**PERFORMANCE SPECIFICATION FOR DESIGN AND CONSTRUCTION AND RECONSTRUCTION OF RIGID PAVEMENT STRUCTURE**

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| Special Provision |

**XXX.01 SCOPE**

This pavement performance specification covers the requirements for the design and construction of new, and reconstructed rigid pavements structure (concrete pavement and concrete base) and associated work, including drainage of the pavement structure, with a seven-year warranty on the performance of the pavement.

**XXX.02 REFERENCES**

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

**Ontario Provincial Standard Specifications, Construction**

OPSS 301 Restoring Unpaved Roadway Surfaces

OPSS 314 Untreated Granular Subbase, Base, Surface, Shoulder and Stockpiling

OPSS 320 Open Graded Drainage Layer

OPSS 366 Repairing Concrete Pavement and Concrete Base

OPSS 904 Concrete Structures

**Ontario Provincial Standard Specifications, Material**

OPSS 1002 Aggregates – Concrete

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

OPSS 1212 Hot Poured Rubberized Asphalt Joint Sealing Compound

OPSS 1315 White Pigmented Curing Compounds for Concrete

OPSS 1350 Concrete - Materials and Production

**Ontario Ministry of Transportation Publications**

Designated Sources for Materials (DSM):

DSM #3.20.45 Concrete – Joint Sealant, Rubberized Asphalt, Hot Poured

DSM #3.05.25 Aggregates: Surface Friction Courses

MTO Forms:

PH-CC-820 Certification of Grade/Crossfall

PH-CC-822PCC Post Construction Certification

PH-D-10 Aggregate Sample Data Sheet

MTO Laboratory Testing Manual:

LS-100 Method of Rounding-off Data and Other Numbers

LS-101 Procedures for Calculating Percent within Limits

LS-296 Method of Test for Calibrating, Correlating, and Conducting Surface Smoothness Measurements Using an Inertial Profiler

LS-309 Practice for Superpave Mix Design

LS-410 Method of Test for Compressive Strength of Concrete Cores

LS-412 Method of Test for Scaling Resistance of Concrete Surface Exposed to Deicing Chemicals

LS-432 Method of Test for Microscopical Determination of Air Void System Parameters in Hardened Concrete

LS-433 Method of Test for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration

LS-450 Method of Test for Determination of Concrete Pavement Thickness Using Drilled Core Specimens

LS-601 Method of Test for Materials Finer Than 75 µm Sieve in Mineral Aggregates by Washing

LS-602 Sieve Analysis of Aggregates

LS-604 Method of Test for Relative Density and Absorption of Coarse Aggregate

LS-606 Method of Test for Soundness of Aggregate by Use of Magnesium Sulphate

LS-608 Method of Test for Determination of Percent Flat and Elongated Particles in Coarse Aggregate

LS-609 Petrographic Analysis of Coarse Aggregate

LS-613 Method of Test for Determination of Insoluble Residue of Carbonate Aggregates

LS-614 Freezing and Thawing of Coarse Aggregate

LS-618 Resistance of Coarse Aggregate to Abrasion in the Micro-Deval Apparatus

LS-619 Resistance of Fine Aggregate to Abrasion in the Micro-Deval Apparatus

LS-620 Accelerated Detection of Potentially Deleterious Alkai-Silica Reactive Aggregate by Expansion of Mortar Bars

LS-621 Method of Test for Determination of Amount of Asphalt-Coated Particles in Coarse Aggregate

LS-625 Guidelines for Sampling of Granular Materials

LS-627 Open-Graded Drainage Layer (OGDL) Core Porosity Test

LS-630 Method of Test for Determination of Amount of Contamination of Coarse Aggregate

LS-631 Qualitative Determination of Presence of Plastic Fines in Aggregates

MI-183 Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions

SP-026 Manual for Condition Rating of Rigid Pavements - Concrete Surface and Composite Distress Manifestations

**American Association of State Highway and Transportation Officials (AASHTO)**

GDPS-4-M AASHTO Guide for Design of Pavement Structures

MEPDG-3 Mechanistic–Empirical Pavement Design Guide: A Manual of Practice

**American Concrete Pavement Association (ACPA)**

StreetPave 12 Structural Design Software for Street and Road Concrete Pavements

Pavement Designer PavementDesign.org web-based pavement design tool

**ASTM International**

E 1703-10 Standard Test Method for Measuring Rut-Depth of Pavement Surfaces Using a Straightedge

E 3013/E3013M - 17 Evaluating Concrete Pavement Dowel Bar Alignment Using Magnetic Pulse Induction

**CSA Standards**

A23.2-14C Obtaining and Testing Drilled Cores for Compressive Strength Testing\*

\* [Part of A23.1-14/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]

**381.03 DEFINITIONS**

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

**Acceptance Criteria** means objective values (numerical or descriptive) that are compared to performance measurements to assess conformance with performance requirements.

**Aggregate** means natural mineral materials such as sand, gravel, and crushed bedrock. Reclaimed materials may substitute for aggregates when specified.

**Average Annual Daily Traffic (AADT)** means the estimated current number of vehicles passing through the highway section during 24 hours, on average for the period from January 1st to December 31st.

**Air-Cooled Blast Furnace Slag** and **Iron Blast Furnace Slag** mean the material resulting from the solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface.

**Automatic Road Analyzer (ARAN)** means an instrumented, calibrated vehicle that measures the severity and extent of pavement wheel track rutting, cracking, alligator cracking, roughness, and other indicators of pavement performance.

**Blow Up** means localized upward movement of slab shattering adjacent to a joint.

**Break Point** means a location in the cross-section where the cross-fall changes.

**Bullnose** means the location where the edge of the Highway and the edge of the ramp meet each other.

**Ceramic** means porcelain, china, and whiteware, e.g. sinks, toilets, and bidets made from clay and silica fired at a high temperature, excluding clay brick and tile, free of organic materials, metal, and plastic.

**Chip Product** means an aggregate co-product from the crushing operation with 100% passing the 9.5 mm sieve, predominantly passing the 4.75 mm sieve and retained on the 2.36 mm sieve.

**Coarse Aggregate** means that portion of an aggregate material retained on the 4.75 mm sieve when tested according to LS-602.

**Coarse Aggregate Loss** means the loss of coarse aggregate from the pavement surface.

**Cold Mix Asphalt (CMA)** means cold mixed, cold laid, cold in-place recycled, open or dense graded bituminous material consisting of a combination of aggregate and emulsified or expanded asphalt cement.

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

**Concrete Base** means a rigid pavement structure, which is overlaid with asphaltic concrete, and may include concrete shoulders.

**Concrete Mix Design** means the design of the proportions of aggregates, cement, water and admixtures, that when uniformly mixed, results in a concrete that provides adequate strength and durability for the intended use and meets the requirements specified in the Contract Documents.

**Concrete Pavement** means a rigid pavement structure with an exposed concrete surface, and may include concrete shoulders.

**Consequences for Non-conformance** means the repairs required such that acceptance criteria are met or exceeded, or the payment due where permitted in lieu of repair.

**Construction Joint** means a vertical contact between new concrete pavement and any HMA pavement or any rigid object that exists at the time the new concrete is laid.

**Crack** means a break in the pavement surface, a separation of the pavement or aggregates at the surface of the pavement, and includes breaks and separations previously repaired by sealing.

**Cross-fall** means the average grade between edges of a cross-section element.

**Cross-Section** means the transverse profile of the Roadway.

**Differential Frost Heave** means the non-uniform rise in pavement elevation resulting from the seasonal formation of ice and ice lenses below the pavement surface.

**Distortion** means a deviation of the pavement surface from its original shape resulting in a pitch, roll, and/or sudden drop of a moving vehicle travelling at posted speed.

**Drainage Layer** means open graded drainage layer that is a rapid draining aggregate course layer located within the pavement structure that is between the concrete pavement and the granular base course. The drainage layer may be cement treated or asphalt treated.

**Duplicate Samples** means two samples taken at the same time and location, one to be used for quality assurance testing and the other for referee testing.

**Environmental Compliance Approval** means as interpreted by Section 2.1 of the Ontario Environmental Protection Act.

**Equivalent Single Axle Load (ESAL)** means equating the damage to the pavement structure caused by the passage of a non-standard load to a standard 80 kN axle load.

**Emergency Repair** means severe to very severe surface polishing and blow up.

**Fine Aggregate** means that portion of aggregate material passing the 4.75 mm sieve when tested according to LS-602.

**Friction Course General (FCG)** is an identifier which indicate the appropriate aggregate requirements.

**Frost Heave** means the seasonal rise in pavement elevation resulting from the formation of ice and ice lenses below the pavement surface.

**Glass** means processed glass obtained from a recycling stream that is free of organic materials, metal, and plastic.

**Gore Area** means the area between the edge of highway, edge of ramp, and the bullnose.

**Grade Raise** means a uniform increase in the existing pavement or design elevation over the cross-section width.

**Hot Mix Asphalt (HMA)** means hot mixed and hot laid asphaltic concrete which also includes mix produced using Warm Mix Asphalt (WMA) technologies, beneficiating HMA, HIR, and SMA. The terms are used interchangeably. HMA may include recycled mixes or specialty mixes.

**Horizontal Alignment** means the deviation, or skew, of the dowel bar from true parallel alignment from the edge of the pavement, measured over the entire length of the dowel bar.

**Horizontal Side Shift** means the location of the dowel bar relative to the planned location from the pavement edge, nearest longitudinal joint, or nearest parallel dowel bar.

**Inert Fill** means earth or rock fill or material of a similar nature that contains no material liable to become putrid, or soluble, or decomposable chemical substance.

**Insulation** means a material with a thermal resistance (the ratio of the temperature difference across the material and the heat flux) of 0.35 K.m2/W or greater for a 25.4 mm thick sample.

**International Roughness Index (IRI)** means a specific mathematical transform of a true pavement profile by means of a Quarter Car Filter where the absolute values of the vertical vibration are accumulated and divided by the sublot length. IRI is expressed in m/km.

**Joint** means a vertical contact between a new bituminous pavement course and any pavement or any rigid object that exists at the time the new course is laid.

**Joint Separation** means the fracture or partition of a joint in the pavement surface.

**Load Transfer Device** means a metal support, or dowel basket, that holds a dowel in place ahead of paving operations.

**Longitudinal Side Shift** means the longitudinal translation of the dowel bar relative to its planned location perpendicular to the pavement edge.

**Magnetic Pulse Induction Equipment (MIT Scan)** means a magnetic imaging tool specifically developed for measuring dowel and tie bar depth and alignment in concrete pavements and concrete bases.

**Mean Roughness Index (MRI)** means the number calculated by averaging the IRI values from two wheel path profiles.

**Miscellaneous Pavement Surface** means the top of the paved portion of the road shoulder, gore area, designated truck pull-off area, residential and commercial entrances, median crossover, snowplough turnaround, and other areas outside of the designated lanes for vehicular travel.

**Nickel Slag** means the non-metallic co-product resulting from the production of nickel.

**Non-Conformance** means that performance measurements do not meet acceptance criteria.

**North American Datum (NAD83)** means the horizontal geodetic datum for geo-referencing in Ontario and North America.

**Pavement Design** means specifying the excavation, treatment, material, methods, and process controls necessary to construct a pavement structure that will perform over the required service life.

**Percent within Limits (PWL)** means an estimate of the percentage of the lot population that is within the specified limits, determined by using the mean and standard deviation of the lot according to LS-101.

**Physical Property of Aggregate** means an inherent attribute or feature of an aggregate material. Tests are carried out to determine an aggregate’s resistance to weathering and/or degradation.

**Polishing** means polished appearance of pavement surface due to glazing of coarse aggregate particles in mix.

**Poor Performing Pavement** means an area of pavement that has performed uncharacteristically worse than the adjoining pavement areas.

**Pothole** means a void in the pavement surface resulting from the loss of pavement materials.

**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 requirements specified in the Contract Documents.

**Quarried Rock** means the material which has been or is being removed from an open excavation made in a solid mass of rock, which, prior to removal, was integral with the parent mass.

**Reclaimed Asphalt Pavement (RAP)** means the processed HMA that is recovered by partial or full depth removal.

**Reclaimed Concrete Material (RCM)** means removed or processed old hydraulic cement concrete, free of embedded materials that are not normal constituents of concrete mix.

**Rigid Pavement Structure** means layers of Base, drainage layer and concrete placed on a Subgrade and designed to resist movement and damage, support traffic loading, and provide drainage.

**Routine, Minor Maintenance** means the performance of crack sealing, pothole repair, spray patching, minor (less than 5% of surface area) hot mix patching, and drainage cleanout.

**Scaling** meansflaking orpeeling away of the concrete pavement surface.

**Service Life** means the length of time that a structure is expected to satisfactorily perform its basic functions, until rehabilitation is required.

**Slab** means a strip of concrete laid as a single un-jointed piece.

**Steel Slag** means the non-metallic co-product resulting from the production of steel in a basic oxygen furnace or an electric arc furnace.

**Tolerance** means a construction working tolerance only, minus or plus:

a) Minus

i. Narrower than the horizontal design dimension as measured from centreline, and

ii. Lower in elevation than the vertical design dimension.

b) Plus

i. Wider than the horizontal design dimension as measured from centreline, and

ii. Higher in elevation than the vertical design dimension.

**Transition Treatment** means a subexcavation at longitudinal and transverse changes in material or material condition designed to mitigate the impact of seasonal volume change due to frost or moisture.

**Vertical Alignment** means the deviation, or tilt, of the dowel bar from true parallel alignment from the surface of the pavement, measured over the entire length of the dowel bar.

**XXX.04 DESIGN AND SUBMISSION REQUIREMENTS**

**XXX.04.01 Pavement Design**

**XXX.04.01.01 General**

The concrete pavement design shall conform with the restrictions and constraints specified in the Contract Documents. The pavement shall be concrete.

