

SPECIFICATIONS FOR **CONCRETE REPAIRS**

1.0 DESCRIPTION

The Work shall consist of:

- .1 Removing the deteriorated concrete as shown and described on the Drawings and in this Specification, including saw cutting the perimeter of the repair area; and
- .2 Preparing the surface of the concrete for the repair, including abrasive cleaning, cleaning of existing reinforcement, and applying bonding agent to the surface; and
- .3 Supplying materials and the mixing and placing of concrete repair mortar or concrete as shown and described on the Drawings and in this Specification including vibrating, finishing and curing; and
- .4 Supplying, fabricating, constructing, maintaining and removing temporary works, including falsework and formwork; and
- .5 Heating and hoarding (when applicable); and
- .6 The quality control (QC) testing of all materials.

2.0 REFERENCES AND RELATED SPECIFICATIONS

All reference standards and related specifications shall be current issue or the latest revision at the date of tender advertisement.

2.1 References

- CSA A23.1, Concrete Materials and Methods of Concrete Construction
- International Concrete Repair Institute (ICRI) Technical Guideline No. 310.1R, Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.
- CAN/CSA G30.18, Billet-Steel Bars for Concrete Reinforcement
- ACI 117, Standard Tolerances for Concrete Construction and Materials
- Reinforcing Steel Institute of Canada, (RSIC), Manual of Standard Practice
- MIT's Approved Products List

2.2 Related Specifications

- Specifications for Supplying and Placing Concrete Reinforcement
- Specifications for Temporary Works

3.0 SUBMITTALS

The Contractor shall submit the following to the Engineer, in accordance with this Specification and the Special Provisions:

- .1 Shop Drawings and proposed procedures for galvanic protection installation that are signed, sealed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba. Shop Drawings shall be submitted to the Engineer prior to the Contractor proceeding with the work.
- .2 Product data sheets and installation procedures for proposed concrete repair mortar(s).

- .3 Detailed design notes, calculations and Shop Drawings for any temporary works, including formwork and falsework, that are signed, sealed and dated by a Professional Engineer registered or licensed to practice in the Province of Manitoba. Shop Drawings shall be submitted to the Engineer prior to the Contractor proceeding with the work.

4.0 MATERIALS

The Contractor shall supply all materials necessary for the repair and restoration of deteriorated concrete areas as follows:

- .1 Concrete repair mortar from the most recent MIT Structures Approved Products List most closely matching the exposure class and properties of the existing concrete and meeting the anticipated placement requirements.
- .2 Sacrificial galvanic anodes (when required) shall be puck-shaped, pre-manufactured, and consist of electrolytic high grade zinc in compliance with ASTM B418-95a Type 1 cast around a pair of steel electric lead wire in compliance with bright annealed ASTM A82-97a and encased in a highly alkaline cementitious shell with a pH of 14 or greater. The cementitious shell shall contain no chlorides, or other corrosive constituents as per ACI Guideline No. 222. The galvanic anodes shall be on the most recent MIT Structures Approved Products List.
- .3 Reinforcing steel (when required) shall conform to the requirements of CAN/CSA G30.18, Grade 400W and shall be deformed bar unless indicated otherwise on the Drawings.
- .4 Low resistivity mortar (when required) as per galvanic anode manufacturer's recommendations or as approved by the Engineer.

5.0 CONSTRUCTION METHODS

5.1 Surface Preparation

Prior to any concrete repairs, the Contractor shall remove all dust, dirt, water and debris from the surface of the concrete in a manner that will not result in the material being deposited into the channel or onto the underlying ground surface below.

The Contractor shall supply and erect appropriate protection barriers/shrouding or other approved means as required on the bridge deck or piers so as to completely contain all loose or flying debris from the surface removal preparations. The means of containment shall be subject to the approval of the Engineer. No debris shall fall into the channel or onto any underlying roadway or ground surfaces.

5.2 Concrete Removal

All areas of unsound concrete to be repaired will be marked by the Engineer once the Contractor has cleaned the existing surface as per Section 5.1 of this Specification. The Contractor shall saw cut the outer perimeter of the repair areas 25 mm deep or as directed by the Engineer. Feathered edges will not be acceptable. The Contractor shall take care to ensure that the existing reinforcing steel or prestressing strands (if applicable) are not damaged during saw cutting. Any damage caused by the Contractor to any portion of the structure not intended for repair shall be repaired by the Contractor, at the Contractor's expense, to the satisfaction of the Engineer.

The Contractor shall remove all areas of unsound concrete by chipping or other approved methods. Only chipping hammers of the 15 kg class or less shall be used, and operated at an angle of 45 degrees or less from the horizontal. The Contractor shall exercise caution and take care not to damage any existing reinforcing steel intended to remain in place.

5.3 Types of Repairs

Concrete repairs will be classified as follows:

.1 Partial Depth Repair – Type A

Partial Depth Repair - Type A repair is defined as removal of unsound concrete to a depth not greater than the top of the existing reinforcing steel. The Contractor shall remove all unsound concrete from the areas as determined by the Engineer until a sound concrete substrate is exposed.

