MATERIAL SPECIFICATION FOR CONCRETE - MATERIALS AND PRODUCTION

TABLE OF CONTENTS

1350.01 **SCOPE**

1350.02 **REFERENCES**

1350.03 **DEFINITIONS**

1350.04 **DESIGN AND SUBMISSION REQUIREMENTS**

1350.05 **MATERIALS**

1350.06 **EQUIPMENT**

1350.07 **PRODUCTION**

1350.08 **QUALITY ASSURANCE**

1350.09 **OWNER PURCHASE OF MATERIAL - Not Used**

APPENDICES

1350-A **Commentary**
1350-B **VOC Compliant Concrete Sealers**
1350-C **Concrete Patching Materials**

1350.01 SCOPE

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

1350.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

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

1350.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

1350.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

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

Ontario Provincial Standard Specifications, Material

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

Ontario Ministry of Transportation Publications

Designated Sources for Materials (DSM)

CSA Standards

A23.1-19	Concrete Materials and Methods of Concrete Construction *
A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens *
A23.2-4C	Air Content of Plastic Concrete by the Pressure Method *
A23.2-5C	Slump and Slump Flow of Concrete *
A23.2-6C	Density, Yield, and Cementing Materials Factor of Plastic Concrete *
A23.2-8C	Flexural Strength of Concrete (Using a Simple Beam with Third-Point Loading) *
A23.2-9C	Compressive Strength of Cylindrical Concrete Specimens *
A23.2-10C	Accelerating the Curing of Concrete Cylinders and Determining Their Compressive Strength *
A23.2-13C	Splitting Tensile Strength of Cylindrical Concrete Specimens *
A283-00 (R2011)	Qualification Code for Concrete Testing Laboratories

A3000-18 Cementitious Materials Compendium
A3001 Cementitious Materials for Use in Concrete**
* [Part of A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete]
**[Part of A3000-18 - Cementitious Materials Compendium]

ASTM International

C157 / C157M 08(2014)e1	Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete
C260 / C260M - 10a	Standard Specification for Air-Entraining Admixtures for Concrete
C457 / C457M - 12	Standard Test Method for Microscopical Determination of Parameters of the Air Void System in Hardened Concrete
C494 / C494M - 13	Standard Specification for Chemical Admixtures for Concrete
C1017 / C1017M - 13e1	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C1202 - 12	Standard Test Method for Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration

Ready Mixed Concrete Association of Ontario Publications (RMCAO)

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

1350.03 DEFINITIONS

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

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

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

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

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

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

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

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

Limestone Filler means divided limestone powder that may be used in concrete as an aggregate in appropriate applications and exposure conditions, after its suitability is determined through physical, chemical and mineralogical testing. Limestone fillers may be used to optimize the aggregate gradation to achieve an improved concrete performance. Limestone fillers are not cementitious materials and should not be used to replace cementing material in concrete. Limestone fillers shall not be included in the calculation of the water-to-cementing materials ratio (w/cm). The water/cement shall not vary significantly with or without the use of limestone fillers. (CSA A23.1) Limestone Filler is added during concrete production.

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

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

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

Portland Limestone Cement – means cement obtained by intergrinding limestone with Portland cement clinker, as defined in CSA A3001. The addition of limestone is done at the cement manufacturing process.

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

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

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

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

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

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

1350.04 DESIGN AND SUBMISSION REQUIREMENTS

1350.04.01 Design Requirements

1350.04.01.01 Mix Design Alterations

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

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

1350.04.02 Submission Requirements

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

1350.04.02.01 Performance Specification Alternative

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

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

a) Establish the concrete mix properties to meet performance criteria for plastic and hardened concrete, after considering the Contractor's methods for construction and placement and the Owner's performance criteria as specified in the Contract Documents.

b) Submit documentation demonstrating the Owner's pre-qualification performance criteria can be met.

c) Prepare, submit, and implement a quality control plan to ensure that the Owner's performance criteria can be met. When specified in the Contract Documents, submit documentation demonstrating that the Owner's performance requirements have been met.

d) Ensure that the concrete supplier submits the following to the Contractor to forward to the Owner.

   i. Certification that the plant, equipment, and all materials to be used in the concrete comply with the requirements of this specification.
   ii. Certification that the mix design satisfies the requirements of this specification.
   iii. Certification that the production and delivery of concrete will meet the requirements of this specification.
   iv. Certification that the concrete complies with the specified performance criteria.

e) Provide documentation verifying that the concrete supplier's plant and equipment meet the plant certification requirements of the RMCAO Approved Quality Program.

