

**CONSTRUCTION SPECIFICATION FOR
COLOURED IMPRESSED CONCRETE**

INDEX

TS 3.85.01	SCOPE	3
TS 3.85.02	REFERENCES.....	3
TS 3.85.03	DEFINITIONS	3
TS 3.85.04	SUBMISSIONS AND DESIGN REQUIREMENTS	3
TS 3.85.04.01	General.....	3
TS 3.85.04.02	Samples	4
TS 3.85.05	MATERIALS	5
TS 3.85.05.01	Concrete	5
TS 3.85.05.02	Water.....	5
TS 3.85.05.03	Admixtures	5
TS 3.85.05.03.01	Colour.....	5
TS 3.85.05.03.02	Colour Release Agent	5
TS 3.85.05.03.03	Evaporation Reducer.....	6
TS 3.85.05.04	Granular Base and Backfill.....	6
TS 3.85.05.05	Expansion Joint Material.....	6
TS 3.85.05.06	Polyethylene Film.....	6
TS 3.85.05.07	Geotextile Fabric.....	6
TS 3.85.06	EQUIPMENT	6
TS 3.85.06.01	Forms	6
TS 3.85.06.02	Boxouts.....	7
TS 3.85.06.03	Finishing Tools	7
TS 3.85.06.04	Textured Mold.....	7
TS 3.85.06.05	Fogger.....	7
TS 3.85.07	CONSTRUCTION.....	7
TS 3.85.07.01	General.....	7
TS 3.85.07.02	Excavation	7
TS 3.85.07.03	Base.....	8
TS 3.85.07.03.01	General.....	8
TS 3.85.07.03.02	Subgrade	8

TS 3.85.07.03.03	Granular Base	8
TS 3.85.07.04	Form Placement	8
TS 3.85.07.05	Utility Adjustment	8
TS 3.85.07.06	Utility Isolation.....	8
TS 3.85.07.07	Placing Concrete	9
TS 3.85.07.08	Finishing Concrete	9
TS 3.85.07.09	Joints	10
TS 3.85.07.09.01	Expansion Joints	10
TS 3.85.07.09.02	Contraction Joints.....	10
TS 3.85.07.09.03	Construction Joints.....	10
TS 3.85.07.10	Concrete Curing.....	11
TS 3.85.07.10.01	General.....	11
TS 3.85.07.10.02	Geotextile Fabric and Water.....	11
TS 3.85.07.10.03	Polyethylene Film.....	11
TS 3.85.08	QUALITY ASSURANCE	11
TS 3.85.08.01	General.....	11
TS 3.85.08.02	Guarantee	11
TS 3.85.09	MEASUREMENT FOR PAYMENT	12
TS 3.85.09.01	Coloured Impressed Concrete Sample.....	12
TS 3.85.09.02	Coloured Impressed Concrete	12
TS 3.85.10	BASIS FOR PAYMENT	12
TS 3.85.10.01	Coloured Impressed Concrete Sample - Item	12
TS 3.85.10.02	Coloured Impressed Concrete - Item.....	12

TS 3.85.01 SCOPE

This specification covers the requirements for supplying and placing coloured impressed concrete and coloured impressed concrete samples.

TS 3.85.02 REFERENCES

This specification refers to the following specifications and publications:

Ontario Provincial Standard Specifications, Construction

OPSS 919 - Formwork and Falsework (Jan. 1995)

City of Toronto Specifications

TS 13.00 - Specification for Non-Structural Concrete (June 2001)

TS 501 - Amendments to OPSS 501 – Construction Specification for Compacting (June 2001)

TS 1010 - Amendments to OPSS 1010 – Material Specification for Aggregates - Granular A, B, M, and Select Subgrade Material (June 2001)

Canadian Standards Association (CSA)

CAN/CSA-A23.1 - Concrete Materials and Methods of Concrete Construction (Current Edition)

TS 3.85.03 DEFINITIONS

For the purposes of this specification the following definitions apply:

Contraction Joint: means a cut or formed joint to regulate the location and degree of cracking in the vertical plane of the coloured impressed concrete.

Expansion Joint: means a physical separation between the concrete and appurtenances, or between two sections of concrete, which allows both horizontal and vertical movement.

Geotextile: means a permeable geosynthetic textile.