.2 Partial Depth Repair – Type B

Partial Depth Repair - Type B shall be defined as removal of unsound concrete to a depth a minimum of 25 mm beyond the existing outer mat of reinforcing steel. For substructure, girder or mass concrete repairs the maximum depth shall be 50 mm beyond the existing outer mat of reinforcing steel or as directed by the Engineer. For slab repairs the maximum depth shall be mid depth of the slab.

.3 Full Depth Repair

Where unsound concrete extends beyond mid depth of the concrete slab as determined by the Engineer, the Contractor shall continue to remove all further concrete within the repair area to the full depth of the slab. All existing reinforcing steel shall be retied and chaired as necessary. The repair areas shall be neatly formed to restore the original geometry of the concrete slab. Forms shall not be suspended from existing reinforcing steel.

The Contractor shall supply and place additional reinforcing steel as directed by the Engineer when the existing reinforcing steel has a section loss of 25% or greater. The reinforcing steel shall be of the same type and size as the existing, and spliced with a minimum lap length of 30 bar diameters. Exposed reinforcing steel shall be sandblasted clean and maintained to a near white condition. The Contractor shall roughen all areas of the existing sound concrete substrate to a 6 mm amplitude using methods acceptable to the Engineer.

All resulting material and by-products from demolition operations shall be collected, loaded, hauled, and disposed of by the Contractor at an approved waste disposal facility.

5.4 Galvanic Protection

Galvanic anodes shall be supplied and installed in accordance with the details as shown on the Shop Drawings or Drawings in accordance with the manufacturer's recommendations. In general, the anodes shall be installed along the perimeter of the repair interface by tying the anodes on the side or beneath exposed rebar as close as practical to the surrounding concrete. The spacing and location of the galvanic anodes as shown on the Drawings is approximate and the final amount, location and maximum spacing of the galvanic anodes shall be determined by the Engineer once the concrete has been sounded and reinforcing steel of the repair area exposed. The anodes shall be installed at a depth that produces at least 30 mm of concrete cover. For repair areas that are too shallow to provide sufficient cover, the Contractor shall remove additional sound concrete where the anode is to be located.

The Contractor shall securely fasten all galvanic anodes to clean reinforcing steel with the attached tie wires. A suitable tie wire twisting tool shall be used to limit free movement of the anodes and to establish electrical continuity between the anode tie wire and reinforcing steel. Electrical continuity between the tie wire and reinforcing steel shall be verified with a multi-meter. The resistivity shall not be greater than 1 ohm. If any discontinuity is encountered, the Contractor shall re-establish continuity with steel tie wires.

If the approved concrete repair mortar has a resistivity higher than 15,000 ohm-cm, the Contractor shall hand pack low resistivity mortar, subject to approval by the Engineer, between the anode and the substrate. The space between the anode and the concrete substrate to be filled shall be no less than 10 mm. The

entire remaining surface of the anodes shall be completely covered in low resistivity mortar to a minimum thickness of 10 mm.

5.5 Surface Preparation

Immediately prior to placing the repair mortar or concrete, the Contractor shall thoroughly clean the existing concrete surfaces and formed repair areas, and apply a low resistivity bonding agent or cement slurry as recommended by the repair mortar manufacturer or as directed by the Engineer.

5.6 Repair Mortar Placement and Finishing

The concrete repair mortar shall be handled, stored, mixed and applied in accordance with the manufacturer's instructions.

Immediately prior to placing the repair mortar, the Contractor shall thoroughly clean the existing concrete surfaces and formed repair areas, and apply a low resistivity bonding agent or cement slurry as recommended by the repair mortar manufacturer or as directed by the Engineer.

The Contractor shall place the repair mortar such that the existing profile and cross section are restored to their original dimensions. Any deviations of 5 mm or greater from the repaired areas to the existing surface shall be repaired by the Contractor at his expense to the satisfaction of the Engineer.

If the existing or repair concrete surface is damaged in any way by construction operations, or if the concrete repair shows signs of distress or scaling prior to final acceptance, it shall be repaired or replaced by the Contractor at his own expense.

The Contractor shall apply a broom finish to all deck slab repair areas. Brooming shall be done when the repair mortar has hardened sufficiently. The broom shall be of an approved type. Each broom stroke shall be continuous for the full width of the area being finished, and at a right angle to the centreline of roadway. Only one (1) stroke per width of the broom will be acceptable with adjacent strokes slightly overlapped. The broom shall be drawn evenly without tearing of the concrete to produce regular corrugations of 3 mm in depth. The broom shall be cleaned in water after each stroke.

All other repair areas shall be finished to a level similar to the adjacent existing concrete surfaces as directed by the Engineer.