1350.04.02.01.01 Performance Based Concrete Mix Data

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

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

1350.04.02.01.02 Mix Design Confidentiality and Indemnity Agreement

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

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

1350.04.02.02 Prescriptive Specification Alternative

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

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

a) Plan the construction methods based on the Owner's mix proportions and parameters.

b) Obtain approval from the Owner for any deviations from the specified mix design or parameters.

c) Identify to the Owner any anticipated problems or deficiencies with the mix parameters related to construction.

d) Provide verification that the plant, equipment, and materials to be used in the concrete comply with the requirements of this standard.

e) Demonstrate that the concrete complies with the prescriptive criteria as supplied by the Owner.

1350.04.02.03 Ready Mixed Concrete Operation or Mobile Mix Concrete Operation

At least 1 week prior to the delivery of concrete to the Work Area, the Contractor shall submit to the Owner a current valid R1025 Certificate of Ready Mixed Concrete Production Facilities or a current valid R1026 Certificate of Mobile Mix Concrete Production Facilities for the plant being used to produce ready mixed concrete, issued under the Approved Quality Program as outlined in the publications, Certificate of Ready Mixed Concrete Production Facilities and Certificate of Mobile Mix Concrete Production Facilities.

1350.04.02.04 Concrete Delivery Ticket

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

a) Name and location of plant.

b) Date and serial number of the ticket.

c) Name of Contractor.

d) Specific designation of the job by name and location.

e) Specified class or designation of the concrete.

f) Volume of concrete.

g) Truck number and cumulative total or load number.

h) Time stamped when mixing of cement and aggregates commences.

i) Ordered slump.

j) Time that the discharge of load was completed.

k) Amount of water added after batching, authorization, and units used.

l) Amount and type of admixtures added after batching.

1350.05 MATERIALS

1350.05.01 Materials for Concrete

1350.05.01.01 Cementing Materials

Cementing materials shall be according to CSA A3000.

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

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

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

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

Portland limestone cement may be used in place of Portland cement only when the supplier of the Portland limestone cement is included in the Designated Sources for Material list. Concrete made with Portland cement and Portland limestone cement shall not be used in the same component. Portland limestone cement shall not be used in combination with limestone filler.

1350.05.01.02 Aggregates

Aggregates shall be according to OPSS 1001 and OPSS 1002.

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

Limestone filler shall comply with the following:

a) The requirements of OPSS 1002 for mineral filler

b) The requirements of CSA A23.1, Annex L, L2 Organic Impurities, and

c) The requirements of CSA A3001, Clause 4.4.3 a) for calcium carbonate content

Limestone filler shall be restricted to a maximum of 15% of the cement by mass.

1350.05.01.03 Water

Water for concrete shall be according to OPSS 1302.

1350.05.01.04 Air Entraining and Chemical Admixtures

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

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

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

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

1350.05.02 Performance Requirements for Concrete

1350.05.02.01 General

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

1350.05.02.02 Exposure Classes of Concrete

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

Classification A exposures do not apply to this specification.

1350.05.02.03 Compressive Strength

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

1350.05.02.04 Air Content

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

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

1350.05.02.05 Slump

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

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

a) Slumps less than 80 mm - the maximum allowable variation shall be $\pm$ 20 mm.

b) Slumps between 80 to 180 mm - the maximum allowable variation shall be $\pm$ 30 mm.

c) Slumps greater than 180 mm - the maximum allowable variation shall be $\pm$ 40 mm.

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

1350.05.02.06 Within Batch Uniformity of Concrete

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

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

The minimum size of sample shall be 30 litres.

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

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

a) Where the result of each test is equal to or less than the acceptance limit, the concrete shall be considered uniform.

b) Where the result of any single test is greater than the rejection limit, the concrete shall be considered non-uniform.

c) If a test result falls between acceptance limit and rejection limit, additional tests shall be made on the next consecutive batch or load delivered by that unit.

