Field density and field moisture determinations shall be made according to ASTM D 6938.

501.07.04.02 Compaction Requirements

501.07.04.02.01 General

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.

501.07.04.02.02 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 associated information relating to the control strip, including target density, lot location, lift thickness, probe depth, moisture content, wet density, and all QC lot compaction calculations shall be recorded at the time of testing on MTO form PH-CC-009. This form shall be available at any time for review, upon request, and shall be submitted to the Contract Administrator prior to placement of any subsequent lift and within 2 Business Days following the completion of a lot.

501.07.04.02.03 Test Equipment and Operator Training

501.07.04.02.03.01 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.

501.07.04.02.03.02 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.

501.07.04.02.03.03 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 sublot 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.

501.07.04.02.04 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.

501.07.04.02.04.01 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 m^2 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.

501.07.04.02.05 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 sublot 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 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.

During the compaction process, the field wet density value and moisture content for each gauge test shall be recorded on MTO form PH-CC-009. The field dry density of each sublot shall then be calculated as a percentage of the target density to the nearest 0.1%. The mean and standard deviation and the Quality Index, where applicable, of the field dry density values shall be calculated to the nearest 0.1% and recorded on the form for each lot.

MTO form PH-CC-009 shall be constantly updated with new test data and the associated calculations completed as the testing is being done. This form shall be made available to the Contract Administrator at any time, upon request.

501.07.04.02.06 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 during the compaction process. 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, utilit structures, or small foundations (e.g., anchor blocks, sign posts, and formwork):

For earth materials: $Q_i = \frac{\bar{x} - 95}{s}$ For granular materials: $Q_i = \frac{\bar{x} - 98}{s}$

b) For materials placed in all other situations:

For earth materials: $Q_i = \frac{\bar{x} - 90}{s}$ 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 sublot test results (dry density expressed as a percentage of the target density). Lot mean is the sum of individual sublot 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 (σ_{n-1}), the statistical value that describes the distribution of sublot 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 sublot 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:

$$s = \sqrt{\frac{\sum_{i=1}^{4} (x_i - \bar{x})^2}{3}}$$

501.07.04.02.07 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 recompacted to meet the specified compaction requirements. Materials that cannot be successfully recompacted shall be removed and replaced with new material.

501.07.04.02.07.01 Rejected Lots

If a QC lot is rejected for compaction, the lot shall be recompacted with adjustment to the moisture content, as required, until satisfactory compaction is achieved. The recompacted 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.

501.08.02 Compaction

501.08.02.01 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.

501.08.02.02 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/m^3 for granulars and 150 kg/m^3 for earth when compared with the QA average dry density, the QC test results shall be considered valid.

501.08.02.03 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.

501.08.02.04 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.

501.08.02.05 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 m^3.

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 shall be at no additional cost to the Owner.

Replacement of unsuitable equipment to obtain an appropriate target density 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.

Note:

1. 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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

AMENDMENT TO OPSS 501, NOVEMBER 2014

Special Provision No. 105S22 August 2021

501.07 CONSTRUCTION

501.07.01 General

Subsection 501.07.01 of OPSS 501 is deleted in its entirety and replaced with the following:

The method of placing and lift thickness of earth or granular material shall be according to the specifications that govern the Work. When not specified, the lift thickness of earth shall not exceed 300 mm and the lift thickness for granular materials shall not exceed 150 mm.

When field testing 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.

501.07.04 Quality Control

501.07.04.02 Compaction Requirements

501.07.04.02.04 Target Density

Clause 501.07.04.02.04 of OPSS 501 is deleted in its entirety and replaced with the following:

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 the materials or both.
   iii. At least once per calendar year on all carry-over Contracts.

b) For earth being placed:

   i. As backfill, after QC lots representing 2000 tonnes or 1000 m^3 of material have been completed, whether accepted or rejected, based on one set of target density values, or
   ii. For all other purposes, after each 10 QC lots of material have been completed, whether accepted or rejected, based on one set of target density values.

c) For granular materials being placed:

   i. As backfill, or at the discretion of the Contract Administrator, any other areas, after QC lots representing 5000 tonnes or 2500 m^3 of material have been completed, whether accepted or rejected, based on one set of target density values, or
   ii. For all other purposes, after each 25 QC lots of material have been completed, whether accepted or rejected, based on one set of target density values.