Subgrade: means the soil prepared and compacted to support a structure or pavement.

TS 3.85.04 SUBMISSIONS AND DESIGN REQUIREMENTS

TS 3.85.04.01 General

Prior to commencing work on site, the Contractor shall supply the following:

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- Catalogue extracts, colour sample sheets, colouring agent mix proportions and manufacturers' mixing and application instructions for all products to be used in the construction of the above item. This shall include colouring agents, proprietary admixtures, curing compound, etc.
 - A full description of the process used to achieve the required finished product.
 - A description of the formula used to achieve each of the sample panels as described in TS 3.85.04.01 in this specification. This shall include each step in chronological order and proportions of each component of the final mix for each sample.
 - A mix design from the concrete supplier.
 - Delivery tickets from the supplier confirming delivery to the site or to the batching plant of the entire design mix quantity of colouring agent, for the selected colour sample.

The Contractor shall strictly conform with the manufacturer's instructions and recommendations.

TS 3.85.04.02 Samples

Samples with dimensions of at least 2 m by 1 m by 130 mm thick shall be cast at the job site in a location where they may be kept for reference throughout the construction period. These samples shall be cast, under exposed conditions, at least two weeks prior to the production of coloured impressed concrete. The Commissioner may require up to six (6) samples to be prepared in order that the mixing, colouring, finishing and curing combination may be approved. Samples shall be cast as close to each other in space and time to ensure that all are cast under the same conditions. All costs associated with casting samples shall be borne by the Contractor.

Each sample shall be identified by number and the full details of the formula used to achieve each sample shall be recorded by the Contractor and submitted to the Commissioner. The job mix formula, of the approved sample, shall then be used for the remainder of the project. The approved sample shall serve as the basis of comparison for acceptance or rejection of the completed work.

Samples shall be prepared in batches of not less than one-half cubic metre per sample to ensure accuracy of mix proportions. All samples shall be mixed in accordance with the manufacturers' specifications and instructions for each ingredient.

The unused, uncast balance of material from each sample batch shall be disposed of, off site, by the Contractor at his own cost. Upon completion of all coloured impressed concrete work, or earlier with the approval of the Commissioner, all samples shall be removed and disposed of, off site, by the Contractor at his own cost. All cost associated with restoring the areas used for casting samples, to at least the condition of the surrounding area, shall be borne by the Contractor, unless these areas are to be restored or altered in the course of other construction under the contract.

TS 3.85.05 MATERIALS

TS 3.85.05.01 Concrete

The materials for and the production of coloured impressed concrete shall meet the requirements of TS 13.00 and the following:

(i)	Cement type	Type 10 Normal Portland
(ii)	Minimum 28 day cylinder compressive strength	32 MPa
(iii)	Class of exposure	C-2
(iv)	Nominal maximum size of coarse aggregate	19 mm
(v)	Slump at point of discharge (formed concrete)	65±15 mm
(vi)	Total air content	6.5±1.5 percent
(vii)	Maximum water/cementing materials ratio	0.45
(vii)	Minimum cementing materials content	335 kg/m ³

The concrete shall contain no calcium chloride or reactive agent.

TS 3.85.05.02 Water

Water shall be potable and free of any minerals or contaminants that could adversely affect the concrete.

TS 3.85.05.03 Admixtures

TS 3.85.05.03.01 Colour

The colour of the coloured impressed concrete shall be “Natural Gray” or as otherwise specified in the contract, or approved by the Commissioner, or based on samples cast.

The colouring agent shall be a product designed and mixed for the express purpose of providing a durable integral colour in a concrete mix. It shall be mixed strictly in accordance with the manufacturer’s instructions and in the correct mix proportions to give the colour intensity of the approved sample. The colouring agent may be integrally mixed into the concrete either at the source or at the construction site, depending on the manufacturer’s instructions.

The colouring agent shall be evenly mixed throughout the concrete to produce a natural gray “concrete” colour matching the sample approved by the Commissioner.

The colouring agent shall be a single-component, pigmented, water-reducing admixture containing a dispersment agent, factory-formulated and packaged in premeasured dosage increments. It shall not need multiple additives and pigments requiring separate measurement and mixing.

TS 3.85.05.03.02 Colour Release Agent

Only an approved dry colour release shall be used such as supplied by an approved supplier.

