PART E

SPECIFICATIONS

PART E - SPECIFICATIONS

GENERAL

E1. APPLICABLE SPECIFICATIONS, STANDARD DETAILS AND DRAWINGS

E1.1 *The City of Winnipeg Standard Construction Specifications* in its entirety, whether or not specifically listed on Form B: Prices, shall apply to the Work.

E1.1.1 *The City of Winnipeg Standard Construction Specifications* is available in Adobe Acrobat (.pdf) format on the Information Connection page at The City of Winnipeg, Corporate Finance, Materials Management Division internet site at http://www.winnipeg.ca/matmgt.

E1.1.2 The version in effect three (3) Business Days before the Submission Deadline shall apply.

E1.1.3 Further to GC:2.4(d), Specifications included in the Bid Opportunity shall govern over *The City of Winnipeg Standard Construction Specifications*.

E1.2 The following Drawings are applicable to the Work:

Drawing Title	***Drawing No.***	***File Name***
Cover Sheet and Site Plan	B112-04-04	237-2004 Drawing 01-R0.pdf
Pier 8 – Rehabilitation Works	B112-04-05	237-2004 Drawing 02-R0.pdf
Pier 15 – Rehabilitation Works	B112-04-06	237-2004 Drawing 03-R0.pdf
Pier 18 – Rehabilitation Works	B112-04-07	237-2004 Drawing 04-R0.pdf

E2. CONCRETE SURFACE REPAIRS

E2.1 Description

This Section shall cover all operations relating to the designated concrete surface repairs for pier no. 8 and pier no. 18. Refer to Section E3 for general concrete specifications which also apply to the Work described in this Section. Where there are differences between the requirements of this Section and those of Section E3, the requirements of this Section shall govern the Work described in this Section.

The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

E2.2 Materials

E2.2.1 General

The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Section.

E2.2.2 Handling and Storage of Materials

All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA-A23.1.

E2.2.3 Testing and Approval

All materials supplied under this Section shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the Owner for any materials taken by the Contract Administrator for testing purposes.

All materials shall be approved by the Contract Administrator at least seven (7) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials in whole or in part, do not conform to the Specifications detailed herein or are found to be defective in manufacture or have become damaged in transit, storage, or handling operations, then such materials shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

E2.2.4 Concrete Aggregate

The Contractor shall furnish in writing to the Contract Administrator, the location of the sources where aggregate will be obtained, in order that it may be inspected and tentatively approved by the Contract Administrator. Changes in the source of aggregate supply during the course of the Contract will not be permitted without notification in writing to and the expressed approval of the Contract Administrator.

(a) Fine Aggregate

Fine aggregate shall consist of sand having clean, hard, strong, durable, uncoated grains; free from injurious amounts of dust, soft or flaking particles, shale, alkali, organic matter, load, or other deleterious substance.

Fine aggregate shall be well-graded throughout and shall conform to the following grading requirements:

Sieve Size	Percent of Total Dry Weight Passing Each Sieve
10 mm	100%
5 mm	95% - 100%
2.5 mm	80% - 100%
1.25 mm	50% - 90%
630 µm	25% - 65%
315 µm	10% - 35%
160 µm	2% - 10%

(b) Coarse Aggregate (14 mm Nominal)

Coarse aggregate shall consist of natural gravel, crushed stone or other approved materials with similar characteristics; having clean, hard, strong durable uncoated particles; free from injurious amounts of soft, friable, thin, elongated or laminated pieces, alkali, organic or other deleterious matter. Coarse aggregate shall be well graded and shall conform to the following grading requirements:

Sieve Size	Percent Passing
20 mm	100%
14 mm	90% - 100%
10 mm	45% - 75%
5 mm	0% - 15%
2.5 mm	0% - 5%

E2.2.5 Cement

All cement, unless hereinafter specifically stated, shall be Type 10 Normal Portland Cement.

E2.2.6 Water

Water used for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

E2.2.7 Admixtures

The following admixtures shall be provided for concrete specified in this section. Admixtures shall be added in the appropriate proportions to produce concrete having the properties specified herein. Concrete mix designs are the responsibility of the Contractor, and it is the Contractor's responsibility to ensure that each admixture is compatible with all other constituent materials with respect to proper performance of the admixture, as well as with respect to proper performance of the other constituents in the presence of the admixture.

(a) Air-Entraining Agent

The air-entraining agent shall conform to the requirements of ASTM Standard C260. It shall produce a satisfactory air void system and an air content within the ranges specified in CSA A23.1 for each class of concrete.

(b) Water-Reducing Agent

Water-reducing agent shall conform to the requirements of ASTM Standard C494.

(c) Superplasticizing Agent (High-range water reducer)

Superplasticizing agent shall conform to the requirements of ASTM Standard C494. The agent shall be free of chlorides and shall not affect the air-entraining agent's ability to produce a satisfactory air-void system.

(d) Shrinkage Reducing Agent

Shrinkage reducing admixture shall conform to the requirements of ASTM Standard C157. An approved product is Tetraguard AS20 by Masterbuilders.

E2.2.8 Epoxy Grout

Epoxy grout shall be Sika Talygrout 100 or equivalent as approved by the Contract Administrator.

E2.2.9 Formliner

Formliner shall be Zemdrain by Dupont, or equal as approved by the Contract Administrator. Formliner shall be used on all formed surfaces.