The new target density shall be established by the construction of a control strip according to the Control Strip clause, except the new 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, when:

a) Placing material in confined areas that do not allow equipment meeting the requirements specified in the Compaction clause to be used.

b) With the consent of the Contract Administrator, a control strip cannot be reasonably constructed or is impractical.

The MDD used for the new target density shall be the average of the MDD calculated from a minimum of three independent samples selected from the materials to be used.

501.07.04.02.04.01 Control Strip

Prior to construction of a control strip:

a) A minimum notice of 24 hours shall be given to the Contract Administrator, and

b) The optimum moisture content (OMC) of the material shall be determined 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. The surface of each control strip shall be graded flat.

Prior to compaction, the field moisture content of the control strip material shall be determined using a nuclear gauge at a minimum of three randomly selected locations. The average moisture content at those three locations shall be 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. If the average moisture content is not within this range, the moisture content of the material shall be uniformly adjusted (e.g. by adding water and re-mixing or scarifying and drying). The material shall then be graded flat and re-tested using a nuclear gauge. This process shall be repeated until the average moisture content of the material, at a minimum of three randomly selected locations, is 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.

When the OMC is within the acceptable range, the compaction equipment shall make six passes over the entire surface of the control strip. A pass shall be deemed to be compaction of the full width of the control strip in one direction only. The field wet density and field moisture content shall be determined at a minimum of three randomly selected locations. The dry density shall be calculated for each of these locations and the average dry density used as the initial value for the dry density.

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.

The compaction equipment shall then make two additional passes over the entire surface of the control strip.

A minimum of three separate random field density and moisture content determinations shall then be made, and a new average dry density shall be calculated.

If the new average dry density exceeds the previous value by more than 0.030 t/m³, then 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/m³, then the compaction of the control strip shall be considered satisfactory and complete.

Upon satisfactory completion of the control strip, an additional seven field wet density and moisture content tests shall be taken at random locations and the dry density values determined. The final dry density of the control strip, which shall be deemed to be the target density, shall be the average of the dry density values determined at these seven additional random locations plus the three most recent values that were determined upon completion of the control strip.

501.08 QUALITY ASSURANCE

501.08.02.02 Gauge Verification

Subsection 501.08.02.02 of OPSS 501 is deleted in its entirety and replaced with the following:

Gauge verification QA shall consist of taking four random field density and moisture content measurements of a compacted lot or control strip and the subsequent calculation of the average dry density. The maximum dry density (MDD) of the material within the compacted lot or control strip as determined by LS-706 shall be used for gauge verification.

The QC gauge test results shall be considered valid provided that the difference between the average percentage of the MDD determined by QC gauge test results and the average percentage of the MDD determined by QA gauge test results for the same material is no more than 4%. If the discrepancy between the QA and QC gauge test results is more than the 4%, an investigation shall take place to resolve the discrepancy. The investigation may include but is not limited to verification of appropriate probe depth, as well as parts d) and e) according to the Compaction clause.

WARRANT: Always with OPSS 501, Construction Specification for Compacting.

CONSTRUCTION SPECIFICATION FOR TEMPORARY PROTECTION SYSTEMS

TABLE OF CONTENTS

539.01 SCOPE

This specification covers the requirements for the design, construction, maintenance, monitoring, and removal of a temporary protection system made necessary by excavation, embankment construction, dewatering, or other work.

539.01.01 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.

539.01.02 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.