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

1350.06 EQUIPMENT

1350.06.01 Batching Plant

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

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

1350.06.02 Mixing Equipment

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

1350.06.03 Non-Agitating Delivery Equipment

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

1350.07 PRODUCTION

1350.07.01 General

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

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

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

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

1350.07.02 Temperature Control

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

1350.07.03 Records and Reporting

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

a) The method used to control the temperature of the concrete during hot weather conditions.

b) The method used to extend the discharge time of the concrete beyond 1.5 hours after introduction of the mix water during hot weather conditions.

c) The type and quantity of any materials added to the concrete after leaving the batch plan, and the time that each material was added.

1350.07.04 Concrete Strengths 35 MPa or Greater

1350.07.04.01 Trial Batch

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

a) Slump.

b) Plastic air content.

c) Compressive strength.

d) Hardened Air Void System (AVS).

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

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

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

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

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

a) There is no change in the source of any material.

b) The performance characteristics of the aggregates have not changed significantly.

c) The concrete mix designated and previously used meets the specified performance requirements.

d) Documentation of this prior approval is submitted to the Owner.

1350.07.04.02 Early Compressive Strength Determination of Mix Design

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

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

1350.07.05 Ready Mixed Concrete

1350.07.05.01 Delivery of Ready Mixed Concrete

1350.07.05.01.01 General

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

1350.07.05.01.02 Delivery by Non-Agitating Equipment

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

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

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

1350.07.05.01.03 Delivery by Agitator or Mixer Trucks

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

When concrete is transported to the site by means of agitating or mixing equipment, discharge of the concrete shall be completed within 1.5 hours after introduction of the mixing water to the cement and aggregates, except when the air temperature exceeds 28 °C and the concrete temperature exceeds 25 °C, the concrete shall be discharged within 1 hour after the introduction of the mixing water.

These times may be extended using a set retarder, provided the Owner approves such use.

1350.07.05.01.03.01 Site Addition of Materials

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

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

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

a) The specified water-to-cementing materials ratio is not exceeded.

b) No more than 60 minutes has elapsed from the time of batching.

c) Addition of water is only at the start of discharge (i.e., not more than 10% of the concrete has been discharged).

d) Not more than the lesser of 16 L/m^3 or 10% of the mixing water shall be added.

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

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

1350.08 QUALITY ASSURANCE

1350.08.01 General

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

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

1350.08.02 Sampling and Testing

1350.08.02.01 General

1350.08.02.01.01 Quality Assurance Testing Staff and Laboratory Requirements

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

a) CCIL Certified Concrete Testing Technician, Concrete Testing and Sampling Certificate, or

b) ACI Concrete Field Testing Technician - Grade 1.

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

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

1350.08.02.01.02 Quality Assurance Test Reporting

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

a) Project identification.

b) A graphical representation of the specified and actual compressive strength data.

c) The average strength value for each age that the concrete is tested.

d) Average slump value for the mix design.

e) Average plastic air content for the mix design.

Testing shall be completed as shown in Table 2.

1350.08.02.02 Air Content in Hardened Concrete

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

1350.08.02.03 Testing for Uniformity of Mixed Concrete

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

1350.08.02.04 Strength Tests and Requirements

1350.08.02.04.01 Compressive Strength

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

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

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

a) The average of all groups of 3 consecutive strength tests shall be equal to or greater than the specified strength.

b) No individual strength test shall be more than 3.5 MPa below the specified strength.

Concrete not meeting these requirements shall be subject to removal and replacement; however the Contractor may submit a proposal in writing for the Owner’s consideration for acceptance of such concrete.