E2.2.10 Concrete Supply

Unless otherwise specified in these Specifications, only the use of a ready-mix concrete plant will be permitted. Concrete shall be proportioned, mixed, and delivered in accordance with the requirements of CSA Standard CAN3-A23.1, "Production of Concrete," except that the transporting of ready-mixed concrete in non-agitating equipment will not be permitted unless prior written approval is received from the Contract Administrator.

Unless otherwise directed by the Contract Administrator, the discharge of ready-mixed concrete shall be completed within one and a half (1.5) hours after the introduction of the mixing water to the cement and aggregates.

The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

E2.2.11 Miscellaneous Materials

The Contractor shall supply all materials, as approved by the Contract Administrator, to ensure the satisfactory completion of the concrete surface repair works.

E2.2.12 Concrete Mix Design for Surface Repairs

Proportioning shall be such as to yield concrete having the required properties as follows:

35 MPa Concrete

(a) Specified Compressive Strength @ 28 Days - 35 MPa
(b) Minimum Cement Content = 390 kg/m^3
(c) Water/Cement ratio = 0.40
(d) Slump = 80 mm ± 20 mm before addition of superplastizer
(e) Aggregate: 20 mm Nominal
(f) Air Content: 5 to 8 percent
(g) Water reducing agent
(h) Superplasticizer (high range water reducer)
(i) Shrinkage reducing admixture

To avoid the need for mechanical vibration, self-compacting concrete will be considered as a possible alternative to superplasticized concrete if proposed by the Contractor. In order to be accepted, such concrete must be capable of completely filling the forms and working fully around all reinforcing steel without segregation of the aggregate and without producing voids or honeycombing. The strength characteristics listed above must also be met. Acceptance of any proposed alternate concrete mix design is at the discretion of the Contract Administrator.

The concrete admixture representative shall be present during batching. The workability shall be suitable for the Contractor's approved placement procedures, and to fill all voids.

The Contractor shall submit the proposed mix designs at least two weeks before the commencement of concrete placing operations.

Fly ash is permitted to a maximum of 15% of cement content.

E2.3 Equipment

All equipment shall be of a type accepted by the Contract Administrator and shall be kept in good working order.

E2.4 Construction Methods

E2.4.1 General

The areas to be repaired are indicated approximately on the Drawings. Confirm the extent of the surface repairs with the Contract Administrator in the field prior to commencing the Work.

E2.4.2 Preparation

Sawcut around the perimeter of the designated repair areas to a depth of 25 mm. Do not allow sawcuts to overlap at corners.

Remove all concrete within the designated repair areas to a depth of 120 mm ± 10 mm. Concrete shall be completely removed from around the reinforcing bars. Ensure the sides of the removal area are straight and square to form a square butt joint with the patch material. There must be 25 mm minimum clear distance between the surface of the concrete and any reinforcing bar after concrete removal. If this cannot be achieved within the designated repair depth, the Contract Administrator may direct additional concrete removal.

The Contract Administrator in his sole discretion may direct that temporary shoring be installed to support the cantilever portions of the piers during concrete removal and surface repair operations. Refer to Section E7 for temporary shoring specifications.

If reinforcing steel is found to be corroded, extend the area of removal as directed by the Contract Administrator such that a minimum of 150 mm of non-corroded rebar is exposed.

After completion of concrete removals, satisfactory to the Contract administrator, all resulting concrete and reinforcing steel surfaces shall be thoroughly cleaned by sandblasting. Remove and replace the existing reinforcing bars if, after blasting, less than 75% of the bar cross-section remains or if damaged by the construction activities. All sandblast materials shall be blown out of the repair area, cleaned up, and removed off and away from the overpass site.

The Contractor shall erect screens or hoardings around the work area as required and as directed by the Contract Administrator to protect adjacent property, vehicles and pedestrians during sandblasting operations.

E2.4.3 Anode Installation

Following preparation, install embedded galvanic anodes as indicated on the drawings. Refer to Section E5 for anode specifications.

E2.4.4 Installation of Reinforcement

Install replacement reinforcing bars as shown on the construction drawings. If necessary, the Contract Administrator may direct that the extent of concrete removal for a given repair area be increased in order to achieve the minimum lap length required between the replacement bars and the remaining existing bars.

Refer to Section E4 for reinforcing steel specifications.

E2.4.5 Concrete Placement

Prior to installing forms or placing concrete, provide access for the Contract Administrator to inspect the concrete substrate in the repair area. The Contract Administrator, in his discretion, may require additional concrete removal based on the condition of the substrate.

The existing concrete substrate shall be in a saturated surface-dry condition at the time of concrete placement. If necessary, as determined by the Contract Administrator, the Contractor shall erect screens to shade the freshly placed concrete from direct sunlight or wind in order to prevent excessive rapid drying of the concrete.

For localized repairs where forms are not open at the top, the forms shall be vented at their highest point to allow for air to escape during placement of concrete. Refer to Section E3 for general formwork requirements.

Place superplasticized concrete in repair areas such that the finished surface is flush with the original surface of the concrete.

The Contractor shall use mechanical vibrators or other means accepted by the Contract Administrator to ensure that the concrete is fully consolidated and thoroughly worked around the reinforcement, around embedded items and into the corners of forms, eliminating all air or stone pockets. The use of superplasticized concrete does not remove the requirement for concrete consolidation by vibration or other means.

Cure concrete in accordance with the curing procedures described in Section E3.

After curing, provide access to the Contract Administrator for inspection of the repair areas. If any defects such as delaminations are found, the defective area shall be removed and redone to the satisfaction of the Contract Administrator.