539.02 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 903 Deep Foundations
OPSS 904 Concrete Structures
OPSS 906 Structural Steel for Bridges
OPSS 942 Prestressed Soil and Rock Anchors

Ontario Provincial Standard Specifications, Material

OPSS 1350 Concrete - Materials and Production
OPSS 1601 Wood Material, Preservative Treatment, and Shop Fabrication

Ontario Ministry of Transportation Publications

Structural Manual

CSA Standards

S6-06 Canadian Highway Bridge Design Code

Ontario Ministry of Labour

Occupational Health and Safety Act, R.S.O. 1990, c.O.1, as amended

American Association of State Highways Transportation Officials (AASHTO)

AASHTO Guide Design Specification for Bridge Temporary Works, 1st Edition with Interim Revisions

International Organization for Standardization/International Electrotechnical Commission (ISO/IEC)

17025 General Requirements for the Competence of the Testing and Calibration Laboratories

539.03 DEFINITIONS

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

Anchor means:

a) A system consisting of prestressed tendons or non-prestressed rods installed in predrilled holes and encapsulated in grout or concrete. A system that derives its load carrying capacity in bond between the grout and concrete body and the surrounding soil or rock; or

b) A tie back to a deadman.

Bracing means the system of walers, struts, anchorages, and like members that connect frames, shores, or panels of a sheathing system to resist external pressures and to provide stability against lateral movement.

Certificate of Conformance means a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in General Conformance with the requirements of the Contract Documents.

Cofferdam means a watertight enclosure.

Dredge Line means the exposed lower limit of the protection system.

Erector means a supervisory person that undertakes the construction of a protection system.

Protection System means the construction necessary to mechanically support existing or proposed work so that its function shall not be affected or construction necessary to support work such as open excavations during actual construction operations for safety and convenience.

Quality Verification Engineer means an Engineer retained by the Contractor qualified to provide the services as specified in the Contract Documents.

Raker means a structural member inclined to the front of the shoring wall providing lateral support.

Shoring Wall means a structural wall consisting of wood, steel, or concrete or any combination of these materials that supports earth or rock and any structure, materials, Utilities, or other facility contained in or on the supported earth or rock mass.

Top of Shoring Wall means the upper limit of the protection system.

539.04 DESIGN AND SUBMISSION REQUIREMENTS

539.04.01 Design Requirements

539.04.01.01 General

The protection system shall be designed for the performance level as specified in the Contract Documents.

Except for Owner designed protection systems, the Contractor shall be responsible for the complete detailed design of the protection system required to carry out the work as specified in the Contract Documents.

Protection systems that are not as specified in the Contract Documents shall be assigned an appropriate performance level for design by the design Engineer. The Contract Administrator shall review the performance level selected at the time of submission of the specified Working Drawings.

The geotechnical and foundation portions of the design shall be based on a method published in AASHTO Guide Design Specification for Bridge Temporary Works and in general conformance with CAN/CSA-S6. The design shall be appropriate for the specific site conditions. Design methods not meeting the AASHTO and CSA design specifications may only be used on this Contract, if approved by the Owner.

A protection system shall be designed to provide protection for excavations at the locations as specified in the Contract Documents and at any other location where the stability, safety, or function of an existing structure or Utility may be impaired by construction work.

The temporary slope geometry used to determine requirements of the protection system shall be according to the Occupational Health and Safety Act.

Performance levels for protection systems are as follows:

Performance Level	Maximum Angular Distortion	Maximum Horizontal Displacement
1a	1:1000	5 mm
1b	1:1000	10 mm
2	1:200	25 mm
3	1:100	50 mm

Where:

Angular Distortion = $\pm \Delta/H$

Δ = Horizontal displacement in mm at height H
H = Height in mm above dredge line to point of measurement or height above the nearest system restraining support.

When performance level 1a is specified, the bracing system shall be preloaded.

Where the bracing systems are preloaded, the effects of the preload shall not cause damage to adjacent facilities.