1350.08.02.04.02 Flexural Strength

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

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

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

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

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

TABLE 1
2-Day Accelerated Compressive Strengths

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

TABLE 2
Quality Assurance Tests

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

TABLE 3
Hardened Concrete Air Void System Requirements

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

Concrete Mix Design Submission

Contract _____ Date Submitted _____

Location _____ Submitted To _____

Contractor _____ Contact _____

Batch Plants: Primary _____ Secondary _____

Concrete Supplier: Name _____

Address _____

City/Province _____

Telephone _____ Fax _____ Email _____

	MIX CODE					
	Application / Element / Location					
SPECIFICATION	**Structural Requirements**					
	- CSA Exposure Class					
	- Maximum W/CM					
	- Minimum Specified Strength, MPa @ Days					
	- Nominal Maximum Aggregate Size, mm					
	- HVSCM Type 1 or 2					
	- Plastic Air Content, %					
	Durability Requirements					
	- Exposure to Sulphate Attack					
	- Alkali Aggregate Reactivity					
	Architectural Requirements					
	- Colour / Texture					
	- Other					
CONTRACTOR REQUIREMENTS	**Rate, m^3/h**					
	Quantity, m^3					
	Slump Range, mm					
	Strength @ Age, MPa @ Days					
	Other					
	Specialty Information					
	- Concrete Set, **D**elay, **N**ormal, **A**ccelerated					
	Method of Placement					

MATERIALS SECTION	**Material**	**Source**
	Cement	
	SCM - Slag	
	SCM - _____	
	Water	
	Fine Agg.	
	Coarse Agg.	
	A.E.A.	
	W.R.	
	S.P.	

Form Submitted By:

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

Contractor's Representative Receiving Form:

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

OPSF 1350-1

CONFIDENTIAL - Concrete Mix Design Submission

Contract _____ Date Submitted _____

Location _____ Submitted To _____

Contractor _____ Contact _____

Batch Plants: Primary _____ Secondary _____

Concrete Supplier: Name _____

Address _____

City/Province _____

Telephone _____ Fax _____ Email _____

	MIX CODE					
	Application / Element / Location					
SPECIFICATION	**Structural Requirements**					
	- CSA Exposure Class					
	- Maximum W/CM					
	- Minimum Specified Strength, MPa @ Days					
	- Nominal Maximum Aggregate Size, mm					
	- HVSCM Type 1 or 2					
	- Plastic Air Content, %					
	Durability Requirements					
	- Exposure to Sulphate Attack					
	- Alkali Aggregate Reactivity					
	Architectural Requirements					
	- Colour / Texture					
	- Other					
CONTRACTOR REQUIREMENTS	**Rate, m^3/h**					
	Quantity, m^3					
	Slump Range, mm					
	Strength @ Age, MPa @ Days					
	Other					
	Specialty Information					
	- Concrete Set, **D**elay, **N**ormal, **A**ccelerated					
	Method of Placement					

MATERIALS SECTION	**Material**	**Source**	**Unit**	**Quantity**			
	Cement		kg/m^3				
	SCM - Slag		kg/m^3				
	SCM -		kg/m^3				
	Water		L/m^3				
	Fine Agg.						
	Coarse Agg.						
	A.E.A.		mL/100 kg				
	W.R.		mL/100 kg				
	S.P.		mL/100 kg				

Form Submitted By:

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

Municipal Representative Receiving Form:

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

OPSF 1350-2

Appendix 1350-A, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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Designer Action/Considerations

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

The designer shall specify the following in the Contract Documents:

- The Owner's choice of concrete specification alternatives, either Performance Specifications or Prescriptive Specifications. (1350.04.02)

The designer should specify the following in the Contract Documents:

- Minimum dose of chemical admixtures. (1350.04.02.01.01)

- Chemical admixtures. (1350.05.01.04)

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

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

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

a) There is no change in the source of any material.

b) The concrete mix designated and used previously meets the specified performance requirements.

c) Documentation of this prior approval is submitted to the Owner.

Where the designer considers the use of Self-Consolidating Concrete (SCC) a special provision shall be written and provided in Contract Documents.

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

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

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

a) Required structural criteria including strength at age.

b) Required durability criteria including class of exposure.

c) Additional criteria for durability, volume stability, architectural requirements, sustainability, and any additional Owner performance, pre-qualification or verification criteria.

d) Quality management requirements.

e) Certification of the concrete supplier through the Approved Quality Program.

f) Any other properties that may be required to meet the Owner's performance requirements.

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

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

a) Mix proportions, including the quantities of any or all materials (admixtures, aggregates, cementing materials, and water) by mass per cubic metre of concrete;

b) The range of air content;

c) The slump range;

d) Use of a concrete quality plan, if required;

e) Other requirements.