The pavement design shall detail the excavations, material, staging, methods, quality control, inspections, and all other operations required to construct the pavement structure as specified in the Construction section and the Contract Documents, and meet the performance requirements of Tables 9 and 10.

The respective design service life of new and reconstructed concrete pavement structure shall be [\* Designer Fill-In, see Notes to Designer] years, minimum. The pavement design shall not include provisions for any work during the warranty period. The design shall be based on the performance of only routine, minor maintenance beyond the warranty period. Discretionary repairs, including joint resealing and crack sealing, may be carried out during the warranty period, subject to prior Owner approval.

The pavement design for the work shall include the removal, recycling or full depth reclamation of the existing pavement layers from the surface to a minimum depth of 100 mm into the underlying unbound granular layer if present. Where there is no underlying unbound granular layer, removal, recycling or full depth reclamation shall be to the bottom of the existing pavement layers. Where the underlying unbound granular layer is less than 100 mm in thickness, removal, recycling or full depth reclamation shall be to the bottom of the underlying unbound granular layer.

As required by other work or existing conditions, location specific pavement designs shall be completed. Other work or existing conditions include, but are not limited to, areas with grade revisions, turn tapers, added lanes, widening, sewer and culvert crossings, frost heaves, poor performing pavement areas, bridges and bridge approaches.

For design purposes, traffic volume information is shown in Table 1. Other traffic information, if available, is included elsewhere in the Contract Documents.

Pavement structures used temporarily for public or construction traffic, prior to the completion of paving, shall be designed for both the temporary traffic volume and the traffic volume in Table 1.

The design shall be according to accepted pavement design methodologies, such as MEPDG-1, GDPS-4-M, StreetPave 12, Pavement Designer, and MI-183. Where a pavement design methodology other than MEPDG-1 or GDPS-4-M is used, a design using MEPDG-1 or GDPS-4-M shall be completed and compared to the selected design. All pavement design work, including design parameters, shall be documented in the Pavement Design Report.

Granular layers shall be designed to be placed at uniform thickness and quality for the full road embankment width, except where subdrainage systems will be used. Where subdrainage systems will be used, the granular layers shall be designed to be placed at uniform thickness and quality to the shoulder rounding, minimum, on the side of the Roadway where subdrainage system will be placed.

The driving lane fully paved shoulder shall be a concrete widened slab of 0.5 m into the shoulder. The shoulder beyond the widened slab shall be as specified in the Contract Documents.

**XXX.04.01.02 Geometric Constraints**

The design top of pavement elevations at the horizontal alignment control line as specified in the Contract Documents shall be used for vertical profile control. When design top of pavement elevations are not provided, the existing top of pavement elevations at the horizontal alignment control line shall be used for vertical profile control. The final top of pavement elevations shall not be raised above the specified top of pavement design elevations or existing top of pavement elevations except as permitted in Table 2.

Each grade raise location shall be preceded and followed by a longitudinal transition zone sloping at 0.1%. The minimum distance between the last station of one grade raise and first station of the adjacent grade raise, excluding the transition zones, shall be 50 m.

Earth slopes, rock slopes, Subgrade, or drainage systems or a combination of these when shown in the Contract Drawings and on the cross-sections, are the Owner’s grading and drainage design. The Owner’s grading and drainage design shall not be changed, except:

a) The longitudinal profile and cross-section of the Subgrade may be raised.

b) In areas designed with 3H:1V or flatter earth embankment slopes, the longitudinal profile of the Subgrade may be lowered.

c) In earth excavation areas designed with 3H:1V or flatter front slopes, the longitudinal profile of the Subgrade may be lowered. If the Subgrade elevation is lowered in excavation areas, the pavement design shall provide adequate drainage of the Subgrade without changing the Owner’s design of the elevation and depth of ditches except that the ditch elevation may be lowered and the corresponding back slope moved out at the locations in Table 3.

**XXX.04.02 Submission Requirements**

**XXX.04.02.01 Pavement Design Report**

A Pavement Design Report (in both hard copy and digital form) bearing the seal and signature of an Engineer shall be submitted to the Contract Administrator at least 5 Business Days prior to the start of any granular Base or Subbase placement, removal or recycling of the existing pavement or excavation of the existing pavement or Shoulders, except for the construction of frost heave treatments, culverts and sewers.

The Pavement Design Report shall include:

a) An original copy of MTO form (PH-CC-822CPD) bearing the seal and signature of an Engineer certifying that the pavement design and the Pavement Design Report are in conformance with the requirements of the Contract Documents. The completed form shall be the first page after the report cover.

b) The printed name of the individual and company responsible for preparing the Pavement Design Report.

c) The concrete pavement structure design for all areas specified in the Contract Documents as “Rigid Pavement Structure, New”, and “Rigid Pavement Structure, Reconstruction”, including the design for all locations requiring a location specific pavement design, all associated calculations, and details of pavement grade raises.

d) Documentation of field review, and field and laboratory investigations completed.

e) Borehole logs, laboratory testing results, pavement core depth data and core analysis data from field and laboratory investigations.

f) Material, construction and laboratory standards, specifications, procedures and sources for the material to be used in the work and any major deviations from standards, specifications and procedures.

g) The design gradation for drainage layer, granular Base and Subbase material.

h) The material and construction requirements for subdrains, granular or paved Shoulders.

i) Details of Subgrade treatment, subexcavation, slope, and drainage installations.

j) Transition treatment details, including frost and approach treatments for culverts and structures.

k) The pavement vertical profile control methodology.

**XXX.04.02.02 Grade Templates**

Cross-section grade templates at maximum 25 m intervals in earth and 10 m in rock along the horizontal alignment shall be submitted to the Contract Administrator with the Pavement Design Report submission. The templates shall include design elevations and offset distances for Subgrade, Base, Subbase, top of pavement, and Shoulder surface, as applicable, at:

a) All break points; and

b) Edges of paved surfaces and edges of Shoulders for all Roadways, entrances, ditches, ramps, turn lanes and tapers, transition treatments, snow plough turnarounds, and truck pull-offs.

In the event of a conflict between the submitted templates and the Contract Documents, the Contract Documents shall take precedence.

**XXX.04.03 Mix Designs**

**XXX.04.03.01 General**

Mix designs for concrete, HMA and CMA shall be submitted to the Contract Administrator at least 5 Business Days prior to the start of mix production and placement. The mix design information shall be prefaced with an index sheet showing the location of the information listed in the clauses below.

For all bituminous mixes, the mix design method shall include a check of the need for an anti-stripping additive.

**XXX.04.03.02 Mix Designs for Concrete Pavement**

The concrete mix design shall result in concrete having adequate strength and durability for the intended use and meeting the requirements as specified in Table 4.

Concrete mix design submissions shall be according to OPSS 1350 Submission Requirements - Mix Design.

**XXX.04.03.03** **Mix Designs for Hot Mix Asphalt Shoulder**

The mix design submission for all HMA mixes shall include, but not be limited to, the following information:

a) For all HMA mixes:

i. Contract number and mix type for which the mix design and JMF were completed and a description of what the use of the mix is to be.

ii. The JMF.

iii. Aggregate sources.

iv. The type of anti-stripping additive and the percentage to be added by mass of total dry aggregate.

v. Asphalt cement grade and source, identification and source of modifiers, and resulting grade of asphalt cement after addition of all mix components including anti-stripping additives.

vi. Additive information including source, type, and percent by mass of asphalt cement.

vii. Information regarding fines which are returned to the mix, aggregate breakdown during production and the resultant changes in the aggregate gradations.

viii. The mix maximum relative density and the mix bulk relative density, surface dry (where applicable).

ix. Extracted bulk relative density, percentage asphalt cement and gradation for the RAP used in the mix, when RAP is used.

x. The mixing and compaction temperature used in the mix design.

b) For HMA mixes designed using the Superpave Volumetric Mix Design method, documentation shall include reporting requirements of MTO laboratory test method LS-309 Superpave Mix Design.

c) The mix design submission for WMA mixes shall include the WMA technology to be used, the complete name and address of the WMA supplier, and the type and dosage of WMA additives, if applicable, and how the additives will be incorporated to produce the WMA.

**XXX.04.03.04 Mix Designs for Cold Mix Asphalt**

The mix design submission for all CMA mixes shall include the following:

a) Information on the grade/type, manufacturer, and supplier of the asphalt cement or emulsified asphalt to be used.

b) The design rate of expanded asphalt or emulsified asphalt.

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

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

**XXX.05 MATERIAL**

**XXX.05.01 General**

Material containing contaminants that may discharge into the environment or have an adverse effect on the natural environment or the Work shall not be used.

Material that may render the pavement unsuitable for future recycling or use as inert fill shall not be used.

The use of material not referenced in this specification is permitted upon approval with the submission of supporting technical evidence to the Contract Administrator, at least 15 Days prior to placement of the material. The supporting technical evidence shall bear the seal and signature of an Engineer and demonstrate that the material has been successfully used elsewhere under similar climatic and traffic conditions, and does not contravene any requirements of the Contract Documents. The submission shall include the source of the material, the approximate quantity of the material to be placed, and the location of placement.

**XXX.05.02 Concrete**

Concrete and concrete materials shall be according to the Materials section of OPSS 1350 with the exception that the maximum allowable proportion by mass of the total cementing material for slag shall be 30%.

The minimum specified 28-day compressive strength shall be 35 MPa.

**XXX.05.03 Aggregates**

**XXX.05.03.01 General**

Aggregates shall meet all of the requirements of this specification when tested according to the applicable MTO, AASHTO, and ASTM test methods identified herein.

Aggregates for drainage layer, granular Base and Subbase, HMA, CMA, and granular backfill below Subgrade shall not contain earth, humus, clay coatings, clay lumps or fragments, wood, clay brick, gypsum, gypsum plaster, cement kiln dust, wallboard, asbestos, steel slag and other contaminants.

**XXX.05.03.02 Granular Base, Granular Subbase and Granular Shoulder Aggregates**

Except as specified below, aggregates for granular Base and Subbase shall be clean, hard, durable particles produced from, or a combination of:

a) Quarried rock;

b) Gravel, cobbles, boulders, sand, fines, or talus from naturally formed deposits;

c) Air-cooled iron blast furnace slag or nickel slag;

d) RCM; and

e) RAP.

Aggregates for granular shouldering shall be Granular A or Granular M according to OPSS 1010.

Aggregates for granular Base and Subbase shall not contain more than 15 percent by mass of crushed glass and/or ceramic material, as determined by LS-609 and no more than 30% asphalt-coated particles, as determined by LS-621.

Aggregates for granular shoulders shall contain no crushed glass or ceramics and no more than 50% asphalt coated particles by mass when tested according to LS-621.

Aggregates for granular shoulders as well as granular Base placed less than 150 mm below the bottom of the concrete layers shall have 100% passing the 26.5 mm sieve, and not more than 10% passing the 75 µm sieve, when tested according to LS-602.

The maximum dimension of all aggregate particles in granular Subbase material shall be less than 150 mm when placed greater than 150 mm below the bottom of the concrete layer.

Granular Base aggregates used under paved lanes and for fully-paved Shoulders shall not be blended with RAP containing steel slag aggregates.

Base and Subbase aggregates shall meet the physical property requirements specified in Table 5A.

**XXX.05.03.03 Drainage Layer Aggregates**

Drainage layer aggregates shall consist of 100% crushed particles produced by crushing bedrock material. Reclaimed materials or crushed reclaimed materials shall not be used.

The gradation of the drainage aggregates used in a drainage layer shall be according to the Gradation Requirements (LS-602) table in OPSS 320.

The physical requirements of drainage layer shall be according to the Physical Property Requirements table in OPSS 320, with the except that the price reduction ranges in the table do not apply.

**XXX.05.03.04 Aggregates for Concrete Pavement**

Except as noted below or elsewhere in the Contract Documents, aggregates may be sands, gravel, or quarried rock; provided the source is of such nature and extent to ensure acceptable processed aggregates of a consistent grading and quality.

The aggregates for concrete pavement shall meet the physical property requirements specified in the physical property requirements for fine aggregate table and the physical property requirements for coarse aggregate table in OPSS 1002.

The gradation of fine aggregates used shall be according to the grading requirements for fine aggregates table in OPSS 1002. The coarse aggregate shall have a combined gradation using aggregates of 37.5 and 19.0 mm nominal maximum aggregate size, according to the grading requirements for coarse aggregate table in OPSS 1002.

**XXX.05.03.05 Aggregates for Hot Mix and Cold Mix Asphalt**

Except as specified below, aggregates for HMA and CMA shall be clean, hard, durable particles produced from, or a combination of:

a) Quarried rock;

b) Gravel, cobbles, boulders, sand, fines, or talus from naturally formed deposits; and

c) RAP.

Steel slag, air-cooled blast furnace slag, nickel slag, copper slag, and RAP containing steel slag shall not be used as aggregates in HMA and CMA. Roof shingle, crumb rubber, glass or ceramic material shall not be used in HMA and CMA.

The gradation of each HMA surface course mix, shall be according to Table 5D.

With the exception of the aggregates extracted from RAP, the physical properties for hot mix shall meet the requirements as specified in Table 5B and Table 5C.

In addition to the physical property requirements for the blended HMA or CMA aggregate components described above, the fine and coarse fractions of the aggregates extracted from samples of HMA or CMA shall also meet the applicable physical property requirements specified in Tables 5E and 5F.

RAP and hot milled material used in an HMA surface or binder course mix shall be comprised of aggregates that, when blended with all of the other aggregates in the HMA, meet the physical property requirements specified in Tables 5E and 5F.

**XXX.05.04 Insulation**

Insulation may be used within the pavement structure subject to the following conditions:

a) the insulation shall not be used on horizontal curves, interchange ramps, and speed change lanes, or within 250 m of horizontal curves, interchange ramps, speed change lanes, vertical curve crests, intersections and entrances, railroad crossings, and bridges;

b) the thickness of the insulation shall not exceed 100 mm;

c) the minimum depth of granular Base and Subbase material overlying the insulation shall be according to Table 6;

d) the insulation shall be installed full pavement width, including below Shoulders; and

e) transition treatments shall be constructed at the longitudinal installation limits.