Following curing, supply and apply pigmented concrete sealer to all new and existing concrete surfaces in accordance with the requirements of Section E3.

E2.4.6 Testing of Concrete Placement

To approve the Contractor's proposed method of placing pier cap concrete, the Contractor shall cast a test section to test the proposed placement method. The test area shall be of a size acceptable to the Contract Administrator.

E2.4.7 Cleanup

The Contractor will be required to pick up and remove from the site all debris created by the repair procedures to the satisfaction of the Contract Administrator.

E2.5 Measurement and Payment

E2.5.1 Method of Measurement

(a) Concrete Removals for Surface Repairs – 120 mm Depth

Concrete removal will be measured on an area basis. The area to be paid for shall be the total number of square metres of concrete removed in accordance with this Specification and accepted by the Contract Administrator as computed from field measurements made by the Contract Administrator. If the removal is on a corner, the short side area beyond 120 mm from the corner will also be measured.

(b) Concrete Surface Repairs – 120 mm Depth

Concrete surface repairs will be measured on an area basis. The area to be paid for shall be the total number of square metres of concrete surface repairs supplied and installed in accordance with this Specification and accepted by the Contract Administrator, as computed from field measurements. All concrete materials, formwork materials, and accessories specified in this section, except galvanic anodes and reinforcing steel, are incidental to the supply and installation of concrete surface repairs and no separate payment shall be made for these items of Work.

(c) Concrete Removals and Repairs – Additional Depth

Concrete removals and surface repairs to additional depths where directed by the Contract Administrator will be measured on a volume basis. The volume to be paid for shall be the total number of cubic metres of concrete removed and replaced beyond 120-mm depth in accordance with this specification and accepted by the Contract Administrator, as computed from field measurements made by the Contract Administrator.

(d) Embedded Galvanic Anodes for Surface Repairs

Refer to E5.4.1(a)

(e) Supply and Placement of Reinforcing Steel

Refer to E4.5.1

(f) Pigmented Concrete Sealer

Refer to E3.6.1(c)

E2.5.2 Basis of Payment

(a) Concrete Removal for Surface Repairs – 120 mm Depth

Concrete removal up to 120 mm depth will be paid for at the Contract unit Price for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described relating to these Items of Work, and all other items incidental to the Work included in these Items of Work.

Items of Work:

Concrete Removal for Surface Repairs – 120 mm Depth

(i) Pier 8
(ii) Pier 18

(b) Concrete Surface Repairs– 120 mm Depth

Concrete surface repairs up to 120 mm Depth will be paid for at the Contract Unit Price for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described relating to these Items of Work, and all other items incidental to the Work included in these Items of Work.

Items of Work:

Concrete Surface Repairs – 120 mm Depth

(i) Pier 8
(ii) Pier 18

(c) Concrete Removals and Repairs – Additional Depth

Concrete removals and surface repairs to additional depths beyond 120 mm where directed by the Contract Administrator will be paid for at the Contract Unit Price for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described relating to these Items of Work, and all other items incidental to the Work included in these Items of Work.

Items of Work:

Concrete Removal and Repairs – Additional Depth

(i) Pier 8
(ii) Pier 18

(d) Embedded Galvanic Anodes for Surface Repairs

Refer to E5.4.2(a)

(e) Supply and Placement of Reinforcing Steel

Refer to E4.5.2

(f) Pigmented Sealer

Refer to E3.6.2(c)

E3. STRUCTURAL CONCRETE

E3.1 Description

This Specification shall cover the preparation of Portland Cement Concrete for, and all concreting operations related to the construction of Portland Cement Concrete works as specified herein.

The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

E3.2 Materials

E3.2.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.

E3.2.2 Handling and Storage

All materials shall be handled and stored in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA A23.1.

E3.2.3 Testing

All materials supplied under this Specification shall be subject to inspection and testing by the Contract Administrator of by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.

All materials shall conform to CSA Standard CAN/CSA A23.1.

All testing of materials shall conform to CSA Standard CAN/CSA A23.2.

All materials shall be approved by the Contract Administrator at least twenty-one (21) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials, in whole or in part, do not conform to the specification detailed herein or are found to be defective in manufacture of have become damaged in transit, storage or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

E3.2.4 Aggregates

The Contractor shall furnish in writing to the Contract Administrator the location of the sources where aggregate will be obtained in order that it may be inspected and tentatively approved by the Contract Administrator. Changes in the source of aggregate supply during the course of the Contract will not be permitted without notification in writing to and the expressed approval of the Contract Administrator.

(a) Fine Aggregate

Fine aggregate shall consist of sand having clean, hard, strong, durable, uncoated grains free from injurious amounts of dust, soft or flaking particles, shale, alkali, organic matter, load or other deleterious substances. Fine aggregate shall be well-graded throughout and shall conform to the following grading requirements.

CANADIAN METRIC SIEVE SIZE	PERCENT PASSING BY WEIGHT
5 000	95% - 100%
2 500	80% - 100%
1 250	50% - 90%
630	25% - 65%
315	10% - 35%
160	2% - 10%
80	0% - 3%

The fineness modulus of fine aggregate shall not be less that 2.2 or more than 3.1 unless otherwise approved by the Contract Administrator.

(b) Course Aggregate Standard

Standard course aggregate shall be used for all the concrete described and required in this Specification.