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

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

Related Ontario Provincial Standards Drawings

No information provided here.

Appendix 1350-B, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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TABLE 1
Protection against chloride ion ingress and scaling

Product	Description		Material Type	Source
MasterProtect H 1000	Single component	Clear	100% silane	BASF Master Builders Solutions
Protectosil 300C	Single component	Clear	100% silane w/ corrosion inhibitor	DRE Industries Inc.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	
1) Sikagard SN 100 + 2) Sikagard 550W Elastic	Two component	Pigmented	1) 100% silane and 2) pigmented acrylic top coat	
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	W.R. Meadows of Canada/ Gemite

TABLE 2
Protection against scaling

Product	Description		Material Type	Source
MasterProtect H 1000	Single component	Clear	100% silane	BASF Master Builders Solutions
Protectosil 300C	Single component	Clear	100% silane w/ corrosion inhibitor	DRE Industries Inc.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	
1) Sikagard SN 100 + 2) Sikagard 550W Elastic	Two component	Pigmented	1) 100% silane and 2) pigmented acrylic top coat	
Weather Worker S100 (J-29-A)	Single component	Clear	100% silane	Dayton Superior Canada Ltd.
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	W.R. Meadows of Canada/ Gemite
Sealmaster 100%	Single component	Clear	100% silane	Technical Barrier Systems Inc.

Appendix 1350-B, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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TABLE 3
For low temperature application - Protection against chloride ion ingress and scaling

Product	Description		Material Type	Min. Rec. Ambient Temperature for Application (ºC)	Source
Protectosil 300C	Single component	Clear	100% silane	-6.5	DRE Industries Inc.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	0	
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	W.R. Meadows of Canada/ Gemite

TABLE 4
For low temperature application - Protection against scaling

Product	Description		Material Type	Min. Rec. Ambient Temperature for Application (ºC)	Source
Protectosil 300C	Single component	Clear	100% silane	-6.5	DRE Industries Inc.
Weather Worker S100 (J-29-A)	Single component	Clear	100% silane	0	Dayton Superior Canada Ltd.
1) Sikagard SN40 Lo VOC + 2) Sikagard Color A50 Lo VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	Sika Canada Inc.
1) Sikagard SN 100 + 2) Sikagard Color A50 LoVOC	Two component	Pigmented	1)100% silane and 2) pigmented acrylic top coat	0	
1) Gem-Gard SL Plus (VOC) + 2) Rain-Shield Stain OP SB VOC	Two component	Pigmented	1) 40% silane and 2) pigmented acrylic top coat	0	W.R. Meadows of Canada/ Gemite

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TABLE 1
List of Concrete Patching Materials

Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
BASF MasterEmaco N 400	✔	✔	✔	✔	✔	✔		≥ 4	76	> 15	N	N	N-C & P	Two components, (Latex) polymer modified lightweight repair mortar, grey colour, dry cure, single lifts up to 76 mm in thickness on vertical surfaces and up to 38mm in thickness on overhead surfaces (without the use of form work).
BASF MasterEmaco N 400 RS	✔	✔	✔	✔	✔			≥ 7	max 38	< 15	N	N	N-C & P	Two components, (Latex) polymer modified rapid setting repair mortar, grey colour, dry cure, single lifts up to 76 mm in thickness on vertical surfaces and up to 38mm in thickness on overhead surfaces (without the use of form work).
BASF MasterEmaco S 440 MC	✔	✔	✔	✔	✔	✔		≥ 4	19 to full	> 15	Y	N	C	Flowable concrete, self compacting for large volume repairs, grey colour, wet cure, contains #4 aggregate. Form & Pump/Pour material.