The minimum granular depths in Table 6 do not account for the compressive strength of the insulation.

**XXX.05.05 Dowel Bars and Load Transfer Devices**

Dowel bars and load transfer devices shall be shop coated with RC-250, Tectyl 506 or an Owner-approved equivalent. Dowel bars shall be greased to prevent bonding to the concrete pavement.

**XXX.05.06 Curing Compound**

Curing compound shall be according to OPSS 1315.

**XXX.05.07 Joint Sealing Compound**

Hot poured rubberized asphalt joint sealing compound shall be according to OPSS 1212, and shall be one of the joint sealing compound on the ministry’s DSM list:

**XXX.06 EQUIPMENT – Not Used**

**XXX.07 CONSTRUCTION**

**XXX.07.01 General**

Concrete pavement construction shall be according to the Pavement Design Report and the Contract Documents, and includes, but is not limited to:

a) Rehabilitation of the existing and the construction of new drainage system(s), in addition to the drainage work specified in the Contract Documents, as required for the performance of the new, or reconstructed concrete pavement structure(s). This includes, but is not limited to; ditch clean-out, new ditching, and subsurface drains.

b) Excavation, removal, recycling, or full depth reclamation of the material in existing pavement structure, Shoulders and Subgrade.

c) Supply and placement of granular material, HMA, CMA, drainage layer material, concrete, recycled material, and other material required to construct the pavement structure(s), and for entrances, shoulders, temporary roadwork, temporary edge ramps, and all other paved and unpaved areas.

d) The treatment of or subexcavation and backfill of Subgrade soils, and the construction of Subgrade slope and drainage installations as required.

e) Excavation and removal of existing material, and the supply and placement of granular material to construct transition treatments, including frost and approach treatments for culverts and structures, sidewalks, curb and gutter, barrier walls and concrete pads; unless otherwise specified in the Contract Documents.

f) The supply and placement of granular material above Subgrade at excavation locations, including, but not limited to, at sewer and culvert locations.

g) Supply and placement of HMA on bridge decks and approach slabs at the total thickness specified in the Contract Documents.

h) Removal of temporary roadwork.

i) Placement of excavated/removed material in embankments, slope flattening in designated locations where applicable, and the management of excess material according to the Contract Documents.

j) Preparation and submission of all specified documentation.

k) Sampling of material for testing.

l) Repair or replacement of work that does not conform to the material or performance requirements, including all associated work.

m) The management of excess material as specified in the Contract Documents.

In the event of a conflict between the Pavement Design Report and the Contract Documents, the Contract Documents shall take precedence.

All inspection and material testing, except for QA sampling and testing, shall be carried out by or under the supervision of an Engineer. QA sampling and testing will be according to the Owner’s procedures.

**XXX.07.02 Design Amendment**

The pavement design may be amended to address localized problem areas occurring during construction.

The pavement design shall be amended to correct work identified by the Contract Administrator, when the work is not conforming to the Pavement Design Report.

Design amendments shall conform to the requirements of the Contract Documents.

The Engineer responsible for the pavement design shall review localized problem areas and non-conforming work and determine the design amendments required.

A Pavement Design Report Addendum, bearing the seal and signature of the Engineer, shall be submitted to the Contract Administrator within 5 Business Days of the review. An Addendum report is not required when non-conforming work is corrected to conform to the Pavement Design Report.

**XXX.07.03 Removals**

Removals shall be performed in such a manner as to leave adjacent pavement and structures undisturbed.

During the work of full-depth pavement removal, where public traffic is to be maintained throughout the work without the use of a temporary bypass, temporary granular ramping shall be constructed and maintained to convey public traffic through the area. The ramping shall be at 20H:1V. Following full-depth pavement removal, the existing roadway granular shall be restored according to OPSS 301, when such roadway is not designated for abandonment.

When the roadway is to be opened to traffic after the daily shut down and full width partial depth pavement removal is required, the following shall apply:

a) For two-lane highways, partial depth pavement removal shall be completed to the same station for the full pavement width prior to shutdown at the end of the day.

b) For multi-lane highways, partial depth pavement removal shall be completed to essentially the same station for the full pavement width for a specific direction prior to shutdown at the end of the day.

c) Prior to opening the lanes to traffic, transverse ramping shall be constructed at the limits of partial depth pavement removal at a slope not steeper than 120H:1V.

If, due to unforeseen circumstances, partial depth pavement removal cannot be completed to the same station for the full pavement width prior to shutdown at the end of the day, then temporary, longitudinal ramping shall be constructed at a slope not steeper than 10H:1V.

When removed pavement material is to remain temporarily on site due to construction operations, the removed material shall be placed on an asphalt or concrete surface until final disposition.

Partial-depth asphalt pavement removal operations and the resulting surfaces from partial-depth asphalt removal operations shall not be permitted between November 16th and June 1st, unless approved by the Owner.

**XXX.07.04 Subgrade and Granular Courses**

**XXX.07.04.01 General**

A granular course includes material produced by full depth reclamation of the existing bituminous mix(es) and underlying granular material with or without stabilization.

The surface of the uppermost layer of granular material shall be bladed, shaped and compacted to produce the required surface contour.

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

**XXX.07.04.02 Tolerances for Subgrade**

All Subgrade surfaces shall, on completion, be shaped to the specified line, grade and cross-section within the following tolerances.

Vertical grading tolerances of finished earth Subgrade are:

+ 30 mm

- 30 mm

Vertical grading tolerances of finished rock Subgrade are:

+ 30 mm

- 100 mm

Horizontal grading tolerances of finished Subgrade are:

+ 300 mm

- 0 mm

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

**XXX.07.04.03 Tolerances for Granular Courses**

All granular grade surfaces shall, on completion, be shaped to the specified line, grade and cross-section within the following tolerances, and the surface shall not deviate more than 15 mm at any place along a 3 m straightedge.

Vertical grading tolerances of the finished granular Base and Subbase are:

+ 30 mm

- 30 mm

Horizontal grading tolerances of the finished granular Base and Subbase are:

+ 30 mm

- 0 mm

**XXX.07.04.04 Granular Shouldering**

Granular shouldering operations shall be completed within 48 hours of completing the pavement surface on pavement sections that are open to traffic. Where the pavement section is not open to traffic, the granular shouldering shall be completed before traffic is permitted on the pavement.

All debris and deleterious material shall be removed from the Shoulder area before commencing Shoulder construction.

A temporary ramp of granular shouldering material shall be built and maintained along the exposed outside edges of each pavement course. Such ramps shall be of a height level with the pavement course and fall away from its edge at a slope not steeper than 4H:1V. Ramps shall be kept completed at all times to the end of that portion of pavement opened to traffic behind the paver, and no portion of the pavement shall be open to traffic until the ramps have been constructed.

**XXX.07.04.05 Grade Checks**

The Contract Administrator shall be notified within 12 hours after completion of each of the following and prior to the next course being placed: Subgrade, Base, Subbase, and drainage layer, including Shoulders.

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

A competent survey crew shall carry out grade checks on all finished Subgrade and granular surfaces. Grade checks shall be based on horizontal and vertical grading tolerances, as specified in the Tolerances for Subgrade and Tolerances for Granular Courses clauses. The grade shall be certified at the stations and offsets on the grade templates.

**XXX.07.04.06 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.

The Contractor shall sign and certify on the grade templates that the components of the work indicated on that template have been correctly constructed to the specified line and grade tolerances. If no template is available, the Contractor shall sign and submit MTO form PH-CC-820 to the Contract Administrator.

**XXX.07.05 Paving Operations**

**XXX.07.05.01 Concrete Paving**

**XXX.07.05.01.01 General**

Concrete shall be placed to the thickness specified in the Pavement Design Report submission and shall meet all acceptance criteria specified in the Contract Documents.

**XXX.07.05.01.02 Operational Constraints**

At daily shutdown of construction operations, there shall be no longitudinal vertical edge drop greater than 40 mm on a portion of the Roadway that will remain closed to public traffic. This requirement does not apply when the entire Roadway will remain closed to public traffic, or when the open and closed portions of the Roadway are separated by a temporary concrete barrier.

Traffic, other than foot traffic and rubber-tired sawing equipment, shall not be permitted on the concrete until it has attained a compressive strength of 20 MPa. The concrete shall be protected from damage to the surface at all times.

Shouldering operations and construction of adjacent lanes may commence once the adjacent concrete has attained a compressive strength of 20 MPa.

Concrete shall only be placed when the ambient air temperature is 1°C and rising, or is less than 32°C. Concrete shall not be placed on or against frozen ground.

**XXX.07.05.01.03 Load Transfer Devices**

Load transfer devices shall be installed according to the Contract Documents.

**XXX.07.05.01.04 Cold Weather Protection**

The cold weather protection system shall be designed for the worst conditions that can be reasonably anticipated from local weather records, forecasts, site conditions, and past experience for the time period during which the protection is required. For cold weather conditions, concrete shall be protected according to the measures specified in the Minimum Cold Weather Protective Measures table of OPSS 904. The conditions shall be monitored, and the protection system modified as required.

**XXX.07.05.01.05 Joints**

Dowel bars shall be placed mid-depth of the concrete pavement or concrete base within the following tolerances:

a) For a pavement or base thickness of < 215 mm, lower limit = - 6 mm, upper limit = + 6 mm

b) For a pavement or base thickness from 215 to 229 mm, lower limit = -12 mm, upper limit = +15 mm

c) For a pavement or base thickness of 230 mm or greater, lower limit = -15 mm, upper limit = +25 mm

Transverse construction joints shall be made at the end of each day's production or when an interruption greater than 20 minutes occurs in the concrete paving operation. Construction joints shall be located at a transverse contraction joint or expansion joint location.

At longitudinal joints, tie bars shall be installed within a tolerance of ±15 mm from the specified depth.

Longitudinal and transverse joints shall be sawcut a minimum of one third the depth of the concrete pavement or concrete base and shall be a maximum of 6 mm in width. Longitudinal and transverse cleaned and dried joints shall be completely filled to the bottom of the sawcut with approved low modulus joint sealing compound listed on the DSM.

The joint shall be filled with joint sealing compound so that upon cooling, the joint sealing compound is recessed 3 to 6 mm below the adjacent pavement or base surface. If the initial placement of material subsides below the required recess depths, additional joint sealing compound shall be placed within eight hours of the original placement. Joint sealing compound shall not be placed when the ambient air or pavement surface temperatures are less than 5 °C. There shall be no reservoir cut and a backer rod shall not be used.

**XXX.07.05.01.06 Curing of Concrete**

Curing shall be applied immediately after initial texturing of the concrete surface, and within 15 minutes of concrete being formed by the paver.

The curing period shall be a minimum of seven Days for concrete cured with curing compound and concrete subject to cold weather. For all other concrete, the curing period shall be a minimum of four Days.

Concrete pavement and concrete base shall be cured using one of the following methods, according to the applicable clauses of OPSS 904:

a) Curing with Curing Compound clause, or

b) Curing with Burlap and Water clause.

Formed surfaces shall require no additional curing where the formwork is left in place for the minimum specified curing period. If formwork is removed during the curing period, formed surfaces shall be cured using one of the methods listed above.

When curing compound is used, it shall not be applied to joint faces against which joint sealing compound will be placed or, to concrete surfaces to which concrete or mortar is to be bonded.

Curing compound used on the surface of a concrete base shall be removed completely prior to the application of tack coat and overlaying with asphalt pavement. The method of removal shall be by abrasive shot blasting and it shall not result in any damage to the concrete surface. The removal process shall meet all environmental constraints as specified in the Contract Documents.

**XXX.07.05.01.07 Texturing of Surface**

The plastic surface of the concrete shall receive an initial texturing immediately after finishing and before the application of curing on the concrete. The initial texturing shall be performed by dragging burlap longitudinally to produce a uniform textured surface. The burlap shall be kept in a clean condition and free from tears and encrusted mortar. It shall be kept damp but shall not add excessive water to the concrete surface.

Concrete pavements shall receive a final texturing by grooving longitudinally. The grooving direction shall be consistent for the extent of concrete paving in the Work.

Grooves shall be cut 2.5 mm in width, with a tolerance of plus 1.5 mm, and between 3.0 and 6.0 mm in depth. Over inductive loop detectors, grooves shall be cut between 1.5 and 3.0 mm in depth. Grooves shall have a centre-to-centre spacing of 19 mm with a tolerance of plus or minus 2.5 mm. Grooves shall be cut to within 150 mm and no closer than 50 mm of longitudinal joints.

**XXX.07.05.02 HMA and CMA Shoulder Paving**

**XXX.07.05.02.01 General**

HMA and CMA shall be placed and compacted to the thickness and shall meet all acceptance criteria specified in the Contract.

The HMA surface course shall be smooth and true to the design profile and cross-section and be of uniform appearance and free of defects.

**XXX.07.05.02.02 Operational Constraints**

Before seasonal shutdown, the shoulders shall be completed to the corresponding elevation of the top of the adjacent pavement surface.

Detours shall be paved with HMA prior to opening the detour to public traffic, except where specified otherwise in the Contract Documents.

**XXX.07.05.02.03 Temporary Ramp Downs**

HMA and CMA courses shall be temporarily ramped down to the existing pavement at a slope of 120H:1V transversely. Transverse ramps downs shall not form part of the permanent pavement and shall be removed prior to paving of the adjacent section.

Where longitudinal ramp downs are permitted or if, due to unforeseen circumstances such as equipment breakdown occurring during paving, paving cannot be completed to the same station across the full pavement width, the HMA or CMA course shall be temporarily ramped down to the existing pavement at a slope of 10H:1V. Only one temporary longitudinal ramp down shall be in place across the width of the pavement at any time. The temporary longitudinal ramp down shall not form part of the permanent pavement and shall be removed prior to paving the adjacent section. The adjacent paving shall be completed such that the ramping is not in place more than 5 Days.