5.7 Hoarding and Heating

When the ambient temperature falls below 5°C or when there is a probability of it falling below 5°C within 24 hours of placing the repair mortar, the Contractor shall make provisions for hoarding and heating the concrete repair. The hoarding shall be constructed to allow the repair mortar to be mixed and placed without the housing having to be opened.

Hoarding enclosures shall be constructed to withstand wind and snow loads and shall be reasonably airtight. The hoarding shall provide sufficient space between the concrete and the sides of the enclosure to permit free circulation of warmed air. The heating apparatus and hoarding shall be sufficient to enclose and protect the structure in such a way that the air surrounding the fresh concrete is kept at a temperature of not less than 15°C and not more than 25°C for 4 days, not counting the day on which the concrete was deposited. During the next 3 days, the concrete shall be allowed to gradually cool to a temperature of not less than 5°C with the drop in temperature never exceeding 5°C over an 8 hour period.

The heating apparatus shall be so positioned that there is no direct discharge of heat on the concrete surfaces or form work containing concrete. The relative humidity within the enclosure shall be maintained at not less than 65%.

Before depositing any of the concrete, the Contractor shall demonstrate that enough heating apparatus is available to keep the air temperature surrounding the forms within the specified range. This shall be accomplished by bringing the temperature inside of the hoarding to the specified 15°C at least 24 h prior to the start of the concrete placing. The temperature of formwork, reinforcement, and/or previously placed concrete shall be at least 10°C prior to the start of concrete placing.

The Contractor shall supply all required heating apparatus and the necessary fuel. When dry heat is used, a means of maintaining atmospheric moisture shall be provided.

Sufficient stand-by heating equipment must be available to allow for any sudden drop in outside temperatures and any breakdowns that may occur in the equipment.

Heating apparatus used to heat the housing shall be of a type that meets Provincial Acts and Regulations. Heating apparatus used in the hoarding that discharges or releases smoke or gas fumes, shall be adequately ventilated in such a manner as to carry away all such smoke or gas fumes from the housing.

The hoarding shall provide sufficient clearance to permit the placing of concrete to proceed unhindered. Where required, the hoarding shall also provide sufficient clearance to allow for the removal of forms in order that the finishing of the exposed concrete surfaces can be completed 3 days before the heating of the inside of the housing is discontinued.

The Contractor shall provide 24 hour surveillance to look after the heating operations. The Contractor shall provide two maximum-minimum type thermometers for each enclosure. The thermometers shall be installed as directed by the Engineer to monitor the temperature of the concrete and the surrounding air during placing and curing. The Contractor shall develop a schedule of temperature monitoring which includes time and temperatures inside and outside of the hoarding. The Contractor shall record the information and provide a copy to the Engineer within 24 hours of every 24 hour period. The methods of heating concrete materials and of maintaining the temperature of deposited concrete shall meet with the approval of the Engineer.

5.8 Curing

Curing shall be in accordance with the manufacturer's instructions or as otherwise directed by the Engineer.

5.9 Opening to Traffic

For concrete deck repairs, the structure shall not be opened to traffic until the concrete repair has attained a minimum compressive strength of 35 MPa.

6.0 QUALITY MANAGEMENT

6.1 General

Concrete repair mortar that is not stored, handled, prepared, placed, or cured in accordance with the manufacturer's instructions will be rejected by the Engineer and his/her decision shall be considered final. The Engineer reserves the right to require immediate removal of any concrete from rejected batches that may have already been placed in the structure.

Quality assurance testing will be carried out by the Engineer and all associated costs will be paid for by the Department. There shall be no charge to the Department for materials taken by the Engineer for testing purposes.

7.0 METHOD OF MEASUREMENT**7.1 Concrete Repairs**

Concrete repairs will be measured on an area basis. The area to be paid for will be the total number of square metres of concrete repaired in accordance with this specification as computed from measurements made by the Engineer.

7.2 Galvanic Anodes

Supply and installation of galvanic anodes will be measured on a unit basis. The number of units to be paid for will be the total number of galvanic anodes supplied and installed in accordance with this Specification.

7.3 Hoarding and Heating

Heating and hoarding will be paid for on a lump sum basis, and no separate measurement will be made for this work.

8.0 BASIS OF PAYMENT**8.1 Partial Depth Repair – Type A**

Partial depth concrete repairs (Type A) will be paid for at the Contract Unit Price per square meter for “Partial Depth Repair – Type A”, measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

8.2 Partial Depth Repair – Type B

Partial depth concrete repairs (Type B) will be paid for at the Contract Unit Price per square meter for “Partial Depth Repair – Type B”, measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

8.3 Full Depth Repair

Full depth concrete repairs will be paid for at the Contract Unit Price per square meter for “Full Depth Repair”, measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

8.4 Galvanic Anodes

Supply and installation of galvanic anodes will be paid for at the Contract Unit Price per anode for “Supply and Install of Galvanic Anodes”, measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

8.5 Hoarding and Heating

Heating and hoarding will be paid for at the Contract Lump Sum Price for “Hoarding and Heating”, measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.