Appendix 1350-C, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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TABLE 1
List of Concrete Patching Materials

Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range	Application Thickness	Working Time	Contains Aggregate [4]	Option to Extend w/ Aggregate [5]	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H			(Celsius)	(mm)	(minutes)	Y/N	(Y/N)		
BASF MasterEmaco T 310 CI	✔	✔			✔			≥ 7	6 to 25	> 15	Y	Y	C	Flowable, lab working time 30 min, dark colour, wet cure for 24h, can be extended with aggregate.
BASF MasterEmaco T 1060	✔	✔			✔	✔		4		< 15	Y	Y	C	Rapid set repair mortar, brown/yellow colour, can be extended with aggregate.
BASF MasterEmaco S 466 CI	✔	✔	✔	✔	✔			≥ 7	25 to 200	> 15	Y	Y	C	Flowable/pourable concrete for large volume repairs, grey colour, wet cure, contains pea size aggregate Extension recommended for placement over 8" thick.
BASF MasterEmaco T 430	✔	✔			✔	✔		-7 to +38	min 13	> 15	Y	Y	C	Yellow/brown colour, wet cure for 24h, contains #4 sand, can be extended with aggregate.
BASF MasterEmaco N 425	✔	✔	✔	✔	✔			4 to 32	max 50	< 15	N	N	C	Polymer modified, silica-fume-enhanced fibre repair mortar, grey colour, wet cure for 3 days.

Appendix 1350-C, November 2019
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TABLE 1
List of Concrete Patching Materials

Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
BASF MasterEmaco S 440	✔	✔	✔	✔	✔			≥ 4	25 to full	> 15	Y	N	C	Flowable/pourable concrete for large volume repairs, grey colour, wet cure, contains pea size aggregate
BASF MasterEmaco T 545 SMasterEmaco T 545 HT	✔	✔			✔	✔		Standard: ≤ 29 HW: 29 to 38	13 to 51	< 15	N	Y	N-C & MP	Magnesium Phosphate, rapid set repair mortar (paste), Two types: standard type has a temperature range of less than 29°C , hot weather type has range of +29°C to 38°C , can be extended with aggregate
BASF MasterEmaco T 1060 EX	✔	✔			✔			4 to 29	38 to full	<15	Y	N	C	Rapid set repair mortar pre-extended with coarse aggregate.
CPD FASTCRETE ULTRA	✔	✔	✔	✔	✔	✔			3 to 38	12 - 15	N		N-C & P	All areas to be patched must be pre-dampened with water and receive a slurry bond coat immediately prior to placing the product.

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TABLE 1
List of Concrete Patching Materials

Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
CPD FASTCRETE (OH GRADE)	✔	✔	✔	✔	✔	✔		≥ 5	min 6.4	<10	N	N	N-C & P	Fast setting and not recommended for structural grouting applications.
CPD RAPID CRETE	✔				✔			23	min 13	>25	N	Y	C	Wet curing of all patches and exposed grout areas is required as specified. Curing by application of a film forming curing compound is not recommended as a direct substitute for wet curing.
Five Star Structural Concrete	✔			✔	✔	✔	✔	2 to 21	6 to 300	> 15	Y	Y	C	Flowable, Formed (must be moist cured for 1 hour or greater), develops 17.2 MPa in 3 hours.
Five Star Structural Concrete V/O	✔		✔	✔	✔	✔		2	min 6	> 15	N	N	C	Can be trowel overhead (must be moist cured for minimum 30mins after final set), develops 17.2 MPa in 3 hours.

Appendix 1350-C, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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TABLE 1
List of Concrete Patching Materials

Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
Five Star Rapid Repair fiber mortar	✔			✔	✔	✔	✔	-18 to 37	12.7 to 152.3	5 -10	N	Y	P	Flowable, formed (must be moist cured for 1 hour or greater), develops 17 MPa in 3 hours.
Five Star Highway Patch	✔			✔	✔	✔		2 to 21	min 25	10	N	Y	C	Placement shall be continuous to avoid cold joints. Repair material shall be protected from freezing until it reaches 6.9 MPa. Never exceed the maximum water content as stated on the package, as this may lead to segregation.
CTS Rapid set Cement All	✔	✔			✔	✔		7 to 32	max 100	< 15	N	N	C	Water cured. Thickness from featheredge to a maximum of 10cm.
CTS Rapid set Concrete Mix	✔	✔			✔	✔		7 to 32	50 to 610	< 15	Y	N	C	Water cured.
EUCLID VERTICOAT SUPREME	✔		✔	✔	✔			7 to 32	6 to 50	> 15	N	N	C & P	Dry polymer in bag and pre-measured water. Trowel application. Corrosion inhibitor included. Wet cure for 3 days.