Loose particles generated during construction of the longitudinal or transverse ramp downs or both shall be removed from the roadway surface prior to re-opening the roadway to traffic.

After removal of the temporary longitudinal ramp down, traffic shall not be permitted to cross over the vertical surface at the longitudinal edge before the adjacent paving is completed.

**XXX.07.06 Sampling of Aggregate**

**XXX.07.06.01 Aggregates**

**XXX.07.06.01.01 General**

All QA samples shall be duplicate samples. Each QA sample shall be treated as a discrete sample and not combined or blended with any other sample.

New or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment shall be used. Metal or cardboard containers are unacceptable. QA samples shall be identified both inside and outside of the sample container. Data to be included with QA samples shall be according to MTO Form PH-D-10.

In the event that the Contractor is unavailable to take any of the samples, no further materials shall be placed in the Work until the samples have been taken.

In addition to the duplicate samples, a third sample shall be taken when requested by the Contract Administrator.

One of each of the duplicate QA samples shall be randomly selected for testing by the QA laboratory. The QA laboratory shall retain the remaining QA samples for referee testing, if required.

**XXX.07.06.01.02 Drainage Layer, Base and Subbase Aggregate**

Drainage layer, Base and Subbase aggregate QA samples shall be taken according to the Contract Documents and LS-625 and shall be road samples or delivery samples from the Work at a location determined by the Contract Administrator.

When required, a front-end loader shall be used to obtain material for QA samples.

When it is not possible to take road or delivery samples, samples of compacted material taken with the permission of the Owner shall be used for QA acceptance purposes.

At least one set of duplicate QA samples of each drainage layer, Base and Subbase aggregate to be used in the Work shall be randomly sampled from lots of 20,000 tonnes or part thereof for physical properties and lots of every 5000 tonnes for gradation, or part thereof. All materials delivered to the Work shall be included within a lot.

For drainage layer, a minimum of one intact 150 mm nominal diameter core shall be taken of the full depth of the drainage layer for each lot at a random location for porosity test. If an intact and undamaged core cannot be obtained, then the sample shall be taken by saw cutting an intact sample with minimum dimensions of 140 by 140 mm and maximum dimensions of 145 by 145 mm, square. The sample shall be delivered intact and undamaged.

**XXX.07.06.01.03 Concrete Aggregate**

Unless otherwise specified, all QA concrete aggregate samples shall be taken at the production plant from individual stockpiles, according to the Stockpile Method clause. In the absence of individual stockpiles at the plant, QA samples shall be taken at the aggregate source.

During production, the following minimum number of random samples shall be obtained for every 10,000 m2, or part thereof, of each concrete mix produced one set of duplicate samples of each aggregate used in the mix, including chip products.

**XXX.07.06.01.03.01** **Aggregate Processing, Handling, and Stockpiling**

Processed aggregates shall be separated into fine and coarse aggregates and stockpiled separately. Aggregates separated during processing, aggregates secured from different sources, aggregates from the same source but of different gradings, or from a new bench in a quarry, or aggregates resulting from a significant change in production that affects physical quality shall be stockpiled separately.

For blended aggregates, one of the following shall be provided:

* 1. A single stockpile of at least 1000 tonnes of uniformly-blended fine aggregate that is intended for use in the mix; OR
  2. The proportion of each fine aggregate component in the mix shall be specified, as part of the mix design submission.

Aggregates that have become mixed with foreign matter of any description, or aggregates that have become mixed with each other, shall not be used and shall be removed from the stockpile immediately.

Aggregate shall be retained in stockpiles for at least 24 hours before use. Suitable stockpile locations include the construction site and the site of batching of the concrete. Other locations may be used for stockpiles provided they are acceptable to the Contract Administrator.

**XXX.07.06.01.04 HMA and CMA Aggregates**

Unless otherwise specified, all QA HMA and CMA aggregate samples shall be taken at the hot mix plant from individual stockpiles, according to the Stockpile Method clause. In the absence of individual stockpiles at the plant, QA samples shall be taken at the aggregate source.

The lot size for HMA and CMA aggregates physical properties and gradation shall be based on 100,000 m2 or part thereof of each HMA and CMA mix produced.

HMA samples shall be taken as HMA is being placed on the Contract.

During production, the following minimum number of random samples shall be obtained for every lot or part thereof of each HMA and CMA mix produced:

a) One set of duplicate samples of each aggregate used in the mix, including chip products.

b) One set of duplicate samples of RAP, if RAP is used in the mix.

c) One set of duplicate samples of CR, if CR is used in the mix.

dc) One set of duplicate samples of HMA or CMA.

ed) One set of duplicate samples of AC.

When an anti-stripping additive is used, QA HMA and CMA aggregate samples shall be taken prior to the addition of the anti-stripping additive. If this is not practical for samples that are coated in hydrated lime, the lime shall be removed by washing prior to testing. In this case, the requirements for LS-601 are waived.

**XXX.07.06.01.05 Sample Size**

The mass of each QA sample shall meet the requirements shown in Table 7. When more than 30 kg of material is required, the total sample shall be recombined prior to testing.

**XXX.07.06.01.06 Stockpile Method**

The stockpiles from which the QA samples are to be taken shall contain a minimum quantity of 500 tonnes of each aggregate, or at least 10% of the total quantity of aggregate needed for each concrete mix, unless otherwise directed by the Contract Administrator. QA sampling from stockpile shall be according to LS-625.

**XXX.07.07** **Sampling of Concrete Pavement or Concrete Base for** **Testing of** **Thickness, 28-Day Compressive Strength, Air Void System (AVS) Parameters and Rapid Chloride Permeability (RCP)**

**XXX.07.07.01 General**

Core samples shall be removed from the concrete pavement or concrete base at locations identified by the Contract Administrator, for acceptance testing of thickness, 28-Day compressive strength, air void system parameters and rapid chloride permeability.

The lot and sublot size, and number of cores per sublot, shall be according to the Quality Assurance section.

**XXX.07.07.02 Coring**

Core samples shall be obtained for acceptance testing. Coring shall be carried out according to CSA A23.2-14C. The cores shall be 100 mm in diameter and shall be drilled through the full depth of concrete pavement or concrete base, perpendicular to the surface of the pavement or base. No core shall be taken within 250 mm of any joint or edge of slab.

Removal of five cores per sublot for testing of 28-day compressive strength, air void system and rapid chloride permeability shall be carried out when the concrete is seven to 10 days of age. The Contract Administrator shall randomly select a location for coring within the sublot, and three cores for acceptance testing of 28-day compressive strength shall be removed from a single panel of concrete pavement or concrete base. Cores for testing of air void system parameters and rapid chloride permeability shall be taken from a panel of concrete pavement or concrete base adjacent to the panel from which the cores for compressive strength testing were taken.

Core samples for measurement of thickness shall be taken after completion of any repairs and of final texturing. A single core shall be removed from each sublot for thickness measurement, at a location randomly selected by the Contract Administrator.

Each core shall be marked legibly with durable ink immediately after removal with the following:

a) The Contract number.

b) Component type (pavement or base).

c) Lot number.

d) Sublot number.

e) Exact location of each individual core.

f) Date of concrete placement (i.e., yyyy-mm-dd).

g) Date of extraction.

Each core shall be placed in a plastic bag and sealed to prevent loss of moisture, before they are placed in a security bag in the presence of the Contract Administrator. The cores shall be accompanied by a transmittal form and the Form A of the concrete mix design for the concrete pavement or concrete base shall all be submitted to the Contract Administrator.

The Contract Administrator may require that additional cores be taken at joint locations, after sealing operations are complete, to evaluate the acceptability of the joint cleaning and sealing, up to two cores per sublot. If the samples show that the joint cleaning and sealing is not according to this specification, additional cores may be required at the Contractor’s expense.

Core holes shall be filled according to OPSS 1350.

**XXX.07.08 Measurement of Position and Alignment of Dowel Bars**

**XXX.07.08.01 Joint Cut-Out Procedure**

Joint cut-outs shall be carried out by the Contractor for evaluation of dowel bar alignment by the Contract Administrator. The joint cut-out measurement shall be according to the Quality Assurance section. The Contract Administrator will select the transverse joint to be evaluated.

At the selected joint, the concrete shall be removed by chipping hammer to a depth exposing the full length of all the dowel bars across the entire joint. The concrete shall be removed without disturbing the dowel bars.

After the selected joint has been measured and evaluated by the Contract Administrator, the joint shall be removed and replaced with a full depth concrete repair, 2 m in length, according to OPSS 366, with the exception that joint sealing shall be according to this specification.

**XXX.07.08.02 Preparation for Measurement of Position and Alignment of Dowel Bars**

The Contract Administrator shall be notified in writing when the concrete pavement or concrete base is ready for measurement by the Owner, of the position and alignment of dowel bars, using the MIT scan. Lot size, measurement and acceptance of position and alignment of dowel bars using MIT Scan shall be according to the Quality Assurance section.

Provisions shall be made for access to the site for acceptance testing of position and alignment of dowel bars.

The area to be measured shall be free of loose stone, debris and obstructions.

After the measurements by the MIT scan are completed, all areas to be repaired shall be marked on the concrete surface at the direction of the Contract Administrator and prior to the commencement of any corrective work.

**XXX.07.09 Preparation for Surface Smoothness Measurement**

The Contract Administrator shall be notified in writing when the concrete pavement or concrete base is ready for surface smoothness acceptance testing. Surface smoothness measurements for acceptance testing shall be carried out after final texturing has been completed.

Provisions shall be made for access to the site for surface smoothness acceptance testing.

The surface to be tested shall be clear of any loose stone, debris, and obstructions which could affect the measurement. The sublot number and station shall be clearly marked at the beginning of each sublot in a way that remains visible to the profiler operator until the final measurements are completed and accepted.

When reflectors are used for quality assurance or referee measurements, reflectors shall be obtained from the profiler operator and placed on the left/right shoulder or the highway median at the beginning and end of each profile run as required by the profiler operator. After smoothness measurements are completed each day, the reflectors shall be removed and returned to the profiler operator.

When Global Position System-Distance Measuring Instrument (GPS-DMI) technology is used for quality assurance or referee measurements, the profiler operator shall collect static GPS coordinates while stopped on the shoulder. Traffic protection for the collection of static GPS coordinates shall be provided.

After the measurements are analyzed, all areas to be repaired due to rejectable sublots or incidents of localized roughness or both, shall be marked on the concrete surface at the direction of the Contract Administrator and prior to the commencement of any corrective work.

**XXX.07.10 Management of Excess Material**

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

**XXX.07.11 Post-Construction Documentation**

Within 15 Business Days after the date of issuance of the Certificate of Contract Completion, an original copy of the MTO form PH-CC-822PCC bearing the seal and signature of an Engineer certifying that the material and construction are in conformance to the Pavement Design Report and the Contract Documents, shall be submitted to the Contract Administrator. The certification shall be based on a review of construction methods, and inspection and material testing records obtained throughout construction. The date of the Engineer’s certification shall not be earlier than the date of issuance of the Certificate of Contract Completion.

The following documentation shall be submitted to the Contract Administrator with the Engineer’s certification:

a) The final pavement construction details and drawings for the as-constructed Roadway(s), frost heave treatments, transition treatments including frost and approach treatments for culverts and structures, the type and location of insulation placement, and drainage systems; including the final Subgrade elevations, ditch grades, ditch profiles in areas of earth/rock ditch clean out, width and cross-fall for lanes and Shoulders.

b) A list of material sources for:

i. Subbase, base and drainage layer aggregates.

ii. Asphalt cement or Portland cement treated drainage layer.

iii. Tie bars, dowel bars, and load transfer devices.

c) All concrete, CMA, HMA mix designs used with the dates and locations where each one was used.

A copy of all inspection and material testing records reviewed by the Engineer prior to certification shall be retained by the Engineer for the duration of the performance warranty period and submitted to the Owner upon request.

**XXX.08 QUALITY ASSURANCE**

**XXX.08.01 Performance Requirements Prior to Contract Completion**

Acceptance of the work prior to Contract Completion shall be based on the following criteria with assessment or testing conducted by the Owner or the Owner’s representative:

a) Grade Checks,

b) Aggregate in drainage layer, Base, Subbase, HMA, CMA, Concrete Pavement and Concrete Base

c) Surface Tolerance,

d) Surface Smoothness,

e) Geometrics and Longitudinal Joint Location, and

f) Strength, thickness, AVS and RCP

g) Dowel Bar Alignments

The Owner shall be responsible for all costs associated with testing for QA purposes, unless otherwise specified. Individual test results shall be forwarded to the Contractor, as they become available.

**XXX.08.01.01 Grade Checks**

**XXX.08.01.01.01 General**

The Owner may conduct random QA grade checks to verify that the grade and cross-section of the Subgrade, drainage layer, Base, and Subbase, including Shoulders, are within the specified tolerances.

**XXX.08.01.01.02 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 specified tolerances, then:

a) The Contract Administrator shall notify the Contractor and advise where the tolerances have not been met.

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 Subgrade or granular surface to within the specified tolerances for grade, at no additional cost to the Owner.

**XXX.08.01.02 Aggregate in Drainage Layer, Base, Subbase, HMA, CMA, Concrete Pavement and Concrete Base**

**XXX.08.01.02.01 General**

The laboratory designated by the Owner may carry out QA testing for purposes of ensuring that the aggregates used in the work conform to the physical property requirements of this specification.

QA testing of drainage layer, Base and Subbase may be waived by the Contract Administrator when the delivery quantity of drainage layer, Base or Subbase is less than 5,000 tonnes.

QA testing shall be conducted on samples of each individual aggregate component in the mix.