Standard course aggregate shall consist of natural gravel, crushed stone, or other approved materials of similar characteristics, having clean, hard, strong, durable, uncoated particles, free from injurious amounts of soft, friable, thin, elongated, or laminated pieces, alkali, organic, or other deleterious matter. Course aggregate shall be well graded throughout and shall conform to the grading requirements in the following table.

GRADING REQUIREMENTS FOR
STANDARD COARSE AGGREGATE

Nominal Size of Aggregate (mm)	Percent of Total Dry Weight Passing Each Sieve (mm)							
	56	40	28	20	14	10	5	2.5
20	-	-	100	90-100	-	25-60	0-10	0-5
14	-	-	-	100	90-100	45-75	0-15	0-5

E3.2.5 Cement

All cement unless hereinafter specifically stated, shall be Type 10 Normal Portland Cement, conforming to requirements of CSA Standard CAN/CSA-A5.

The Contractor shall obtain and furnish to the Contract Administrator a statement signed by an officer or chemist of the cement manufacturer, certifying that the cement furnished does

not exceed 0.6 percent alkali equivalent, as measured by the percent of sodium oxide plus 0.658 times the percent of potassium oxide.

Tests for determining alkali content shall be carried out in accordance with ASTM Standard C114-83A paragraph 17.1 Standard Method of Chemical Analysis of Hydraulic Cement.

E3.2.6 Supplementary Cementing Materials

Use of pozzolans, fly ash or silica fume will not be permitted for use in Structural Concrete supplied under this Specification.

E3.2.7 Water

Water used for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

E3.2.8 Admixtures

No admixtures, other than Air-Entraining Agent and Water Reducing Agent, as specified below, shall be used without the written authorization of the Contract Administrator, unless otherwise specified in these Specifications. It shall be the Contractor's responsibility that each admixture is compatible with all other constituent materials, with respect to the proper performance of the admixture as well as with respect to the proper performance of the other constituents in the presence of the admixture.

(a) Air-Entraining Agent

The air-entraining agent shall conform to the requirements of ASTM Standard C260 and shall produce a satisfactory air-void system and an air content within the ranges specified in CSA Standard CAN/CSA-A23.1 for each class of concrete.

(b) Water-Reducing Agent

The water reducing agent shall be Type WN and shall conform to the requirements of ASTM Standard C494.

(c) Other Admixtures

No other admixtures will be authorized for use in Portland Cement Concrete, unless authorized in writing by the Contract Administrator.

E3.2.9 Styrofoam

Styrofoam shall be low-density expanded polystyrene with a maximum compressive strength of 70 kPa at 10% deformation.

E3.2.10 Patching Mortar

The patching mortar shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than l part cement to 2 parts sand by damp loose volume. White Portland Cement shall be substituted for a part of the grey Portland Cement on exposed concrete in order to produce a colour matching the colour of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling or placing.

E3.2.11 Formwork

Unless otherwise indicated on the Drawings, all formwork shall comply as follows:

Formwork materials shall conform to CSA Standard CAN/CSA-A23.1 and American Concrete Publication SP-4 "Formwork for Concrete".

Form sheeting plywood shall be exterior Douglas Fir, concrete form grade, conforming to CSA 0121, a minimum of 20 mm thick.

Boards used for formwork shall be fully seasoned and free from defects such as knots, warps, cracks, etc., which may mark the concrete surface.

No formwork accessories will normally be allowed to be left in place within 50 mm of the surface following form removal. However, if the Contract Administrator does permit these items to be left in place, they must be made from a non-rusting material or galvanized steel; and they shall not stain, blemish, or spall the concrete surface for the life of the concrete.

Forms for exposed surfaces may be either new plywood or steel as authorized by the Contract Administrator.

Studding shall be spruce or pine and shall have such dimensions and spacing that they shall withstand without distortion, all the forces to which the forms will be subjected.

Walers shall be spruce or pine, with minimum dimensions of 100 mm x 150 mm. Studding shall be spruce or pine, with minimum dimensions of 50 x 150.

All forms are incidental to these works and must be removed by the Contractor once adequate strength and curing of the concrete has been achieved.

E3.2.12 Plain Formliner

Plain formliner shall be Zemdrain by Dupont, or equal as accepted by the Contract Administrator. This formliner shall be used on all exterior exposed formed surfaces.

E3.2.13 Non-Shrink Grout

Where non-shrink grout is used, it shall be Sternson M-bed Standard, CPD Non-Shrink Grout or Sika 212 Non-Shrink Grout. The minimum compressive strength of the grout at 28 days shall be 40 MPa.

E3.2.14 Epoxy Grout

Where epoxy grout is used, it shall be Sika Talygrout 100, or equal as accepted by the Contract Administrator.

E3.2.15 Pigmented Concrete Sealer

Sealing compounds shall be pigmented type, acrylic sealers, and colour to be selected by the Contract Administrator.

Accepted products include:

Product	Rate of Application (m^2/L)
Cappar Cap Seal A50	4.0

or equivalent as accepted by the Contract Administrator

E3.3 Concrete Design Requirements

E3.3.1 Mix Design Statement

For each type of concrete used, the Contractor shall provide the Contract Administrator with a Mix Design Statement, certifying the constituent materials and mix proportions that will be used in the Portland Cement Concrete. The Contractor shall include, in the certification, the following information:

(a) List the product name and source of all proposed constituent materials of the concrete including cement, coarse aggregate, fine aggregate, water, water reducing agent, and

air entraining admixture. A statement is required indicating that the constituent materials proposed for each mix design are compatible with each other, thereby providing concrete with good long-term durability capabilities.