Appendix 1350-C, November 2019
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	NC	HPC	OH	V	H									
EUCLID CONCRETE TOP SUPRIME	✔		✔	✔	✔			7 to 32	10 to 50	> 15	Y	Y	C & P	Dry polymer in bag and pre-measured water. Aggregate required for thickness over 50mm up to 200mm. Corrosion inhibitor included.
EUCLID EUCOCRETE	✔	✔		✔	✔			7 to 32	25 to 150	> 15	Y	Y	C & P	Dry polymer in bag and pre-measured water. Aggregate required for thickness over 50mm up to 200mm. Corrosion inhibitor included.
EUCLID EUCOSPEED MP	✔	✔	✔	✔	✔	✔		-17 to 29	12 to 25	< 15	Y	Y	MP	Pea gravel required for thicknesses over 25mm up to 200mm. Do not extend with limestone aggregate. Do not let the product come in contact with galvanized steel. Do not featheredge. Do not place over carbonated concrete.
EUCLID VERSASPEED	✔	✔			✔	✔		-7 to 29	6 to 25	> 15	Y	Y	C	Aggregate required for thicknesses greater than 50 mm up to 152 mm.

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TABLE 1
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	NC	HPC	OH	V	H									
EUCLID EUCOSPEED	✔	✔			✔			4 to 32	12 to 50	< 15	Y	Y	C	Aggregate required for thicknesses greater than 50 mm up to 150 mm.
EUCLID THINTOP SUPREME	✔				✔			7 to 38	1.6 to 10	> 15	N	N	C & P	Very high shrinkage, use for thin coats only. Dry Polymer in bag and pre-measured water. Corrosion inhibitor included. Trowel application. Do not wet cure.
WEBER.cem HB40	✔		✔	✔	✔			> 5	Min 10 V: max 75 OH: max 50	> 15	N	N	C & P	Contains fibres and spray dried acrylic polymer.
WEBER.cem Mortar	✔			✔	✔			> 5	Min: 10 V: max 20		N	N	N-C	Do not feather edge.
WEBER.cem Lightweight mortar	✔	✔	✔	✔	✔				Min: 10 OH: max 75		N	N	C & P	High build up to 75 mm in overhead patch without formwork. Do not feather edge.
WEBER.cem Pyrapatch					✔			> 5	25 to 100	> 15	Y	Y	P	Pavement repair

Appendix 1350-C, November 2019
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	NC	HPC	OH	V	H									
WEBER.cem Plug 530									25 to 50	< 15	N	N	C & P	Not to be used as a concrete repair material. Working time of 20 seconds. Sets within one minute.
WEBER Five Star repair concrete	✔	✔			✔			> 5	min 15	> 15	Y	N	C	Pavement repair
KING In-Pakt Construction	✔				✔			5 to 30	6 to 50	> 15	N	N	C	Can be troweled or form and pump/pour depending on water content. Grout for precast units, dowels, plates.
KING MS-S10 SCC	✔				✔			5 to 30	50 to full	> 15	Y	N	C	Gravity feed/pump into forms and remove forms after 75% strength is achieved.
KING In-Pakt Precision	✔				✔			5 to 30	6 to 50	> 15	N	N	C	Use in precast units, dowels, and plates.
KING In-Pakt Precision CT	✔				✔			-5 to 30	6 to 50	> 15	N	N	C	Cold Temperature use (up to -5° C). Best used for precast units, dowels, and plates.

Appendix 1350-C, November 2019
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	NC	HPC	OH	V	H									
KING RS-S10	✔				✔	✔		0 to 30	38 to full	20	Y	N	C	High early strength Concrete for horizontal concrete repairs, requireing early return-to-service
KING HP S10	✔				✔			5 to 30	38 to full	> 15	Y	N	C	
MAPEI PLANITOP 15	✔		✔	✔	✔		✔	7 to 35	10 to 100	> 15	Y	Y	C	Form and Pump Only. Do not use with spraying pump or trowel. Formwork must be in place for 3 days of curing. Corrosion inhibitor included.
MAPEI Mapecem 101	✔				✔			7 to 35	max 25	> 15	N	N	C & P	Trowel or screed application only. Used for thin coats. Not to be used where asbestos is present.
MAPEI PLANITOP 23	✔	✔	✔	✔	✔			7 to 35	6 to 50	> 15	N	N	C & P	Apply by trowel. Corrosion inhibiter included.
MAPEI MAPECEM 202	✔	✔			✔			7 to 35	6 to 50	> 15	N	Y	C & P	Corrosion inhibitor included. (name changed - Quickem Top)