Protection systems with a face within a horizontal distance of 1/3H of any part of a structure foundation shall be designed for performance level 1a.

539.04.01.02 Designer Qualifications

The design Engineer and design-checking Engineer shall have demonstrated expertise for the work. As well, the design Engineer and design-checking Engineer shall have a minimum of 5 years experience in designing protection systems of similar nature and scope to the required work.

One person shall not perform both the design Engineer and design-checking Engineer roles for a protection system.

539.04.01.03 Design Assumptions

The design assumptions shall accurately represent the subsurface conditions prevalent at the site and shall be specific to the type of protection system used. The design shall address the subsurface conditions at the project site as specified in the Contract Documents.

539.04.01.04 Vertical and Horizontal Loadings

Vertical and horizontal design loadings used shall represent existing conditions and accepted design practice. Future loadings that are known and may affect the protection system during its useful life shall be considered.

539.04.02 Submissions

539.04.02.01 Working Drawings

The Contractor shall submit 3 sets of Working Drawings to the Contract Administrator at least 7 Days prior to commencement of the protection system installation, for information purposes only. Prior to making a submission, the seals and signatures of a design Engineer and a design-checking Engineer shall be affixed on the Working Drawings verifying that the drawings are consistent with the Contract Documents.

Where multi-discipline engineering work is depicted on the same Working Drawing and the design or design-checking Engineer or both are unable to seal and sign the Working Drawing for all aspects of the work, the drawing shall be sealed and signed by as many additional design and design-checking Engineers as necessary.

Prestressed anchor submissions shall be according to OPSS 942.

When other authorities are involved, 1 set of Working Drawings shall be submitted for each authority at least 5 weeks prior to the commencement of falsework construction. The requirements of each authority shall be satisfied prior to commencement of the protection system installation.

The Contractor shall have a copy of the Working Drawings at the site during protection system installation.

For protection systems that are not specified in the Contract Documents, the Contractor shall submit the Working Drawings for these systems to the Contract Administrator at least 3 weeks prior to the commencement of any construction.

The following information and details shall be shown on the Working Drawings:

a) Plans, Elevations, and Details

   i. Location of protection system and station limits.
   ii. Plan and elevation of shoring showing the extent of the protection system.
   iii. Details of the shoring system, including cross-sections.
   iv. Details of internal bracing.

b) Design Criteria

   i. Pressure diagrams including values of horizontal and vertical loads, dead load, and live load surcharge.
   ii. Design assumptions and parameters.
   iii. Anchor bond stresses.
   iv. Pile design.
   v. Anchor system stressing schedule specifying working loads, stressing loads, and lock in loads.
   vi. Details of preload, when required.
   vii. For protection systems not specified in the Contract Document, the performance level shall be designated.

c) Materials

   i. Grade of structural steel and grade and species of structural wood.
   ii. Concrete strengths.
   iii. Grout strengths.
   iv. Details of protection from rain and frost action.
   v. Wood lagging and size.
   vi. Mill certificates or test reports from an independent organization certified by the Standards Council of Canada certifying that the steel meets the requirements of the grade, where specified.
   vii. Details of patented accessories, including load test data.

d) Installation Procedure

   i. Installation sequence and procedure, including to the installation of piling, lagging, anchor systems, and rakers.

e) Monitoring Method

   i. The proposed method of monitoring the performance of the protection system during installation and use. The method of monitoring shall be consistent with the requirements specified in the Quality Control subsection.

f) Removal of Protection System

   i. The details of the procedures associated with the removal of the protection system indicating: method, sequence of work, and removal limits, except when the protection system is specified in the Contract Documents to be left in place.

539.04.02.02 Amendments to Protection Systems

Work shall not proceed on amendments to the protection system until the Contractor has received sealed and signed approval to proceed from the design Engineer and design-checking Engineer and has submitted a copy of the approval to the Contract Administrator.