Unless otherwise specified the colour of the release agent shall be black and applied to produce a random mottled colour to match the sample approved by the Commissioner.

TS 3.85.05.03.03 Evaporation Reducer

Evaporation reducer shall be a spray-on mono-molecular material such as Confilm, supplied by an approved supplier.

TS 3.85.05.04 Granular Base and Backfill

Granular base shall be 19 mm crusher run and shall conform to the requirements of TS 1010.

Backfill, if required, shall be 19 mm crusher run and shall conform to the requirements of TS 1010.

TS 3.85.05.05 Expansion Joint Material

Expansion joint material shall be bituminous fibreboard having a minimum thickness of 12 mm and shall meet the requirements of TS 13.00.

TS 3.85.05.06 Polyethylene Film

White opaque polyethylene film shall be 100 µm thick and shall meet the requirements of ASTM C 171.

TS 3.85.05.07 Geotextile Fabric

Geotextile fabric used as a curing medium shall be a white, synthetic, permeable textile meeting the requirements of OPSS 1860 for Class I, non-woven geotextile. A minimum thickness of 0.9 mm is required.

TS 3.85.06 EQUIPMENT

TS 3.85.06.01 Forms

Where necessary, forms shall be steel, wood or metal plate forms and shall meet the requirements of OPSS 919. They shall be of sufficient cross section and strength, and so secured as to resist the pressure of the concrete when placed, and the impact and vibration of any construction equipment they support, without springing or settlement.

Forms shall be pinned or staked in place with not less than 3 pins for each 3 m length, and with a pin at each side of each form butt joint. The top surface of the formwork shall comply with the specified tolerances. The inside face of the form shall be vertical. The form shall deviate from grade by no more than 3 mm in 3 m, and in alignment by no more than 6 mm in 3 m.

Forms shall be cleaned and coated with form oil before each use.

TS 3.85.06.02 Boxouts

Boxouts shall not be used in coloured impressed concrete.

TS 3.85.06.03 Finishing Tools

An aluminum or magnesium float shall be used to float the coloured impressed concrete. Borders at the edges of the slabs and at expansion joints are not permitted.

TS 3.85.06.04 Textured Mold

The textured mold for coloured impressed concrete shall be specially designed to produce the required Ashlar Slate texture in 200 mm x 200 mm Running Bond pattern with joints 6mm wide by 4 mm deep or as specified.

TS 3.85.06.05 Fogger

Fogger shall be a device capable of applying a light fog mist to the surface of the concrete, to maintain the humidity of the air at the surface of the concrete at 100%, without marring the surface or accumulating water.

TS 3.85.07 CONSTRUCTION

TS 3.85.07.01 General

Impressed concrete shall not be placed if the air temperature is at or below 5°C, or is likely to fall below this limit within 7 days after the concrete placement.

TS 3.85.07.02 Excavation

The excavation shall be to the lines and grades specified by the Commissioner and shall allow for a minimum of 100 mm of granular base and 130 mm of coloured impressed concrete. Care shall be taken to prevent damage to utilities and other appurtenances such as hydrants, water services, poles and gas valves which may be in or under the proposed coloured impressed concrete.

At the direction of the Commissioner, the Contractor shall make good all damage caused during the course of the work and return the area to its initial condition.

Excavated material shall be removed from the site in accordance with OPSS 180, at the Contractor's expense.

TS 3.85.07.03 Base

TS 3.85.07.03.01 General

The granular base shall be moistened prior to the placement of concrete, but without any standing water. At the time of placing concrete, the base shall not be saturated, soft or frozen.

TS 3.85.07.03.02 Subgrade

The subgrade shall be compacted to a minimum of 95 percent of the maximum dry density as specified in TS 501.

TS 3.85.07.03.03 Granular Base

Granular base shall be placed and compacted to a minimum depth of 100 mm, or as specified in the contract, and to a minimum of 100 percent of the maximum dry density as specified in TS 501.

TS 3.85.07.04 Form Placement

Forms shall be set true to the lines and grades specified in the contract and in direct contact with the base.

Unless otherwise directed by the Commissioner, the cross fall of the coloured impressed concrete shall be at a slope of 2 percent toward the curb.