(b) Supply recent records of each mix design for concrete quality control tests including slump, total air content, and 7 and 28-day compressive strengths. The Contractor shall supply reasonable evidence that the mix designs submitted will produce concrete with the specified strength, workability and yield.

When previously satisfactory strength data on the proposed mix is not available, the Contract Administrator may require the preparation of field trial batches in order that the concrete be tested prior to construction. Such field trial batches shall be carried out in similar conditions and using similar equipment, batching, and mixing procedures as will be used in the actual construction. The number of trial batches required shall be determined by the Contract Administrator and shall depend on the class of concrete materials.

(c) Supply recent test information, on coarse aggregates of water absorption and abrasion.

(d) Supply recent information, if available on coarse aggregate alkali-silica reactivity.

(e) Supply recent information on tests performed on Portland Cement.

(f) Supply any other information deemed applicable.

E3.3.2 The Contractor shall perform the following tests and submit the results to the Contract Administrator prior to the start of construction.

(a) Determine the gradation of fine and coarse aggregates in accordance with CSA Test Method A23.2-2A. Results shall be within acceptable limits specified herein.

(b) The Contractor shall submit test data showing that the Contractor's proportioning and mixing equipment, procedures and concrete mix constituent materials are capable of producing a satisfactory air-void system in the hardened concrete. Prior to site mobilization, the Contractor shall prepare and cast representative test specimens of each type of concrete using the same proportioning and mixing equipment and procedures, and the same concrete admixtures as will be employed for the supply and placement of each type of structural concrete.

(c) As a minimum, the air-void system testing program to be carried out by the Contractor prior to site mobilization must include the following:

(i) Date test specimen cast.

(ii) Air temperature during casting.

(iii) Concrete temperature during placement.

(iv) Air content of the plastic concrete as determined in accordance with CSA Standard Test Method A23.2-4C, "Air Content of Plastic Concrete by the Pressure Method".

(v) Slump of the plastic concrete as determined in accordance with CSA Standard Test Method A23.2-5C, "Slump of Concrete".

(vi) Total air-void content, specific surface, spacing factor, and air-paste ratio of the air-void system in the hardened concrete, as determined in accordance with CSA Standard Test Method A23.2-17C, "Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete".

(vii) Density of the hardened concrete.

(viii) Brand and dosage rate of air-entraining and water-reducing admixtures and any other admixtures used in the test specimens.

The test specimen concrete will be considered to have a satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 microns with no single test greater than 260 microns.

(d) Determine the water soluble chloride ion content of the hardened concrete in accordance with CSA Test Method A23.2-4B prior to the start of construction.

(e) All testing shall be carried out by a CSA certified concrete testing laboratory.

(f) The cost for batching, casting, and testing trial batch specimens shall be incidental to the Supply and Placement of Structural Concrete. No measurement or separate payment will be made for this Work.

E3.3.3 Concrete Strength and Workability

The Mix Design Statement shall be submitted to the Contract Administrator at least twenty-one (21) days prior to the delivery of any concrete to the job site. Once accepted by the Contract Administrator, all concrete shall be supplied in accordance with this Statement, which shall be called the Job Mix Formula.

No changes in the Job Mix Formula will be permitted without following the above procedure.

Proportioning of fine aggregate, coarse aggregate, cement, water and air-entraining agent shall be such as to yield concrete having the required properties as follows:

35 MPa Concrete:

(a) Minimum Compressive Strength @ 28 days = 35 MPa
(b) Maximum Water/Cement Ratio = 0.40
(c) Minimum Cement Content = 365 kg/m³
(d) Slump = 80 mm ± 20 mm
(e) Coarse Aggregate Maximum Size = 20 mm Nominal
(f) Cement = Type 10
(g) Air Content = 5.0% to 8.0%

The minimum compressive strength of the in-place concrete shall be 20 MPa before it may be subjected to freezing temperatures.

E3.3.4 Concrete Supply

Unless otherwise specified in these Specifications of the Contract, only the use of a certified ready-mixed concrete plant will be permitted in accordance with Standard Specification CW 3310-R5. Concrete shall be proportioned, mixed and delivered in accordance with the requirements of CSA Standard CAN/CSA-A23.1, "Production of Concrete", except that the transporting of ready-mixed concrete in non-agitating equipment is not permitted without the written permission of the Contract Administrator.

Unless otherwise directed by the Contract Administrator, the discharge of ready-mixed concrete shall be completed within 1½ hours after the introduction of the mixing water to the cement and aggregates.

The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

E3.3.5 Equipment

(a) General

All equipment shall be of a type accepted by the Contract Administrator. The equipment shall be in good working order, kept free from hardened concrete or foreign materials, and shall be cleaned at frequent intervals.

The Contractor shall have sufficient standby equipment available on short notice at all times.

(b) Vibrators

The Contractor shall have sufficient numbers of concrete vibrators and experienced operators on site to properly consolidate all concrete in accordance with ACI 309. The type and size of vibrators shall be appropriate for the particular application, the size of the pour, and the amount of reinforcing and shall conform to standard construction procedures.

The Contractor shall have standby vibrators available at all times during the pour.

(c) Miscellaneous Equipment

The Contractor shall provide all miscellaneous equipment as required to properly and thoroughly execute and complete all operations related to the supply and placement of structural concrete.