Amendments to the protection system shall be submitted to the Contract Administrator on revised Working Drawings bearing the seal and signature of the design Engineer and design-checking Engineer.

539.04.02.03 Preconstruction Survey

Prior to commencing the work, the Contractor shall submit to the Contract Administrator, a condition survey of property and structures that may be affected by the work. The survey shall include the locations and conditions of adjacent properties; buildings; underground structures; Utility services; and structures, such as walls abutting the site within a horizontal distance of $2H_w$ from the face of the protection system, where H_w is the height of the wall from the ground surface to the dredge line.

539.04.02.04 Materials

539.04.02.04.01 Structural Steel

539.04.02.04.01.01 Mill Certificates

The Contractor shall submit to the Contract Administrator at the time of delivery 1 copy of the mill certificates, indicating that the steel meets the requirements for the appropriate standards for H-piles, tube piles, casings, and sheet piles.

Where mill test certificates originate from a mill outside Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

For Contractor designed protection systems using previously used structural steel that a mill test certificate is not available and coupons have not been tested to verify the steel's material properties, a mill test certificate is not required when the yield strength specified on the Working Drawings does not exceed 250 MPa. If the yield strength specified exceeds 250 MPa, the Contract Administrator may request that the material be tested to confirm the material properties indicated on the Working Drawings. The costs of this testing shall be at the expense of the Owner if the test results indicate that the material is according to the Working Drawings, and at the expense of the Contractor if the test results indicate that the material is not according to Working Drawings.

539.04.02.05 Milestone Inspections

539.04.02.05.01 Excavation Depths Less Than or Equal to Three Metres

The Quality Verification Engineer shall witness interim inspections of the following work:

a) Installation of protection system, including excavation to dredge line.

b) Removal of protection system.

A copy of the written permission to proceed shall be submitted to the Contract Administrator prior to commencement of the successive operation.

539.04.02.05.02 Excavation Depths Exceeding Three Metres

The Quality Verification Engineer shall witness interim inspections of the following work:

a) Layout and extent of protection system.

b) Piling.

c) Installation of protection system, including excavation to dredge line.

d) Removal of protection system.

A copy of the written permission to proceed shall be submitted to the Contract Administrator prior to commencement of the successive operation.

539.05 MATERIALS

539.05.01 Wood

Wood shall be according to OPSS 1601.

Wood shall be of the size, grade, and species shown on the Working Drawings and shall be in sound condition, free from defects that may impair its strength. Wood lagging does not have to be grade-stamped.

539.05.02 Proprietary Shoring and Patented Accessories

Where proprietary shoring or patented accessories are to be used, the Contractor shall follow the manufacturers' recommendations for load carrying capacity. The recommended load carrying capacities shall be supported by test results from an accredited testing laboratory approved by the Owner.

539.05.03 Concrete

Concrete shall be according to OPSS 1350.

539.05.04 Other Materials

The design Engineer may consider other suitable materials when sufficient information is available to quantify the allowable design loads or when the manufacturer's recommendations regarding load carrying capacities are supported by test results from an independent organization accredited by the Standards Council of Canada.

539.07 CONSTRUCTION

539.07.01 General

The Contractor shall be responsible for the design, materials, construction, maintenance, monitoring, and removal of a temporary protection system.

The erector shall be experienced in the method of construction of protection systems. Such experience shall have been obtained within the preceding 5 years on projects of similar nature and scope to the required work.

Protection systems shall be built according to the specifications and the Working Drawings.

Piling shall be according to OPSS 903 and the Working Drawings.

Concrete construction shall be according to OPSS 904. Concrete shall be placed in the dry. Where cofferdams are used, they shall be sealed sufficiently to permit concrete to be placed in the dry.

The Contractor shall carry out dewatering, as required, to facilitate the installation of the protection system.

Tremie concrete shall be placed according to the requirements of OPSS 904.

Structural steel shall be according to OPSS 906 and the Working Drawings.