**XXX.08.01.02.02 Alternative to LS-614**

LS-614 shall be used for acceptance, unless written notification to the Contract Administrator to replace it with LS-606 for acceptance is received prior to sampling of the applicable materials for QA purposes. Provided that the Contract Administrator has received such a request, LS-606 shall be used. Otherwise, conformance to LS-614 shall be required.

When notification to replace LS-614 is received after QA testing using LS-614 has been initiated, the Contractor shall then be charged $600.00 for each test initiated, which includes the cost of the testing using LS-614, administrative charges, and additional sampling, if required.

**XXX.08.01.02.03 Acceptance**

**XXX.08.01.02.03.01 Drainage Layer, Base and Subbase Aggregate**

The aggregates within a lot of drainage layer, Base or Subbase shall be deemed to be acceptable if all of the test results for the aggregates representing that lot meet all applicable requirements of this specification.

If QA test results of an aggregate sample representing a lot of drainage layer, Base or Subbase do not meet all of the requirements of this specification, then a payment reduction shall be given for the aggregates within that lot, as long as the applicable test results for that sample:

a) Do not exceed the requirement for LS-618 by more than 10% of the specified value.

b) Meet all other physical property requirements of this specification.

c) For drainage layer, be within 10% of the acceptable range on each sieve for gradation, as specified in the gradation requirements table in OPSS 320.

If QA test results of an aggregate sample representing a lot of drainage layer, Base or Subbase do not meet the requirements listed above, then all of the aggregates within that lot shall be considered rejectable and any drainage layer, Base or Subbase that includes those aggregates shall be removed from the Work at no cost to the Owner.

**XXX.08.01.02.03.02 Concrete Aggregate**

The aggregates within a lot of concrete shall be deemed to be acceptable if all of the test results for the aggregates representing that lot meet all applicable requirements of this specification.

If QA test results of an aggregate sample representing a lot of concrete do not meet all of the requirements of this specification, then a payment reduction shall be given for the aggregates within that lot, as long the applicable test results for that sample:

a) Do not exceed the requirement for LS-614, or LS-606 if it has been accepted by the Owner as an alternative to LS-614, by more than 25% of the specified value.

b) Do not exceed a petrographic number of 135 for concrete pavement and 150 for structural concrete when tested according to LS-609.

c) Do not exceed the requirement for LS-618 by more than 10% of the specified value.

d) Meet all other concrete aggregates requirements of this specification.

If QA test results of an aggregate sample representing a lot of concrete do not meet the requirements listed above, then all of the aggregates within that lot shall be considered rejectable and any concrete that includes those aggregates shall be removed from the Work at no cost to the Owner.

**XXX.08.01.02.03.03 Hot Mix and Cold Mix Asphalt Aggregate**

The aggregates within a lot of HMA or CMA shall be deemed to be acceptable if all of the test results for the aggregates representing that lot meet all applicable requirements of this specification, including the physical property requirements for aggregates blended in the laboratory as given in Tables 5B and 5C and the physical property and gradation requirements for aggregates extracted from HMA as given in Tables5D, 5E and 5F.

If the QA test results of an aggregate sample representing a lot of HMA or CMA do not meet all of the requirements of this specification, then a payment reduction shall be given for the quantity of HMA or CMA left in the Work that includes any of the aggregates within that lot, as long as the applicable test results for that sample:

a) Do not exceed the requirement for LS-614, or LS-606 if it has been accepted by the Owner as an alternative to LS-614, by more than 25% of the specified value;

b) Do not exceed the requirement for LS-618 by more than 10% of the specified value; and

c) Do not exceed the requirement for LS-619 by more than 15% of the specified value.

If QA test results of an aggregate sample representing a lot of HMA or CMA do not meet the requirements listed above, then all of the aggregates within that lot shall be considered rejectable and any HMA or CMA that includes aggregates from the rejected lot shall be removed from the Work and replaced with acceptable HMA or CMA, as applicable, at no cost to the Owner.

**XXX.08.01.02.04 Referee Testing**

The Contractor may invoke referee testing for one or more attributes by submitting a written request to the Contract Administrator, within 5 Business Days of receiving test results that an aggregate sample representing a lot does not meet the requirements of this specification.

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

The retained duplicate QA samples shall be used for referee testing.

The referee laboratory shall be designated by the Owner based on the applicable roster. Referee test results shall be forwarded to the Contractor as they become available.

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

If a lot is not accepted as full payment based on the referee test results, then the Contractor shall be responsible for the cost of the referee testing of that lot, including the cost of transporting the samples to the referee laboratory, at the rates specified elsewhere in the Contract Documents. In all other cases, the Owner shall bear the cost of the referee testing and the cost of transporting the samples of that lot.

**XXX.08.01.03 Surface Tolerance**

The surface tolerances of any HMA and CMA pavement or granular surface shall be such that when tested with a 3 m straight edge placed anywhere, including the edge of the pavement, in any direction on the surface, except across the crown or drainage gutters, there shall not be a gap between the bottom of the straight edge and the pavement or granular surface:

a) greater than 15 mm for all CMA surfaces and granular surfaces,

b) greater than 6 mm for all HMA surfaces other than surface course, or

c) greater than 3 mm for all surface courses.

The cross-fall of the finished concrete surface, including paved shoulders, shall not vary more than plus or minus 0.25% from the cross-fall specified in the Contract Documents.

The final elevation of the finished concrete surface shall not be less than the design elevation; and shall not be more than the design elevation plus 25 mm except where a lower tolerance is required due to a minimum vertical clearance restriction or where the surface elevation must match an existing condition such as curb and gutter or barrier wall.

The minimum width of the finished concrete surface shall be the design width. The maximum width the finished concrete surface shall be the design width plus 50 mm, except where there are more than 2 traffic lanes in the same direction the maximum width shall be the design width plus 100 mm.

Longitudinal joints in the finished concrete surface shall correspond to the demarcation between lanes as specified in the Contract Documents.

The surface of the concrete shall be such that when tested with a 3 m long straight edge placed in any location and direction, including the edge of pavement or base and joints, except across the crown or drainage gutters, there shall not be a gap greater than 3 mm between the bottom of the straight edge and the surface of the concrete pavement or concrete base. This requirement also applies to all longitudinal and transverse joints.

For concrete base, the tolerance relative to a 3 m straight edge shall be 6 mm.

**XXX.08.01.04 Initial Surface Smoothness**

The initial surface smoothness is to be measured during construction when the concrete pavement or concrete base is completed.

Smoothness measurement of the surface of the concrete pavement or concrete base, and incidents of localized roughness shall be measured according to LS-296, using an inertial profiler. The surface smoothness shall be determined by calculating the Mean Roughness Index (MRI), the average of the IRI values from the left and right wheel path profiles.

For concrete pavement, a sublot’s smoothness shall be acceptable if the average MRI is less than or equal to 1.000 m/km. If the sublot’s MRI is greater than 1.000 m/km but less than or equal to 1.250 m/km, the sublot is accepted with a price adjustment according to Table 11. If the sublot’s MRI is greater than 1.250 m/km, the sublot is unacceptable and shall be repaired or removed and replaced.

For concrete base, a sublot’s smoothness shall be acceptable if the average MRI is less than or equal to 1.200 m/km. If the sublot’s MRI is greater than 1.200 m/km but less than or equal to 1.500 m/km, the sublot is accepted with a price adjustment according to Table 11. If the sublot’s MRI is greater than 1.500 m/km, the sublot is unacceptable and shall be repaired or removed and replaced.

In addition, incidents of localized roughness of greater than or equal to 2.400 m/km are unacceptable and shall be repaired or removed and replaced.

Payment adjustments, where applicable, shall be calculated according to the Basis of Payment section.

**XXX.08.01.04.01 General**

Lot acceptance for surface smoothness of concrete pavement or concrete base shall be based on measurements of Mean Roughness Index (MRI) and incident(s) of localized roughness. All acceptance testing of surface smoothness shall be performed by the Owner. Test results shall be forwarded to the Contractor as they become available.

Requirements for smoothness apply regardless of whether the concrete pavement or base is constructed adjacent to existing pavement or base, respectively, except as provided for in Lot Size subsection, d) below.

Acceptance testing of surface smoothness will be done upon completion of construction of the concrete pavement or concrete base, or as portions of the work are completed.

The Contract Administrator will arrange for acceptance testing after:

a) Final texturing has been completed, and

b) Written notification that the pavement or base is ready for acceptance testing is received, and

c) The Contract Administrator is satisfied that the pavement or base is free of loose stone, debris, and obstructions.

The Contract Administrator shall provide 48 hours’ notice of when the surface smoothness measurements will begin. When, according to the equipment manufacturer’s recommendations weather conditions are unsuitable for testing, testing shall be suspended and shall resume only when conditions are acceptable for testing.

**XXX.08.01.04.02 Lot Size**

A lot shall consist of the total quantity of concrete pavement or concrete base. Each lot shall be generally divided into 100 m single lane sublots. When the last sublot is less than 50 m in length, it will be added to the previous sublot.

The Owner shall measure all through lane concrete surfaces with the following exceptions:

a) Where the posted speed is 60 km/hour or less

b) Lanes less than 400 m in length

c) Shoulders

d) Within the first or last 10 m length of the new concrete pavement section where the new concrete pavement abuts against an existing asphalt or concrete pavement where the Contractor is not responsible for the adjoining surface.

e) Bridge decks and within 10 m of bridge deck expansion joints or approach slabs.

**XXX.08.01.04.03 Referee Testing**

Referee testing for surface smoothness is as specified in the Contract Documents.

**XXX.08.01.05 Geometrics and Longitudinal Joint Location**

**XXX.08.01.05.01 Pavement Width**

The Contract Administrator shall conduct random spot checks of the width of the concrete for acceptance. The Contractor shall provide and maintain offset stakes on both sides of the roadway, or other identifiers acceptable to the Contract Administrator, for use in checking the pavement width at 25 m maximum intervals until the Contract Administrator advises the Contractor that the stakes or identifiers are no longer required.

The width of each lift shall be accepted provided the:

a) Outside edges of the lanes and the paved shoulders are parallel to the centerline and visually uniform.

b) Width across all the adjacent lanes from the outside edge to outside edge is not less than the sum of the specified lane widths, and

c) Width of the paved shoulders is not less than the specified paved shoulder width.

If the width is not acceptable at any location, the Contract Administrator shall notify the Contractor in writing that the pavement is rejectable and the Contractor shall submit a written proposal for corrective action to the Contract Administrator within 3 Business Days of receiving the notification.

**XXX.08.01.05.02 Pavement Elevation**

The final elevation of the concrete surface course shall not be less than the design elevation; and shall not be more than the design elevation plus 25 mm except where a lower tolerance is required due to a minimum vertical clearance restriction or where the surface elevation must match an existing condition such as curb and gutter or barrier wall.

If the elevation is not acceptable at any location, the Contract Administrator shall notify the Contractor in writing that the pavement is rejectable and the Contractor shall submit a written proposal for corrective action to the Contract Administrator within 3 Business Days of receiving the notification.

**XXX.08.01.05.03 Pavement Crossfall**

The cross-fall of the concrete surface, including paved Shoulders, shall not vary more than plus or minus 0.25% from the cross-fall specified in the Contract Documents. Pavement that exceeds this tolerance shall be repaired by removal and replacement.

**XXX.08.01.05.04 Longitudinal Joint Location**

Longitudinal joints not meeting the Contract requirements shall be removed and replaced or assessed a payment reduction.

**XXX.08.01.06 Acceptance of Thickness, 28-Day Compressive Strength, Air Void System Parameters and Rapid Chloride Permeability**

**XXX.08.01.06.01 General**

Acceptance of thickness, 28-day compressive strength, air void system parameters and rapid chloride permeability shall be based on testing of cores removed from the hardened concrete. Acceptance of 28-day compressive strength and thickness shall be on a lot basis. Acceptance of air void system parameters and rapid chloride permeability shall be on a sublot basis.

**XXX.08.01.06.02 Lot Size for Thickness, 28-Day Compressive Strength, Air Void System Parameters and Rapid Chloride Permeability**

A lot shall consist of the total quantity of concrete pavement or concrete base of the same specified thickness and specified 28-day compressive strength. Each lot shall be divided into sublots of approximately 2,000 m2. A minimum of three sublots are required for each lot.

A total of six cores shall be removed from each sublot:

a) Three cores from each sublot for determination of the 28-day compressive strength.

b) One core for determination of air void system parameters.

c) One core for determination of rapid chloride permeability.

d) One core for determination of thickness.

**XXX.08.01.06.03 Acceptance Testing for Thickness, 28-Day Compressive Strength, Air Void System Parameters and Rapid Chloride Permeability**

**XXX.08.01.06.03.01 28-Day Compressive Strength Testing**

Testing of 28-day compressive strength shall be according to LS-410, with the exception that determination of concrete pavement thickness is not required. The 28-day compressive strength of a sublot shall be the average of the set of three cores for the sublot rounded to one decimal place.

**XXX.08.01.06.03.02 Air Void System in Hardened Concrete**

One half of one core representing the sublot shall be tested for air void system parameters to determine the acceptability of concrete. The core shall be tested according to LS-432. The other half of the core shall be retained by the Owner for audit purposes.

**XXX.08.01.06.03.03 Rapid Chloride Permeability**

The core taken for rapid chloride permeability shall be tested according to LS-433. Acceptance testing shall be carried out at 28 to 32 days. Two 50 mm long samples shall be cut from the core representing the sublot for rapid chloride permeability and tested to determine the acceptability of the concrete within the sublot.

**XXX.08.01.06.03.04 Thickness Testing**

The concrete pavement or concrete base thickness for each sublot shall be determined based on the length of the core removed from each sublot for thickness testing., when measured according to LS-450.

**XXX.08.01.06.04 Basis of Acceptance for Thickness, 28-Day Compressive Strength, Air Void System Parameters and Rapid Chloride Permeability**

**XXX.08.01.06.04.01** **28-Day Compressive Strength**

Acceptance of pavement or base 28-day compressive strength shall be based on the average of the three cores for each sublot.