Sufficient formwork shall be available to ensure it remains in place until the concrete has set at least four hours.

TS 3.85.07.05 Utility Adjustment

The Contractor shall adjust all water services, raise or lower tops of all maintenance holes and other related castings and gratings within the area of work, to fit flush with the surface of the new coloured impressed concrete.

Appurtenances owned by private utility companies shall not be adjusted by the Contractor; such work shall be performed by the utility company concerned under arrangement by the Commissioner. The Contractor shall assist by excavating to the edge of the appurtenances and indicate the required grade of the new sidewalk for adjustment.

TS 3.85.07.06 Utility Isolation

Utility isolations shall be constructed as described in TS 3.85.07.09.01 of this specification.

Expansion joint material shall be placed flush with the outside edge of all poles, chambers, handwells, etc.

For major structures, such as Bell and Hydro chamber lids, the Contractor shall also isolate the adjacent section of coloured impressed concrete. A full depth transverse expansion joint shall be placed on each side of the frame between 150 mm and 300 mm from its outer edge. The joints shall match the direction and location of the Running Bond pattern and extend the full width of the coloured impressed concrete.

TS 3.85.07.07 Placing Concrete

The Contractor shall adopt methods to ensure that no adjacent or abutting surfaces become stained by colour from the coloured impressed concrete. All stained material shall be replaced at the Contractor's expense.

Concrete shall be placed and consolidated to meet the requirements of Clause 19 of CAN/CSA-A23.1 and the requirements of this Specification. The concrete delivery and spreading operations shall be coordinated as to provide a uniform rate of progress for the placing operation.

The concrete shall be placed to the specified line and grade. The minimum thickness of coloured impressed concrete shall be 130 mm or as otherwise specified in the contract. The concrete shall be thoroughly consolidated by vibrators and other suitable tools against all formwork, expansion joints or adjacent surfaces to eliminate voids, honeycombing and entrapped air.

TS 3.85.07.08 Finishing Concrete

Subject to the approval of the Commissioner, set-retarding admixtures may be used during hot weather to aid in proper finishing of concrete.

The concrete surface shall be finished while it is sufficiently plastic to achieve the desired grades, elevations and texture, with no water on the surface. The surface shall be uniform, dense and free from undulations and projections apart from those specified in the drawings.

The top surface shall be screeded to true grade and cross-section and finished with a magnesium or aluminum float. The surface shall not be trowelled at any time.

The application of water, neat cement or sand to the surface shall not be permitted. Localized surface imperfections shall be dug out and repaired with fresh concrete before the evaporation reducer is sprayed.

The evaporation reducer is to be sprayed onto the surface of the concrete strip as per the manufacturer's instructions.

Dry surface agents shall be spread over the wet surface, after the evaporation reducer has been applied, using an approved fine-mesh sieve, or other method specially designed and approved for the purpose. Dry surface agents shall be uniformly spread over the entire surface of the concrete so as to completely cover it, but they shall not be thick enough to risk creating uneven surface texture. Dry surface agents shall not be spread by means of hand broadcasting.

The coloured impressed concrete shall be of consistent colour and shading throughout the construction area. Noticeable variations in colour or shading from the approved sample will be rejected.

The textured mold shall be oriented so that the Running Bond is perpendicular to the road. Stamping shall commence in a timely manner to ensure homogenous impressions throughout the slab surface.

TS 3.85.07.09 Joints

TS 3.85.07.09.01 Expansion Joints

Expansion joints shall be constructed to the full thickness of the coloured impressed concrete.

Expansion joints shall be formed with 12 mm thick bituminous fibre expansion joint material. The top surface of the bituminous fibre shall be flush with the concrete surface. The joint shall be vertical and straight in alignment.

Expansion joints shall be formed at intervals of 6.0 m±, where the concrete abuts buildings and rigid structures (curbs, sidewalks, etc.), encounters appurtenances, or as shown on the contract drawings.

TS 3.85.07.09.02 Contraction Joints

Coloured impressed concrete shall have all of the contraction joints sawcut between 6 and 18 hours after concrete placement. Contraction joints shall be sawcut to a minimum depth of $\frac{1}{3}$ the total slab thickness, at intervals of 2.0 m±.

The sawcut shall be perpendicular to the road and shall coincide with the patterning, and shall also align with joints in adjacent sidewalk and curb, where possible.