Prestressed anchors shall be supplied, installed, and stressed according to OPSS 942.

The protection system shall be protected from the detrimental effects of rain and frost action.

Material used in the protection system shall remain the property of the Contractor.

Loss of soil from behind the shoring shall be prevented during and following the installation of the lagging.

539.07.02 Removal of Protection Systems

Protection systems may be left in place, unless otherwise specified.

Where protection systems are left in place, the top shall be removed to at least 1.2 m below the finished grade or ground level or at least 0.6 m below the streambed.

Where protection systems are specified for removal or the Contractor elects to remove, the method and sequence of removal shall be so that there shall be no damage to the new work, existing work, and facility being protected.

All disturbed areas shall be restored to an equivalent or better condition than existed prior to the commencement of construction.

539.07.03 Quality Control

539.07.03.01 General

In addition to the quality control measures instituted by the Contractor, the Contractor shall complete a preconstruction condition survey and monitor the protection system installation as specified herein, and as shown on the Working Drawings.

539.07.03.02 Inspection of Welds

The Contractor shall be responsible for visual inspection of all welds. Any required testing of welds shall be as specified by the design Engineer of the protection system.

539.07.03.03 Monitoring

539.07.03.03.01 General

Monitoring shall be conducted by a Registered Ontario Land Surveyor or an Engineer according to the program submitted with the Working Drawings.

The minimum requirements for monitoring shall include the survey measurements of scaled targets attached to the shoring wall at the elevations specified. The scaled targets shall be placed at a maximum spacing of 6 m with targets placed at the extreme ends and the targets distributed between the outer limits. The survey targets shall be monitored for horizontal displacement from the vertical at the frequency specified.

All test results, observations, and records, including the preconstruction survey, taken during construction and operation of the protection system shall be available on the site for review by the Contract Administrator.

If movement of the protection system is more rapid than is expected, or if movement approaches the allowable limit, the Contract Administrator shall be notified immediately and suitable measures shall be taken to ensure stability of the protection system and to ensure movement does not exceed the performance level specified in the Contract Documents.

539.07.03.03.02 Excavation Depths Less Than or Equal to Three Metres

The protection systems shall be monitored during construction. Readings shall be taken during installation of the protection system at the top of the protection system at each construction stage during the installation. After installation, the above readings shall be taken every two weeks.

539.07.03.03.03 Excavation Depths Exceeding Three Metres

The protection systems shall be monitored during construction. Readings shall be taken during installation of the protection system at the top, at each restraint point, at the dredge line, and halfway between the restraint points at each construction stage during the installation of the protection system. After installation, the above readings shall be taken weekly.

539.07.03.04 Certificates of Conformance

539.07.03.04.01 Excavation Depths Less Than or Equal to Three Metres

For protection systems to facilitate excavation depths less than or equal to 3 m and provided that surcharge loading due to vehicular traffic, construction equipment and materials, or other is beyond a horizontal distance defined by a 1H:2V line projected from the dredge line at the face of the protection system to the roadway surface, a completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the operation of the protection system and removal of the protection system. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the protection system was installed, monitored, and subsequently removed in general conformance with the Working Drawings and as specified in the Contract Documents.

Should traffic be within a horizontal distance defined by a 1H:2V line projected from the dredge line at the face of the protection system to the roadway surface, the Certificate of Conformance requirements as specified in the Excavation Depths Exceeding Three Metres clause shall apply.

539.07.03.04.02 Excavation Depths Exceeding Three Metres

For protection systems to facilitate excavation depths that exceed 3 m or should traffic, construction equipment and materials, or other be within a horizontal distance defined by a 1H:1V line projected from the dredge line at the face of the protection system to the roadway surface, a completed Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the operation of the protection system and removal of the protection system. The Qualification Verification Engineer's seal and signature shall be affixed on the completed Certificate of Conformance confirming that the materials have been supplied and installed in general conformance with the Working Drawings and that the protection system was installed, monitored, and subsequently removed in general conformance with the Working Drawings and as specified in the Contract Documents.