E3.4 Construction Methods

E3.4.1 Scope of Work

It is intended that this Specification cover the construction of cast-in-place concrete items, as indicated on the Drawings:

E3.4.2 Formliner

Plain formliner shall be used on all exposed formed surfaces. The installation of the formliner shall be in strict accordance with the manufacturer's recommendations. The supply and use of the plain formliner finish shall be considered incidental to the works of this Specification and no separate payment will be made.

E3.4.3 Formwork and Shoring

Formwork shall be designed, erected, braced and maintained to safely support all vertical and lateral loads until such loads can be supported by the concrete all in accordance with CSA Standard CAN/CSA S269.3.

As a maximum, the following spacings shall apply, for studding and waling:

20 mm plywood:	studding - 400 mm centre to centre
	walers - 760 mm centre to centre

Forms shall be clean before use. Plywood and other wood surfaces shall be sealed against absorption of moisture from the concrete by a factory-applied liner.

Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be commercially manufactured types. The portion remaining within the concrete shall leave no metal within 50 mm of the surface when the concrete is exposed to view. Spreader cones on ties shall not exceed 25 mm in diameter.

All exposed edges shall be chamfered 25 mm unless otherwise noted on the Drawings.

Slots, recesses, chases, sleeves, inserts, bolts, hangers and other items shall be formed or set in coordination and cooperation with the trade concerned. No openings shall be made in structural members, which are not shown on the structural Drawings without the prior approval of the Contract Administrator.

Shores shall be provided with positive means of adjustment (jacks or wedges). All settlement shall be taken up before or during concreting as required.

Mud sills of suitable size shall be provided beneath shores, bedded in sand or stone, where they would otherwise bear on soil. The soil below shores must be adequately prepared to avoid settlements during or after concreting. Shores must not be placed on frozen ground.

Brace shores horizontally in two directions and diagonally in the same two vertical planes so that they can safely withstand all dead and moving loads to which they will be subjected.

The loads and lateral pressures outlined in Part 3, Section 102 of "Recommended Practice for Concrete Formwork", (ACI 347) and wind loads as specified by the National Building Code shall be used for design. Additional design considerations concerning factors of safety for formwork elements and allowable settlements outlined in Section 103 of the above reference shall apply.

Formwork shall have sufficient strengths and rigidity so that the resultant finished concrete conforms to the shapes, lines and dimensions of the members shown on the Drawings.

Formwork shall be constructed to permit easy dismantling and stripping and such that removal will not damage the concrete. Provision shall be made in the formwork for shores to remain undisturbed during stripping where required.

Forms shall be constructed and maintained so that the completed work is within minus 3 mm or plus 6 mm of the dimensions shown on the Drawings.

Formwork shall be cambered, where necessary to maintain the specified tolerances, to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads.

Forms shall be sufficiently tight to prevent leakage of grout or cement paste.

Form panels shall be constructed so that the contact edges are kept flush and aligned.

Where required by the Contract Administrator, the Contractor shall cast test panels not using less than two panels of representative samples of the forms he proposes for reuse and shall strip them after 48 hours for the Contract Administrator to judge the type of surface produced.

All form lumber, studding, etc., becomes the property of the Contractor when the Work is finished, and it shall be removed from the concrete and the site by the Contractor after the concrete is set, free of extra charge, and the entire site left in a neat and clean condition.

It shall be permissible to use the forms over again where possible to a maximum of 3 uses, provided they are thoroughly cleaned and in good condition after being removed from the former portions of the Work. The Contract Administrator shall be the sole judge of their condition and his decision shall be final regarding the use of them again.

E3.4.4 Placing Concrete

The Contract Administrator must be notified at least 24 hours prior to concrete placing so that an adequate inspection may be made of formwork, shoring, reinforcement, and related Works. Placement without required prior notification will not be allowed.

Equipment for mixing or conveying concrete shall be thoroughly flushed with clean water before and after each pour. Water used for this purpose shall be discharged outside the forms. Pumping of concrete will be allowed only on permission from the Contract Administrator and all equipment and processes are subject to his acceptance.

Concrete shall be conveyed from the mixer to the place of final deposit by methods, which will prevent segregation and a marked change in consistency.

Runways for concrete buggies shall be supported directly by the formwork and not on reinforcement.

Before depositing any concrete, all debris shall be removed from the space to be occupied by the concrete, and any mortar splashed upon the reinforcement or forms shall be removed.

Placing of concrete, once started, shall be continuous. No concrete shall be placed on concrete, which has sufficiently hardened to cause the formation of seams of "cold joints" within the section. If placing must be interrupted, construction joints shall be located where shown on the Drawing or as accepted by the Contract Administrator.

Concrete shall be placed as nearly as possible in its final position. Rakes or mechanical vibrators shall not be used to transport concrete.

The maximum drop of free concrete into the forms shall not be greater than 1.5 m otherwise rubber tubes or pouring ports spaced not more than 1.5 m vertically and 2.5 m horizontally shall be used. The Contractor shall obtain the Contract Administrator's acceptance prior to pouring concrete of all placing operations.

All concrete, during and immediately after depositing, shall be consolidated by mechanical vibrators so that the concrete is thoroughly worked around the reinforcement, around embedded items and into the corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Mechanical vibrators shall have a minimum frequency of 7000 revolutions per minute immersed.