Additional joints shall be sawcut at sudden changes in width and at corners.

When the coloured impressed concrete is greater than 2.5 m wide, the Contractor shall sawcut a contraction joint parallel to the road at equal intervals not to exceed 1.5 m. This joint shall coincide with the patterning, as much as possible.

After sawcutting of the contraction joints, the surface of the coloured impressed concrete shall be immediately and thoroughly pressure washed of all dry and/or loose material.

TS 3.85.07.09.03 Construction Joints

At the end of each day's work, or in the event of an unavoidable stoppage of concrete placement extending more than 45 minutes, a formed joint shall be constructed and shall coincide with the planned location of a contraction joint. Any excess concrete shall be removed at the Contractor's expense.

TS 3.85.07.10 Concrete Curing

TS 3.85.07.10.01 General

No cold weather concreting will be allowed.

Immediately after stamping and as necessary, a light fog mist shall be applied to the entire surface of the coloured impressed concrete. Care shall be taken to prevent accumulation of water that may reduce the quality of the cement paste. The humidity of the air, just above the surface of the coloured impressed concrete, shall be maintained at 100% until the application of geotextile fabric and polyethylene film.

Two (2) hours after the concrete pour or as soon as the concrete can withstand the weight of the curing fabric without marring the surface, the coloured impressed concrete is to be cured by using two layers of geotextile fabric and polyethylene film.

TS 3.85.07.10.02 Geotextile Fabric and Water

Geotextile fabric shall be presoaked by immersion in water for at least 6 hours immediately prior to placing. Two layers of fabric shall be applied to the surface of the concrete and shall cover the entire width and edges of the exposed concrete. Strips shall overlap 100 mm and shall be held down to prevent displacement. The fabric shall be maintained in place and kept saturated for a minimum period of 7 days. The Contractor may constantly water the mats or cover them with opaque polyethylene film, or a combination of both, in order to keep the mats saturated.

TS 3.85.07.10.03 Polyethylene Film

White, opaque polyethylene film shall be placed such that air flow between it and the concrete surface is prevented. The film shall be held down at the edges and laps, and shall be overlapped a minimum of 150 mm, to prevent displacement. The film shall be kept in place for a minimum period of 7 days.

TS 3.85.08 QUALITY ASSURANCE

TS 3.85.08.01 General

Quality assurance shall meet the requirements of TS 13.00.

TS 3.85.08.02 Guarantee

All work performed as part of this specification shall be guaranteed for a period of two (2) years measured from the substantial performance of the contract or completion of this item, whichever is later.

The Contractor shall, at his own expense, rectify any defects or faults which are observed or discovered during the guarantee period. The rectification of such defects or faults shall proceed within fifteen days from the date of notice to do so.

All corrections shall conform to the original requirements of the work.

All rectifications to the work shall have a guarantee of the same length and conditions applicable for the original guarantee. The new guarantee shall begin from the date of the acceptance of the rectifications.

TS 3.85.09 MEASUREMENT FOR PAYMENT

TS 3.85.09.01 Coloured Impressed Concrete Sample

Measurement for the above item shall be for each sample prepared, up to a maximum of six (6).

TS 3.85.09.02 Coloured Impressed Concrete

Measurement for the above item shall be by the square metre, without deduction for maintenance holes and appurtenances.

TS 3.85.10 BASIS FOR PAYMENT

TS 3.85.10.01 Coloured Impressed Concrete Sample - Item

Payment at the contract price for the above item shall be full compensation for all labour, equipment, materials and incidentals to do the work for a maximum six samples. Payment shall include, but not be limited to, casting, finishing, disposal and reinstatement of the sample area.

All costs associated with any additional samples required to produce the desired colour and quality shall be borne by the Contractor.

TS 3.85.10.02 Coloured Impressed Concrete - Item

Payment at the contract price for the above item shall be full compensation for all labour, equipment, materials and incidentals to do the work. Payment shall include, but not be limited to, excavation below the level of the top of the finished concrete, compacting the subgrade, placing and compacting any subbase, supplying and placing coloured concrete, repairing any damaged or stained area, removing surplus material and all that is shown and/or is specified on the drawings.

Payment for adjustments to appurtenances will be made under the appropriate items.