If the average compressive strength is equal to or greater than 35.0 MPa, the sublot is acceptable. Sublots with an average compressive strength less than 35.0 MPa and greater than or equal to 30.0 MPa shall be considered unacceptable, but with the agreement of the Owner may be permitted to remain in the Work with a payment adjustment. The payment adjustment shall be calculated according to Table 8C Sublots with an average compressive strength less than 30.0 MPa shall be rejected.

**XXX.08.01.06.04.02 Air Void System in Hardened Concrete**

For a sublot to be considered acceptable, the core representing the sublot shall have an air content of 3.0% or more and a spacing factor of 0.230 mm or less. Acceptable sublots shall be subject to full payment.

Sublots with an air content of less than 3.0% and/or a spacing factor greater than 0.230 mm and less than or equal to 0.260 mm shall be considered unacceptable but, with the agreement of the Owner, may be permitted to remain in the Work with a payment adjustment. The payment adjustment shall be calculated based on individual sublots and applied according to the Basis of Payment section.

Sublots with a spacing factor greater than 0.260 mm shall be rejected.

**XXX.08.01.06.04.03 Rapid Chloride Permeability**

Sublots with rapid chloride permeability less than or equal to 2500 coulombs are considered acceptable. Sublots with a rapid chloride permeability result greater than 2500 coulombs and less than or equal to 3500 coulombs shall be considered unacceptable but, with the agreement of the Owner, may be permitted to remain in the Work with a payment adjustment. The payment adjustment shall be calculated based on individual sublots and applied according to the Basis of Payment section.

Sublots with rapid chloride permeability results exceeding 3500 coulombs shall be rejected.

**XXX.08.01.06.04.04 Thickness**

Acceptance of pavement or base thickness shall be based on the measurement of the core from each sublot.

If the thickness is equal to or greater than the specified thickness, the sublot is acceptable. Sublots with a thickness greater than or equal to the specified thickness minus 10 mm shall be considered unacceptable, but with the agreement of the Owner may be permitted to remain in the Work with a payment adjustment. The payment adjustment shall be calculated according to Table 8B. Sublots with a thickness less than the specified thickness minus 10 mm shall be rejected.

**XXX.08.01.06.05 Referee Testing**

**XXX.08.01.06.05.01 General**

Referee testing for a sublot may only be invoked by the Contractor within five Business Days of receiving the test results for that sublot.

Referee testing shall be carried out according to the test methods specified in the Acceptance Testing subsection of this specification.

The referee laboratory shall be designated by the Owner based on the applicable roster. Referee test results shall be forwarded to the Contractor as they become available.

**XXX.08.01.06.05.02 28-Day Compressive Strength**

Referee testing of 28 Day compressive strength for a sublot shall be done on a new set of three cores removed within 24 hours of invoking the referee testing. Cores for referee testing for each disputed sublot shall be taken in the presence of the Contract Administrator at a location no more than 1 m from the location that each of the disputed acceptance cores were removed. The core size and core extraction shall be according to the Coring clause.

If the difference between the referee test result and the acceptance test result is less than or equal to the confirmation value, then the acceptance test result is confirmed, and the acceptance test result shall be used in the determination of acceptance and payment for the concrete. If the difference between the referee test result and the acceptance test result is greater than the confirmation value, the acceptance test result is not confirmed, and the acceptance test result shall be disregarded and not used in the determination of acceptance and payment.

The confirmation value for confirming the acceptance test result shall be the greater of 10% of the specified strength or 10% of the strength of the acceptance cores, expressed to one decimal place.

When the referee result confirms the acceptance test results, the Contractor shall be charged the cost of referee testing. When the referee result does not confirm the acceptance test result, the Owner shall bear the cost.

When acceptance results are eliminated from the analysis as a result of the referee process, the concrete shall be assessed based on the available strength results for the lot.

**XXX.08.01.06.05.03 Air Void System in Hardened Concrete**

Referee testing for air voids shall be carried out on the same half of the core samples that was tested for acceptance. When the referee testing is invoked, the sample representing the sublot shall be referee tested and the acceptance test results discarded. The sublot referee test results shall replace the acceptance test result in the acceptance requirements of this specification.

When the referee results indicate that the refereed sublot is acceptable, the Owner shall bear the cost. When the referee results indicate that the refereed sublot is not acceptable, the Contractor shall be charged the cost of the air void system referee testing.

**XXX.08.01.06.05.04 Rapid Chloride Permeability**

Referee testing of rapid chloride permeability of a sublot shall be done on a new core removed within 24 hours of invoking the referee testing. Cores for referee testing for each disputed sublot shall be taken in the presence of the Contract Administrator at a location no more than 1 m from the location from which the disputed acceptance core was removed. The core size, core extraction and filling shall be according to the Coring clause.

When the referee result is greater than the acceptance test result or no more than 500 coulombs below the acceptance test result, the acceptance test result is then confirmed and shall remain valid. When the referee test result for the lot is more than 500 coulombs below the acceptance test result, the acceptance test result is then not confirmed, and the referee test result shall replace the acceptance test result in the acceptance requirements of this specification.

When the referee result confirms the acceptance test results, the Contractor shall be charged the cost of referee testing. When the referee result does not confirm the acceptance test result, the Owner shall bear the cost.

**XXX.08.01.06.05.05 Thickness**

Referee testing of thickness for a sublot shall be done on the same core that was used for acceptance testing of thickness.

If the difference between the referee test result and the acceptance test result is less than or equal to the confirmation value, then the acceptance test result is confirmed, and the acceptance test result shall be used in the determination of acceptance and payment for the concrete. If the difference between the referee test result and the acceptance test result is greater than the confirmation value, the acceptance test result is not confirmed, and the acceptance test result shall be disregarded and not used in the determination of acceptance and payment.

The confirmation value for confirming the acceptance test result shall be 5.0 mm.

When the referee result confirms the acceptance test result, the Contractor shall be charged the cost of referee testing. When the referee result does not confirm the acceptance test result, the Owner shall bear the cost.

When acceptance results are eliminated from the analysis as a result of the referee process, the concrete shall be assessed based on the available thickness results for the lot.

**XXX.08.01.07 Acceptance of Position and Alignment of Dowel Bars**

**XXX.08.01.07.01 General**

All testing shall be carried out by the Owner. Test results shall be forwarded to the Contractor as they become available.

Acceptance testing of position and alignment of dowel bars will be carried out upon completion of construction of the concrete pavement or concrete base, or as portions of the work are completed.

The Contract Administrator will arrange for acceptance testing after:

a) Written notification that the pavement or base is ready for acceptance testing is received, and

b) the Contract Administrator is satisfied that the pavement or base is free of loose stone, debris, and obstructions.

The Contract Administrator shall provide 48 hours’ notice of when the dowel position and alignment measurements will begin. When weather conditions are unsuitable for testing according to the equipment manufacturer’s recommendations, testing shall be suspended and shall resume only when conditions are acceptable for testing.

**XXX.08.01.07.02 Lot Size for Position and Alignment of Dowel Bars**

The total quantity of concrete pavement or concrete base on the contract shall be divided into lots, with each lot containing all the transverse joints with dowel bars placed by the same method (load transfer devices or automatic dowel bar inserter). Each lot shall be divided into sublots such that each transverse joint shall be considered a sublot. One joint for every 20 sublots, or a minimum of 10 joints shall be randomly selected by the Contract Administrator and dowel alignment shall be measured for that joint.

**XXX.08.01.07.03 Measurement and Acceptance for Position and Alignment of Dowel Bars**

Measurement of dowel position and alignment using magnetic pulse induction equipment (MIT scan) shall be according to ASTM E3013.

Verification of the MIT scan result by means of a joint cut-out, shall be done on a joint from the first sublot. The procedure for joint cut-outs shall be according to the Joint Cut-Out Procedure clause. The Contract Administrator will inspect the joint and measure and record the depth, horizontal and longitudinal side shift, vertical and horizontal alignment of all the dowel bars and compare to the measurements obtained using the MIT scan to verify accuracy.

Acceptance of the dowel bar position and alignment for the lot will be based on the mean and standard deviation of the lot MIT scan measurements for vertical alignment, horizontal alignment, longitudinal side shift and depth. The dowel bar closest to the longitudinal joint shall be removed from the analysis due to possible interference of the tie bar. All MIT scan measurements for vertical alignment, horizontal alignment and longitudinal side shift shall be converted to positive values prior to calculating the mean and standard deviation. The Contract Administrator will calculate the PWL for each criterion as described in LS-101. For calculation of PWL, the upper limit and lower limits for each attribute are as specified in Table 8E.

If the lot PWL is greater than or equal to 90%, the lot is acceptable for the criteria. If the lot PWL is less than 90% the lot is unacceptable.

In addition, any sublot which contains an individual dowel bar which exceeds any of the criteria identified in Table 8F for vertical alignment, horizontal alignment, horizontal side shift, longitudinal side shift and depth, is rejectable and shall be removed and replaced. The Owner shall scan joints on either side of the unacceptable sublot, until five consecutive joints on each side are found with no rejectable bars. Any joints with rejectable bars shall be removed and replaced.

The area to be removed shall be bounded by the nearest adjacent transverse joints, longitudinal joint and outside edge of pavement or base, so that there shall be no additional joints.

The replacement concrete pavement or concrete base for lots and sublots that have been removed and replaced shall be evaluated for acceptance on the same basis as the original lots or sublots.

**XXX.08.01.07.04 Referee Testing for Position and Alignment of Dowel Bars**

For each measurement taken by the Owner a single written request for referee testing no more than five Business Days after receiving the test results may be made. Each request shall identify the sublots for referee testing.

Referee testing of dowel position and alignment shall be done using magnetic pulse induction equipment (MIT scan) according to ASTM E3013.

Referee testing shall be done by the Owner. Up to two representatives can witness the referee testing. Referee test results shall be forwarded to the Contractor as they become available.

**XXX.08.01.07.04.01 Referee Testing Cost**

When the referee result for a sublot confirms the acceptance test result, the Contractor shall be charged the cost of referee testing. When the referee result does not confirm the acceptance test result, the Owner shall bear the cost.

**XXX.08.01.08 Repairs Prior to Contract Completion**

All repairs shall be completed at no cost to the Owner.

All transverse joints in concrete repairs shall butt up to a full depth vertical surface. Repairs shall consist of the removal and replacement of the full thickness of the concrete when permitted by the Contract Administrator.

Repairs shall be full lane or full shoulder width except where localized repairs are allowed as specified in the Contract Documents.

The materials used for repairs and the construction of repairs shall meet the requirements of this specification.

The limits and type of repairs requires the acceptance of the Contract Administrator and shall be accepted prior to the repair being carried out.

Unless specified otherwise, all concrete repairs area to be removed shall be bounded by the nearest adjacent transverse joints, longitudinal joint and outside edge of pavement or base, so that there shall be no additional joints.

With the exception of emergency repairs, repairs shall be completed within 60 calendar days or prior to seasonal shutdown each year, whichever is the lesser, unless permitted by the Owner.

All pavement surfaces not meeting the surface tolerance requirements shall be repaired by diamond grinding to a maximum of 5 mm or removed and replaced. Slurry produced from diamond grinding shall be removed from the Working Area and managed as specified in the Contract Documents. These requirements do not relieve the Contractor of obligations imposed by the Contractor’s Environmental Compliance Approval for a Waste Management System.

All granular surfaces not meeting the surface tolerance requirement shall be repaired by the addition of granular Base as required, and grading and compacting.

**XXX.08.02 Performance Warranty**

**XXX.08.02.01 General**

The emergency repair requirements specified elsewhere in the Contract Documents applies to all Work, including any locations exempted from the performance warranty.

For the duration of the performance warranty period, the performance requirements in Table 9 shall be met. The performance requirements in Table 9 and Table 10 shall both apply in the final 12 months of the performance warranty period. The following locations are exempt from the requirements of Tables 9 and 10:

[\*\*\* Designer Fill-In, see Notes to Designer]

Descriptions of surface distresses in Tables 9 and 10 are according to this specification and SP-026. In the event of a conflict between this specification and SP-026, this specification shall take precedence.

If a performance requirement is not met, the specified consequences for non-conformance shall be completed.

Repairs required as a consequence for non-conformance and warranty administration shall be as specified in the Contract Documents.

When there are multiple non-conformances in the same segment, with conflicting repair requirements, the Owner shall resolve the conflict(s) by selecting the consequences for non-conformance that shall apply.

**XXX.08.02.02 Performance Warranty Period**

The performance warranty period shall be seven (7) years.

**XXX.08.02.03 Performance Measurement Segments**

Performance measurement segments shall be established by the Contract Administrator as specified in the Contract Documents.

NAD83 latitude and longitude geographic coordinates accurate to one metre shall be recorded at the start and end stations of all segments and submitted to the Contract Administrator in hardcopy and digital form prior to Contract Completion.

**XXX.08.02.04 Surface Smoothness – During and Final Warranty Period**

The concrete pavement surface smoothness during the entire warranty period and at final warranty period are to be measured according to the Contract Document.

Smoothness measurement of the surface of the concrete pavement and incidents of localized roughness shall be measured according to LS-296, using an inertial profiler. The surface smoothness of each sublot shall be determined by calculating the Mean Roughness Index (MRI), the average of the International Roughness Index (IRI) values from the left and right wheel path profiles. The performance criteria and consequences for non-conformance are listed in Table 9 and 10.

**XXX.08.02.04.01 General**

Acceptance for surface smoothness of concrete pavement shall be based on measurements of Mean Roughness Index (MRI) and incident(s) of localized roughness. All acceptance testing of surface smoothness shall be performed by the Owner.

The Owner shall measure all through lane concrete surfaces with the following exceptions:

a) Where the posted speed is 60 km/hour or less

b) Lanes less than 400 m in length

c) Shoulders

d) Within the first or last 10 m length of the new concrete pavement section where the new concrete pavement abuts against an existing asphalt or concrete pavement where the Contractor is not responsible for the adjoining surface.

e) Bridge decks and within 10 m of bridge deck expansion joints or approach slabs.