539.07.04 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

539.10 BASIS OF PAYMENT

539.10.01 Protection System - 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 item for protection systems, the Contract price for the items directly associated with the protection system shall include full compensation for all labour, Equipment, and Material to do the work described in this specification.

Appendix 539-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

No information provided here.

Related Ontario Provincial Standard Drawings

No information provided here.

AMENDMENT TO OPSS 539, NOVEMBER 2014

Special Provision No. 105S09 March 2018

539.03 DEFINITIONS

Section 539.03 of OPSS 539 is amended by the deletion of the definitions for **Certificate of Conformance** and **Quality Verification Engineer**.

539.04 DESIGN AND SUBMISSION REQUIREMENTS

539.04.02.05 Milestone Inspections

Clause 539.04.02.05 of OPSS 539 is deleted in its entirety.

539.07 CONSTRUCTION

539.07.03.03.02 Excavation Depths Less Than or Equal to Three Metres

Clause 539.07.03.03.02 of OPSS 539 is amended with the following:

The Contractor's Engineer shall inspect the following Work:

a) Installation of the protection system, including excavation to dredge line.

b) Removal of the protection system.

539.07.03.03.03 Excavation Depths Exceeding Three Metres

Clause 539.07.03.03.03 of OPSS 539 is amended with the following:

The Contractor's Engineer shall inspect the following Work:

a) Layout and extent of protection system.

b) Piling.

c) Installation of protection system, including excavation to dredge line.

d) Removal of protection system.

539.07.03.04 Inspection of Protection Systems

539.07.03.04.01 Excavation Depths Less Than or Equal to Three Metres

Clause 539.07.03.04.01 of OPSS 539 is deleted in its entirety and replaced with the following:

For protection systems to facilitate excavation depths less than or equal to 3 m and provided that surcharge loading due to vehicular traffic, construction equipment and materials, or other is beyond a horizontal distance defined by a 1H : 2V line projected from the dredge line at the face of the protection system to the roadway

surface, the Contractor's Engineer shall inspect and verify that the that the protection system was installed, monitored, and subsequently removed according to the Contract Documents.

A Certificate of Conformance shall be submitted to the Contractor Administrator upon completion of the installation of the protection system.

A Certificate of Conformance shall be submitted to the Contractor Administrator upon completion of the removal of the protection system.

Should the traffic be within a horizontal distance defined by a 1H: 2V line projected from the dredge line at the face of the protection system to the roadway surface, the Certificate of Conformance requirements as specified in the Excavation Depths Exceeding Three Metres clause shall apply.

539.07.03.04.02 Excavation Depths Exceeding Three Metres

Clause 539.07.03.04.02 of OPSS 539 is deleted in its entirety and replaced with the following:

For protection systems to facilitate excavation depths that exceed 3 m or should traffic, construction equipment and materials, or other be within a horizontal distance defined by a 1H:1V line projected from the dredge line at the face of the protection system to the roadway surface.

The Contractor's Engineer shall inspect and verify that the materials have been supplied and installed according to the Contract Documents. A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the installation of the materials.

The Contractor's Engineer shall inspect and verify and that the protection system was installed, monitored, and subsequently removed according to the Contract Documents. A Certificate of Conformance shall be submitted to the Contract Administrator upon completion of the removal of the protection system.

WARRANT: Always with OPSS 539, Construction Specification for Temporary Protection Systems.

CONSTRUCTION SPECIFICATION FOR THE PLACEMENT OF UNSHRINKABLE FILL

TABLE OF CONTENTS

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

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

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^{o} 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:

1. 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:

1. 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.
2. 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.
3. For unshrinkable fill in contact with permanent concrete elements, the limit of SO_4 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.
4. This requirement is specified where the unshrinkable fill will be in direct contact with concrete or steel pipe.