Vibrators shall be inserted systematically into the concrete at intervals such that the zones of influence of the vibrator overlap (generally 300 to 900 mm). Apply the vibrator at any point until the concrete is sufficiently compacted (5 to 15 seconds), but not long enough for segregation to occur. Spare vibrators in working condition shall be kept on the job Site during all placing operations.

Concrete shall not be placed during rain or snow unless adequate protection is provided for formwork and concrete surfaces.

E3.4.5 Finishing of Concrete Surfaces

(a) Type 1 Finish - Unformed Surfaces

All unformed concrete surfaces except the bridge deck slab and approach slabs shall be finished as outlined hereinafter.

Screeding of all unformed concrete surfaces shall be performed by the sawing movement of a straightedge along wood or metal strips or from edges that have been accurately set at required elevations.

Screeding shall be done on all concrete surfaces as a first step in other finishing operations. Screeding shall be done immediately after the concrete has been vibrated.

After screeding, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared. The surface shall then be consolidated with hand floats. Concrete surfaces after floating shall have a uniform, smooth, granular texture.

E3.4.6 General Curing

Refer to E3.4.9 for cold weather curing requirements and E3.4.10 for hot weather curing requirements.

The use of curing compound will not be allowed.

Freshly finished concrete be covered and kept moist by means of wet polyester blankets immediately following finishing operations and shall be maintained in that condition at above 10°C for a curing period of at least seven (7) consecutive days thereafter.

Concrete shall be protected during the curing period from the harmful effects of sunshine, drying winds, surface dripping, or running water, vibration, and mechanical shock. Concrete shall be protected from freezing until at least 24 hours after the end of the curing period.

Changes in temperature of the concrete shall be uniform and gradual and shall not exceed 3°C in one hour or 20°C in 24 hours.

Surfaces of concrete which are protected by formwork that is left in place for seven (7) days shall not require any additional curing. If forms are removed in less than seven (7) days the concrete shall receive a moist curing as described since the concrete was placed.

E3.4.7 Form Removal

The Contract Administrator must be notified at least 24 hours prior to form removal and give approval prior to beginning work.

The concrete forms shall remain in place a minimum of three (3) days, unless otherwise accepted by the Contract Administrator.,

The minimum strength of concrete in place for safe removal of soffit forms for horizontal or inclined members shall be 25 MPa, with the added provision that the member shall be of sufficient strength to safely carry its own weight, together with super-imposed construction loads, and that the forms shall stay in place a minimum of five days unless otherwise accepted by the Contract Administrator.

Field-cured test specimens representative of the cast-in-place concrete being stripped, will be tested as specified in this Specification to verify the concrete strength.

E3.4.8 Patching of Formed Surfaces

Immediately after forms have been removed but before any repairing or surface finishing is started, the concrete surface shall be inspected by the Contract Administrator. Any repair or surface finishing started before this inspection may be rejected and required to be removed.

All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back seventy-five (75) mm from the surface before patching.

Minor surface defects caused by honeycomb, air pockets greater than 5 mm in diameter and voids left by strutting and tie holes shall be repaired by removing the defective concrete to sound concrete, dampening the area to be patched and then applying patching mortar. A slurry grout consisting of water and cement, shall be well brushed onto the area to be patched. When the slurry grout begins to lose the water sheen, the patching mortar shall be applied. It shall be struck off slightly higher than the surface and left for one hour before final finishing to permit initial shrinkage of the patching mortar, it shall be touched up until it is satisfactory to the Contract Administrator. The patch shall be cured as specified in this Specification. The final colour shall match the surrounding concrete.

All objectionable fins, projections, offsets, streaks, or other surface imperfections shall be removed by means acceptable to the Contract Administrator. Cement washes of any kind shall not be used.

Concrete surfaces shall have a normal finish. Concrete shall be cast against forms, which will produce plane surfaces with no bulges, indentations, or protuberances other than those shown on the Drawings. The arrangement of panel joints shall be kept to a minimum. Panels containing worn edges, patches, or other defects which will impair the texture of concrete surfaces shall not be used.

E3.4.9 Cold Weather Concreting

The requirements of this section shall be applied to all concreting operations during cold weather; if the mean daily temperature falls below 5° during placing or curing.

The Contract Administrator will advise the Contractor, in writing, as to the degree of heating of water and aggregates.

Supplementary equipment as required below shall be at the job site if concrete is likely to be placed in cold weather.

Formwork and reinforcing steel shall be heated to at least 5°C before concrete is placed.

The temperature of the concrete shall be maintained at not less than 10°C for 7 days or 15°C for 5 days or 20°C for 3 days after placing. The concrete shall be kept above freezing temperature for at least a period of 9 days. In no case, shall the heating be removed until the concrete has reached a minimum compressive strength which will be specified by the Contract Administrator as determined from compressive strength tests on specimens cured under the same conditions as the concrete Works in question.

Aggregates shall be heated to a temperature of not less than 20°C and not more than 65°C. Water shall be heated to a temperature between 55°C and 65°C. The temperature of the concrete at the time of placing in the forms shall be within the range specified in CSA Standard CAN/CSA A23.1 for the thickness of the section being placed.

When the mean daily temperature may fall below 5°C, a complete housing of the Work, together with supplementary heat shall be provided.

Combustion-type heaters may be used if their exhaust gases are vented outside the enclosures and not allowed to come into contact with concrete surfaces. Fire extinguishers must be readily at hand wherever combustion-type heaters are used.

When the ambient temperature is below -15°C, the housing shall be constructed so as to allow the concrete to be placed without the housing having to be opened. If the mixing is done outside of the housing, the concrete shall be placed by means of hoppers installed through the housing. The hoppers are to be plugged when not in use.