**XXX.09 MEASUREMENT FOR PAYMENT – Not Used**

**XXX.10 BASIS OF PAYMENT**

**XXX.10.01 General**

Payment at the Contract price for the work, including any applicable payment adjustments, shall be full compensation for all labour, Equipment, and Material to do the work and shall be full compensation for meeting the specified performance requirements, including all specified consequences for non-conformance to the performance requirements.

No advance payment shall be made for aggregates.

Changes to earth and rock excavation quantities due to permitted cross section changes, subexcavations, or other changes impacting grading quantities shall be at no additional cost to the Owner.

Payment shall not be increased or decreased based on any other specification, special provision or contractual provisions in the Contract Documents that specifies monetary penalties, bonuses, increases, reductions or any other type of adjustment to payment for materials or construction work.

No additional payment shall be made for the work carried out to address non-conformance to the performance requirements.

The Owner has the right to withhold payment or make a set off anytime during construction or at the completion of the work until any specified consequences for non-conformance are complete. The amount withheld or set off shall be of an approximate value of the repair work.

Irrespective of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

**XXX.10.02 Payment Reduction for Grade Checks Outside Tolerance**

For each station where the QA grade check of the finished grade is found to be outside of the specification limit, $250.00 shall be deducted from payment.

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

**XXX.10.03 Payment Reduction for Aggregates - General**

The following presumed item costs shall be used to calculate the payment reduction for aggregates:

**[\*\*\*\*\*\*\***Designer Fill-In, see Notes to Designer]

The item cost is the aggregate cost for drainage layer, base and subbase, and for the bounded layer shall be the respective item cost for concrete, HMA and CMA.

**XXX.10.03.01 Payment Reduction for Non-Conformance Aggregates**

Payment reductions for drainage layer, Base and Subbase aggregates shall be calculated as the product of the theoretical volume in cubic metres of aggregates within the lot that is left in the Work as follow:

Payment Reduction = Non-conformance aggregate left in the Work (m3) x Item cost ($/m3) x 15%

Payment reductions for concrete, HMA and CMA aggregates shall be calculated as the product of the theoretical area in square metres of aggregates within the lot that is left in the Work as follow:

Payment Reduction = Non-conformance aggregate left in the Work (m2) x Item cost ($/m2) x 5%

**XXX.10.04 Combined Price Adjustment for Thickness, 28-Day Compressive Strength, Air Void System Parameters and Rapid Chloride Permeability**

For each sublot, the total combined price adjustment (P) for thickness, 28-day compressive strength, air void system parameters and rapid chloride permeability shall be calculated using the following formula:

P = PT+PC+PA+PR ($/m2)

Where:

P = combined price adjustment in dollars per square metre of concrete ($/m2)

PT = penalty based on thickness (Table 8B)

PC = penalty based on 28Day compressive strength (Table 8C)

PA = penalty based on air void system parameters (Table 8A)

PR = penalty based on rapid chloride permeability (Table 8D)

The maximum combined price adjustment penalty shall not exceed $100/m2.

**XXX.10.04.01 Penalty for Thickness and 28-Day Compressive Strength**

The penalty for thickness (PT) and 28-day compressive strength (PC) shall be determined according to Table 8B and 8C.

**XXX.10.04.02 Penalty for Air Void System Parameters**

The penalty for air void system parameters (PA) for each acceptable sublot and each unacceptable sublot that the Owner has permitted to remain in the Work will be determined by the Contract Administrator according to Table 8A.

**XXX.10.04.03 Penalty for Rapid Chloride Permeability**

The penalty for rapid chloride permeability (PR) for each unacceptable sublot that the Owner has permitted to remain in the Work will be determined by the Contract Administrator according to Table 8D.

**XXX.10.05 Price Adjustment Calculation for Smoothness**

The smoothness price adjustment is based on the average of the sublot, as shown in Table 11, and rounding to three decimal places according to LS-100.

Price Adjustment for smoothness ($) = sublot quantity (m2) x Adjustment ($/m2)

**Table 1**

**Traffic Volume Information**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Roadway** | **Classification** | **AADT / laneNote 1** | **Total ESAL (Millions)** | |
| **Warranty Period (10 years)** | **20 year** |
|  |  |  |  |  |

Note 1: Calculation to be based on lane distribution factor as per MI-183 report.

[\*\*\*\* Designer Fill-Ins for Table 1, see Notes to Designer]

**Table 2**

**Permitted Locations of Pavement Grade Raise**

|  |  |  |  |
| --- | --- | --- | --- |
| **Location** | | | **Permitted Grade Raise (mm)** |
| **Roadway** | **Sta. to Sta.** | **Township** |
|  |  |  |  |

[\*\*\*\*\* Designer Fill-Ins for Table 2, see Notes to Designer]

**Table 3**

**Permitted Locations of Ditch Elevation Lowering**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Location** | | | | **Permitted Ditch Grade Lowering**  **(m)** |
| **Roadway** | **Sta. to Sta.** | **Township** | **Lt/Rt** |
|  |  |  |  |  |

[\*\*\*\*\*\* Designer Fill-Ins for Table 3, see Notes to Designer]

**Table 4**

**Concrete Properties**

|  |  |  |
| --- | --- | --- |
| **Property** | **Test Methods** | **Requirement** |
| Compressive Strength | LS-410 | Min. 35MPa (at 28 days) |
| Air Voids | LS-432 | Air voids ≥ 3.0 %  Max. spacing factor 0.230 mm |
| Rapid Chloride Permeability | LS-433 | ≤ 2500 coulombs (at 28 to 32 days) |

**Table 5A**

**Base and Subbase Aggregates Physical Property Requirements**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Laboratory Test** | | **MTO Test Number** | **Base** | **Subbase** |
| Micro-Deval Abrasion Coarse Aggregate Loss, % maximum | | LS-618 | 25 | 30 |
| Micro-Deval Abrasion Fine Aggregate Loss, % maximum | | LS-619 | 30 | 35 |
| Amount of Contamination, % maximum | | LS-630 | 1.0 (Note 1) | |
| Plastic Fines | | LS-631 | NP (Non-Plastic) | |
| 1. Base and subbase may contain up to 15% by mass of crushed glass or ceramic material or both. In addition, a combined mass of wood, clay brick and/or gypsum and/or gypsum wall board or plaster shall be limited to 1%. | | | |

**Table 5B**

**HMA and CMA Aggregates Physical Property Requirements for Aggregates Blended in the Laboratory - Fraction Passing the 4.75 mm Sieve** (Note 1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Laboratory Test** | **MTO Test Number** | **Surface Type** (Note 2) | | | **Binder Course / CMA** |
| **FC2** | **FC1** | **FCG** |
| Micro-Deval Abrasion, % maximum loss (Note 3) | LS-619 | 15 | 20 | 25 | 25 |

**Table 5C**

**HMA and CMA Aggregates Physical Property Requirements for Aggregates Blended in the Laboratory - Fraction Retained on the 4.75 mm Sieve** (Note 1)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Laboratory Test** | **MTO Test Number** | **Surface Type** (Note 2, Note 4) | | | | | | | | **Binder Course / CMA** |
| **FC2** | | | **FC1** | | | | **FCG** |
| **(D)** | **(T)** | **(M)** | **(G)** | **(D)** | **(T)** | **(M)** |
| Absorption, % maximum | LS-604 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 |
| Unconfined Freeze-Thaw, % maximum loss (Note 5) | LS-614 | 7 | 6 | 6 | 6 | 7 | 6 | 6 | 6  (Note 6) | 15  (Note 6) |
| Micro-Deval Abrasion, % maximum loss (Notes 4 and 7) | LS-618 | 15 | 10 | 15 | 10 | 15 | 10 | 15 | 17 | 21 |
| **Alternative Requirement for LS-614** | | | | | | | | | | |
| Magnesium Sulphate Soundness, % maximum loss (Note 6) | LS-606 | - | | | | | | | 12 | 15 |

|  |
| --- |
| Notes for Tables 5B and 5C:  1. The aggregate used for the following tests shall be prepared by first splitting off sufficient quantities of each of the aggregate components, based on their individual percentages stated in the mix design and the overall blended quantity required for the test(s). Then, with the exceptions of RAP, the split portions of each of the other aggregate components shall be placed in a vessel of appropriate size and blended together by mixing. The blended aggregate shall then be split on the 4.75 mm sieve and the portions passing and retained on the 4.75 mm sieve set aside for testing.  2. FC2, FC1, and FCG are identifiers which indicate the appropriate aggregate requirements. FC1, FC2, or FCG are selected according to the designated surface course type in the MTO Surface Course Directive. FC1 is used where the coarse aggregate for the surface course shall be supplied from aggregate sources for Superpave 12.5FC1 named on DSM #3.05.25. FC2 is used where the coarse aggregate and fine aggregate for the surface course for those locations shall be supplied from aggregate sources for Superpave 12.5FC2 named on DSM #3.05.25. FCG is used where Superpave 12.5 is the designated surface course type.  3. In addition, the Micro-Deval Abrasion loss for any individual aggregate component where the aggregate passing the 4.75 mm sieve represents more than 5% of the overall mix design gradation, by mass, shall not exceed 35%.  4. Categories (G), (D), (T), and (M) refer to a group of specific lithologies (i.e. rock types) included in the cell, entitled “Product Description and Designation Type” for each approved source listed on DSM #3.05.25.  5. When this test is being carried out on the coarse aggregate fraction of a FC1 Surface Type mix that contains coarse aggregates from more than one source, the minimum value of the maximums shown below for the coarse aggregate types that are included in that mix shall be used for acceptance.  6. For FCG Surface Type and Binder Course, the Owner shall waive the requirements for LS-614, Unconfined Freeze-Thaw, provided the Contractor has submitted a written request that the coarse aggregate meet the alternative requirements for LS-606, Magnesium Sulphate Soundness before any HMA or CMA aggregate testing is carried out on the Contract.  7. In addition, the Micro-Deval Abrasion loss for any individual aggregate component where the aggregate retained on the 4.75 mm sieve represents more than 5% of the overall mix design gradation, by mass, shall not exceed 25%. |

**Table 5D**

**Gradation Requirements for Extracted Aggregates from Hot Mix Asphalt Used in Surface Courses**

**(MTO Test Numbers LS-282 or LS-292)**

| **Percentage Passing by Dry Mass of Aggregates** | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sieve** | **mm** | | | | | | | | **µm** | | | |
| **19.0** | **16.0** | **13.2** | **12.5** | **9.5** | **4.75** | **2.36** | **1.18** | **600** | **300** | **150** | **75** |
| **Surface Course Mixes** | 100 | - | - | 90-100 | 90 max. | 45-65 | 28-58 | - | - | - | - | 2-10 |

**Table 5E**

**Physical Property Requirements for Aggregates Extracted From HMA and CMA**

**- Aggregates Passing the 4.75 mm Sieve** (Note 1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Laboratory Test** | **MTO Test Number** | **Surface Type** (Note 2) | | | **Binder Course / CMA** |
| **FC2** | **FC1** | **FCG** |
| Acid Insoluble Residue for retained 2.36 mm fraction, minimum % retained on 75µm sieve | LS-613 | - | - | 60  (Note 3) | - |
| Petrographic analysis, minimum % of Category 1 aggregates passing the 4.75 mm sieve and retained on the 2.36 mm sieve (Note 4) | LS-616, Part B | 90 | - | - | - |

**Table 5F**

**Physical Property Requirements for Aggregates Extracted From HMA and CMA**

**- Aggregates Retained on the 4.75 mm Sieve** (Note 1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Laboratory Test** | **MTO Test Number** | **Surface Type** (Note 2) | | | **Binder Course / CMA** |
| **FC2** | **FC1** | **FCG** |
| Petrographic Analysis, minimum % of Category 1 aggregates retained on the 4.75 mm sieve (Note 4) | LS-609, Part B | 90 | 90 | - | - |
| Petrographic Analysis, maximum % of Category 2 aggregates retained on the 4.75 mm sieve (Note 5) | LS-609, Part B | - | - | 40  (Note 3) | - |
| Petrographic Analysis, maximum % of Category 3 Contaminants retained on the 4.75 mm sieve (Note 5) | LS-609, Part B | 0.5 | 0.5 | 0.5 | 0.5 |
| Acid Insoluble Residue, minimum % retained on the 75m sieve | LS-613 | 45 / 90  (Note 6) | 45 / 90  (Note 6) | 60  (Note 7) | - |

|  |
| --- |
| Notes for Tables 5E and 5F:  1. All of the aggregates used for the following tests shall be extracted from HMA and CMA using LS-282 and then split on the 4.75 mm sieve, prior to testing.  2. FC2, FC1, and FCG are identifiers which indicate the appropriate aggregate requirements. FC1, FC2, or FCG are selected according to the designated surface course type in the MTO Surface Course Directive. FC1 is used where the coarse aggregate for the surface course shall be supplied from aggregate sources for Superpave 12.5FC1 named on DSM #3.05.25. FC2 is used where the coarse aggregate and fine aggregate for the surface course for those locations shall be supplied from aggregate sources for Superpave 12.5FC2 named on DSM #3.05.25. FCG is used where Superpave 12.5 is the designated surface course type.  3. This requirement is only applicable to surface courses placed on the Thousand Islands Parkway; Highway 33 from west of Bath to Picton; Highway 35 from County Road 121 northerly to Norland; and in the area to the north and west of a boundary defined by the north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay (excluding Manitoulin Island), along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly to Calabogie and easterly to Arnprior and the Ottawa River.  4. Category 1 aggregates shall include:  a) for the aggregates passing the 4.75 mm sieve, all Category 1 aggregates or their acceptable major mineral components or both listed on Table 1 of LS-616 Part B.  b) for the aggregates retained on the 4.75 mm sieve, the following rock types, according to the descriptions given in the Appendix of LS-609, entitled, “Rock and Quality Type Descriptions for the Petrographic Analysis of Coarse Aggregate”:  i. Types 3, 4, 5, 6, 7, 8, 9, 10, 11, 22; and  ii. No more than 12.5% Types 25, 27, 29, and 30, where the primary coarse aggregate specified in the mix design is designated as a “(G)”, “(M)”, or “(T)” type aggregate in the cell entitled “Product Description and Designation Type” on DSM #3.05.25; or  iii. Types 1, 2, 20 and 21, where the primary coarse aggregate specified in the mix design is designated as a “(D)” type aggregate in the cell entitled “Product Description and Designation Type” on DSM #3.05.25, and by petrographic examination (i.e., and confirmed by insoluble residue testing, using LS-613, when the Petrographer is unsure), that the siliceous component for these aggregate types is determined to be at least 45%.  5. Category 2 aggregates and Category 3 contaminants are listed on Table 2 of LS-609.  6. Where the primary coarse aggregate specified in the mix design is designated in the cell entitled “Product Description and Designation Type” on DSM #3.05.25:  a) as a “(D)” type aggregate, then the % of acid insoluble residue retained on the 75µm sieve, shall be no less than 45%.  b) as a “(G)”, “(M)”, or “(T)” type aggregate, then the % of acid insoluble residue retained on the 75µm sieve, shall be no less than 90%.  7. LS-613 shall be required, when the fraction retained on the 4.75 mm sieve is found to contain more than 40% Category 2 aggregates, as determined by petrographic examination, in accordance with LS-609 – Part B, and where the Contractor has invoked referee testing. |