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Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
MAPEI PLANITOP 18	✔	✔			✔	✔		0 to 35	12 to 50	< 15	N	Y	C	Corrosion inhibitor included. Develops 20 MPa in 1.5 hours.
MAPEI PLANITOP X	✔	✔	✔	✔	✔	✔		5 to 29	0 to 100	< 15	N	N	C & P	Can be applied from feather edge to 100 mm per lift. Working time of 5 to 6 minutes. Use for small repairs only (0.001 m3). Avoid use where the substrate contains asbestos. Reaches 25 MPa in 3 hours. Corrosion inhibiter included.
MAPEI Mapecem Quickpatch	✔	✔			✔			7 to 29	1.5 to 38	> 15	N	Y	C	Can be placed up to 75mm thick in areas no larger than 2.23 m^2. Not to be installed with substrates containing asbestos. Do not expose to loads within 24 hours of placement. Self curing.

Appendix 1350-C, November 2019
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

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TABLE 1
List of Concrete Patching Materials

Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
MAPEI PLANITOP 25	✔	✔			✔			7 to 35	6 to 25	> 15	Y	Y	C & P	Form and pump. For exposure to traffic, must be applied at a minimum thickness of 12 mm. Corrosion inhibiter included. High concentration of synthetic polymer.
SIKA SIKATOP 122 PLUS	✔	✔		✔	✔			≥ 7	3 to 38	> 15	Y	Y	C & P	Corrosion inhibitor included.
SIKA SIKATOP 123 PLUS	✔	✔	✔	✔	✔			≥ 7	3 to 38	> 15	N	N	C & P	Corrosion inhibitor included.
SIKA Sika Set 45	✔				✔			-7 to 35	13 to 38	< 15	Y	Y	N-C & MP	Do not extend with limestone aggregates. 20 MPa in 45 minutes. Air cures.
SIKA SIKATOP 121 Plus	✔	✔			✔			≥ 7	max 4	< 15	N	N	C & P	Very high shrinkage, for thin coats only. Corrosion inhibitor included. Application done by trowel.
SIKA SIKACRETE 08-SCC	✔			✔	✔		✔	≥ 7	25 to 450	> 15	N	N	C	Form and pour.

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Product	Use for Repairs to: [1]		Applications [2]			High Early Strength [3]	Self Level	Ambient Working Temperature Range (Celsius)	Application Thickness (mm)	Working Time (minutes)	Contains Aggregate [4] Y/N	Option to Extend w/ Aggregate [5] (Y/N)	Binder [6]	Comments from Manufacturers Recommendations
	NC	HPC	OH	V	H									
AMBEX RS-SCC-10 (Beton)	✔			✔	✔	✔	✔	5 to 30	19 to full	> 15	Y	N	C	Not to be used in thin feather edge applications. Form and pour or hand placement. Trowel finish surfaces. Pumping is not recommended due to short working time. Beige in colour.
AMBEX SCC-10 (Beton)	✔	✔			✔		✔	5 to 30	19 to full	> 15	Y	N	C	Form and pump or form and pour. Trowel finish surfaces.

[1] NC - Normal Concrete, HPC - High Performance Concrete
[2] OH - Overhead, V - Vertical, H - Horizontal (Based on Manufacturers Literature)
[3] HIGH-EARLY STRENGTH > 20 Mpa @ 4 HOURS
[4] AGGREGATES ARE INCLUDED IN PRODUCT OR INCLUDED PACKAGED SEPERATELY (to be added to the neat material)
[5] MANUFACTURER HAS GIVEN PERMISSION TO EXTEND PRODUCT (and has submitted separate test results for extended product)
[6] C - Cementitious, N-C - Non-Cementitious, P - Polymer (polymer or latex is added instead of, or with, water), MP - Magnesium Phosphate

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