**Table 6**

**Minimum Depth of Granular Material Over Insulation**

|  |  |  |
| --- | --- | --- |
| **Zone** | **Geographic Area** | **Minimum Granular Thickness (mm)** |
| A | South of a line drawn from Quebec at Arnprior to Highway 41 at Kaladar to Highway 62 at Bannockburn to Highway 28 at Woodview to Highway 35 at Rosedale to Highway 12 at Brechin, along the south side of Highway 12 to Waubaushene, along the shore of Georgian Bay to Tobermory, and along the shore of Lake Huron to Sarnia | 400 |
| B | Between Zone A and Zone C | 500 |
| C | Between Zone D and a line drawn along the north side of Highway 17 from Mattawa to the Highway 17/144 interchange, to Highway 108 at Elliott Lake, to the Highway 129/554 intersection, to Highway 556 at Glendale, and to the Highway 17/552 intersection | 600 |
| D | North of a line drawn along the north side of Highway 66 from Quebec to Kenogami Lake, from Kenogami Lake to Chapleau, along the north side of Highway 101 to Wawa, along the shore of Lake Superior to Nipigon, from Nipigon to Dryden, and along the north side of Highway 17 from Dryden to Manitoba | 700 |

**Table 7**

**Sample Size**

|  |  |
| --- | --- |
| **Material** | **Minimum Mass of Field Samples, kg** (Note 1) |
| Drainage Layer | 25 |
| Granular Base | 25 |
| Granular Subbase | 50 |
| Concrete Coarse Aggregate | 25  50 for 37.5 mm Coarse Aggregate |
| Concrete Fine Aggregate | 15 |
| Concrete | 30 |
| Hot Mix Coarse Aggregate | 25  50 for 37.5 mm Coarse Aggregate |
| Hot Mix Fine Aggregate | 15 |
| **Notes:**  **1. Individual sample containers shall hold no more than 30 kg of aggregate. Where more than 30 kg is required, additional sample containers shall be used.** | |

**TABLE 8A**

**Penalty Air Void System Parameters of Hardened Concrete $/m2**

| **Spacing Factor, mm** | **Air Content, %** | | | | |
| --- | --- | --- | --- | --- | --- |
| 1.0-1.4 | 1.5-1.9 | 2.0-2.4 | 2.5-2.9 | >2.9 |
| <0.100 to 0.230 | 50 | 40 | 30 | 20 | 10 |
| 0.231 to 0.260 | 80 | 80 | 50 | 40 | 30 |

**TABLE 8B**

**Penalty for Thickness**

| **Thickness**  **(mm)** | **Penalty**  **($/m2)** |
| --- | --- |
| Thickness up to 5.0 mm less than specified thickness | 20 |
| Thickness up to 10.0 mm less than specified thickness | 35 |
| Thickness >10.0 mm less than specified thickness | Rejectable |

**TABLE 8C**

**Penalty for 28-Day Compressive Strength**

| **28 Day Compressive Strength**  **(MPa)** | **Penalty**  **($/m2)** |
| --- | --- |
| Average strength between 35.0 MPa to 33.0 MPa | 25 |
| Average strength between 32.9 MPa to 32.0 MPa | 50 |
| Average strength between 31.9 MPa to 31.0 MPa | 75 |
| Average strength between 30.9 MPa to 30MPa | 100 |
| Average strength less than 30 MPa | Rejectable |

**TABLE 8D**

**Penalty for Rapid Chloride Permeability**

|  |  |
| --- | --- |
| **Rapid Chloride Permeability**  **(coulombs)** | **Penalty ($/m2)** |
| Average >2500 and ≤3000 | 25 |
| Average >3000 and ≤3500 | 50 |
| Average >3500 | Rejectable |

**TABLE 8E**

**Specification Limits for Position and Alignment of Dowel Bars**

|  |  |  |
| --- | --- | --- |
| **Attribute** | **Lower Limit** | **Upper Limit** |
| Horizontal alignment (mm) | Not Applicable | 15 |
| Vertical alignment (mm) | Not Applicable | 15 |
| Horizontal or Longitudinal Side Shift (mm) | Not Applicable | 50 |
| Depth Tolerance (for specified pavement or base thickness): |  |  |
| < 215 mm | Mid-depth -6 | Mid-depth +6 |
| 215 to 229 mm | Mid-depth -12 | Mid-depth +15 |
| ≥ 230 mm | Mid-depth -15 | Mid-depth +25 |

**TABLE 8F**

**Rejection Criteria for Position and Alignment of Dowel Bars**

|  |  |  |
| --- | --- | --- |
| **Attribute** | **Lower Limit** | **Upper Limit** |
| Horizontal alignment (mm) | -38 | 38 |
| Vertical alignment (mm) | -38 | 38 |
| Horizontal or Longitudinal Side Shift (mm) | -75 | 75 |
| Depth (for specified pavement or base thickness): |  |  |
| < 215 mm | Mid-depth -10 | Mid-depth +10 |
| 215 to 229 mm | Mid-depth -18 | Mid-depth +23 |
| 230 to 259 mm | Mid-depth -25 | Mid-depth +35 |
| ≥ 260 mm | Mid-depth -25 | Mid-depth +40 |

**Table 9**

**Performance Requirements During the Entire Warranty Period**

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Requirement** | **Measurement Procedures** | **Acceptance Criteria** | **Consequences for Non-Conformance**  (Note 1) |
| Coarse Aggregate Loss | SP-026 Evaluation | No locations of coarse aggregate loss with a severity of severe or very severe | Remove and Replace concrete – Uniform Depth, within 30 Days |
| Polishing | SP-026 Evaluation | No locations of flushing with a severity of severe or very severe | Diamond grinding or grooving, within 30 Days |
| Scaling | SP-026 Evaluation | No locations of scaling with a severity of severe or very severe | Remove and replace concrete |
| Blow Up | SP-026 Evaluation | Not acceptable | Remove and replace concrete |
| Faulting | SP-026 Evaluation | No location of faulting with a severity of severe or very severe | Diamond grinding or grooving |
| Joint and Crack Spalling | SP-026 Evaluation | No location of spalling with a severity of severe or very severe | Remove and replace concrete |
| Joint Sealing Compound Loss | SP-026 Evaluation | Not permitted | Resealing of joint |
| Cracking | MTO ARAN Survey | Not permitted | Longitudinal crack ≤ 20 mm width shall be repaired using cross-stitching with rout and seal the crack. |
| Any crack > 20 mm shall remove and replace concrete |
| Smoothness | LS 296 | No lane segments with average MRI > 1.40 m/km (Note 2)  No localized roughness with average MRI > 2.8 m/km (Note 2) | Diamond grinding or grooving |
| Notes:  1. Repairs required as a consequence for non-conformance shall be as specified in the Contract Documents. The repair limits shall be to the extent of the non-conformance and extended at the Design-Builder’s option.  2. Not applicable to miscellaneous pavement surface as defined in XXX.08.02.04.01. | | | |

**Table 10**

**Performance Requirements During the Final Year of the Warranty Period**

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Requirement** | **Measurement Procedures** | **Acceptance Criteria** | **Consequences for Non-Conformance**  (Note 1) |
| Coarse Aggregate Loss | SP-026 Evaluation | The total area of the locations of each individual surface distress of moderate severity shall be < 10% of the segment area | Remove and Replace concrete – Uniform Depth, within 30 Days |
| Polishing | SP-026 Evaluation | The total area of the locations of each individual surface distress of moderate severity shall be < 10% of the segment area | Diamond grinding or grooving, within 30 Days |
| Scaling | SP-026 Evaluation | The total area of the locations of each individual surface distress of moderate severity shall be < 10% of the segment area | Remove and replace concrete |
| Blow Up | SP-026 Evaluation | Not acceptable | Reconstruction |
| Faulting | SP-026 Evaluation | The total length of moderate severity faulting shall be < 10% of the segment length | Diamond grinding or grooving, within 30 Days |
| Smoothness | LS 296 | No lane segments with average MRI >1.40 m/km (Note 2)  No localized roughness with average MRI > 2.8 m/km (Note 2) | Diamond grinding or grooving |
| Joint Efficiency | Random Coring of one joint per segment | Joint completely filled with joint sealing compound to the bottom of the joint. | Resealing of all joints |
| Longitudinal Joint Separation | Horizontal measure of the width of longitudinal joint separation | Separation shall be < 25 mm | Joint Sealing |
| Notes:  1. Repairs required as a consequence for non-conformance shall be as specified in the Contract Documents. The repair limits shall be to the extent of the non-conformance and extended at the Design-Builder’s option.  2. Not applicable to miscellaneous pavement surface, as defined in XXX.08.02.04.01. | | | |

**TABLE 11**

**Sublot Price Adjustment for Initial Smoothness**

|  |  |
| --- | --- |
| **Concrete Pavement Price Adjustment** | |
| **MRI (m/km)** | **Adjustment ($/m2)** |
| Average ≤ 0.500 | 1.25 (bonus) |
| Average > 0.500 to 0.550 | 0.83 (bonus) |
| Average > 0.550 to 0.650 | 0.42 (bonus) |
| Average >1.000 and ≤ 1.100 | -15 (penalty) |
| Average >1.100 and ≤1.250 | -30 (penalty) |
| Average >1.250 | Rejectable |
|  | |
| **Concrete Base Price Adjustment** | |
| **MRI (m/km)** | **Adjustment ($/m2)** |
| Average > 1.200 to 1.500 | -10 (penalty) |
| Average > 1.5000 | Rejectable |

**THE FOLLOWING NOTES TO DESIGNER AND USAGE GUIDEINES MUST BE DELETED PRIOR TO ADVERTISING:**

NOTES TO DESIGNER:

Designer Fill-In

\* Insert the pavement design service life in years as recommended by the Regional Geotechnical Section.

Designer Option

\*\* Insert Option A or B as recommended by the Regional Operations Office.

Option A:

Partial paving of the full pavement width is permitted except with the conditions listed below.

Partial paving of the full pavement width is not permitted when one or more of the following conditions exist:

a) when the ramping height would be greater than 50 mm, or

b) the pavement slope would cause water to accumulate at the edge of the ramping and extend onto an adjacent lane or shoulder that will be open to traffic.

When partial paving of the full pavement width is permitted, temporary longitudinal and transverse ramp downs shall be placed regardless of the difference in height elevations between adjacent pavement surfaces.

Option B:

Partial paving of the full pavement width is not permitted.

Designer Fill-In

\*\*\* Insert stations and/or roadways that are to be exempted from the warranty, as recommended by the Regional Geotechnical Section. If none, insert N/A.

Designer Fill-In for Table 1

\*\*\*\* Insert classification (Freeway, Arterial, or Collector), AADT data as recommended by Regional Traffic Section, and ESAL as recommended by the Regional Geotechnical Section, for each Roadway. Design lane ESAL and/or AADT should be calculated by applying the lane distribution factors given in the MI-183 Report. ESAL shall be in millions and to 1 decimal ie. enter 21,542,430 ESAL as 21.6

Designer Fill-In for Table 2

\*\*\*\*\* Insert locations and permitted grade raise amounts for any locations within the roadway where an increase in the specified top of pavement elevation can be accommodated. Bridge clearance should be considered.

Designer Fill-In for Table 3

\*\*\*\*\*\* Insert locations and permitted ditch elevation lowering amounts for any locations within the roadway where a lowering of the ditch elevation can be accommodated.

Designer Fill-In for Recommended Item Costs

\*\*\*\*\*\*\* Insert the item cost as recommended by the Regional Geotechnical Section. Below are the recommended item costs as reference:

|  |  |
| --- | --- |
| **Item** | **Item Costs** |
| Drainage Layer Aggregates | $15.00/m3 |
| Base Aggregates | $23.00/m3 |
| Subbase Aggregates | $15.00/m3 |
| Concrete Pavement | $100.0/m2 |
| Concrete Base | $90.0/m2 |
| HMA (SMA) | $16.0/m2 |
| HMA (SP 12.5, FC1 or FC2) | $15.5/m2 |
| HMA (SP 19.0) | $14.0/m2 |
| CMA | $10.0/m2 |

WARRANT: Use with the above non-standard work in consultation with Regional Geotechnical Section.

CUSTODIAN: Stephen Lee, EMO - Pavements.