When the ambient temperature is equal to or above -15°C, the Contractor will be permitted to open small portions of the housing for a limited time to facilitate the placing of the concrete.

Before depositing any of the concrete, the Contractor shall show that enough heating equipment 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 housing to the specified 20°C at least 12 hours prior to the start of the 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 standby heating equipment must be available to allow for any sudden drop in outside temperatures and any breakdowns, which may occur in the equipment.

The Contractor shall keep a curing record of each concrete pour. The curing record shall include date and location of the pour, mean daily temperature, temperatures above and below the concrete within the enclosure, temperatures of the concrete surface at several points and notes regarding the type of heating, enclosure, unusual weather conditions, etc. This record shall be available for inspection by the Contract Administrator at all times, and shall be turned over to the Contract Administrator at the end of concreting operations.

E3.4.10 Hot Weather Concreting

The requirements of this section shall be applied during hot weather, i.e. air temperatures above 25°C during placing.

Concrete shall be placed at as low a temperature as possible, preferably below 15°C but not above 27°C. Aggregate stockpiles may be cooled by water sprays and sun shades.

Ice may be substituted for a portion of the mixing water, providing it has melted by the time mixing is completed.

Form and conveying equipment shall be kept as cool as possible before concreting by shading them from the sun, painting their surfaces white and/or the use of water sprays.

Sun shades and wind breaks shall be used as required during placing and finishing.

Work shall be planned so that concrete can be placed as quickly as possible to avoid "cold joints".

The Contract Administrator's acceptance is necessary before the Contractor may use admixtures such as retardants to delay setting, or water-reducing agents to maintain workability and strength, and these must then appear in the Mix Design Statement submitted to the Contract Administrator.

Curing shall follow immediately after the finishing operation.

When the air temperature is at or above 25°C, or when there is probability of its rising to 25°C during the placing period, facilities shall be provided for protection of the concrete in place from the effects of hot and/or drying weather conditions. Under severe drying conditions, as defined below the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by fogging and evaporation.

The temperature of the concrete as placed shall be as low as practicable and in no case greater than that shown below for the indicated size of the concrete section.

Thickness of Section, m	Temperatures °C Minimum	Maximum
Less than 0.3	10	27
0.3 - 1	10	27
1.2	5	25

Moderate Drying Conditions:

When surface moisture evaporation exceeds 0.75 kg/m^2/h, windbreaks shall be erected around the sides of the structural element.

Severe Drying Conditions:

When surface moisture evaporation exceeds 1.0 kg/m^2/h, additional measures shall be taken to prevent rapid loss of moisture from the surface of the concrete. Such additional measures shall consist of the following:

(a) Erecting sunshades over the concrete during finishing and placing operations.
(b) Lowering the concrete temperature.
(c) Applying fog spray immediately after placement and before finishing. Care shall be taken to prevent accumulation of water that may reduce the quality of the cement paste.

(d) Beginning the concrete curing immediately after trowelling.

The nomograph, Figure D1, Appendix D of CSA Standard CAN/CSA A23.1 shall be used to estimate surface moisture evaporation rates.

E3.4.11 Construction Joints

Construction joints shall be located only where shown on the Drawings or as otherwise accepted in writing by the Contract Administrator. Construction joints shall be at right angles to the direction of the main reinforcing steel. All reinforcing steel shall be continuous across the joints.

The face of joints shall be cleaned of all laitance and dirt, after which an epoxy adhesive bonding agent shall be applied. Forms shall be re-tightened and all reinforcing steel shall be thoroughly cleaned at the joint prior to concreting.

E3.4.12 Application of Pigmented Concrete Sealer

Concrete shall be cured and dry before application of the sealer. Surfaces must be free of dust, oil, grease, rubber tire residue, curing compounds, paint, or other contaminants prior to application. Any curing compound or other contaminants shall be removed using a method that does not damage the concrete surface finish. The cleaning procedures require the prior acceptance of the Contract Administrator. Sandblasting will not be allowed. Application of the sealer shall be in accordance with the manufacturer's written instructions.

Pigmented concrete sealer shall be applied to the surface of all newly placed concrete and existing concrete of rehabilitated piers.

E3.4.13 Concrete Removal at Pier 15

Remove portions of the existing concrete pier where designated on the drawings and as required to achieve the final design geometry shown for the proposed structural jacket and top slab.

All concrete debris and reinforcing steel from the demolished portion of the existing shall be removed and disposed of off site by the Contractor.

Cut all reinforcing bars protruding from the existing concrete that is to remain in place flush with the surface of the concrete.

E3.5 Quality Control

E3.5.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final acceptance of the specified Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or works, which are not in accordance with the requirements of this Specification.

E3.5.2 Access

The Contract Administrator shall be afforded full access for the inspection and control testing of concrete and constituent materials, both at the site of Work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification.

E3.5.3 Materials

All materials supplied under this Specification shall be subject to testing and acceptance by the Contract Administrator in accordance with E3.2.3.

E3.5.4 Concrete Quality

Quality control tests will be used to determine the acceptability of the concrete supplied by the Contractor.

The Contractor shall provide, without charge, the samples of concrete and the constituent materials required for quality control tests and provide such assistance and use of tools and construction equipment as is required.

The frequency and number of concrete quality control tests shall be in accordance with the requirements of CSA Standard CAN/CSA-A23.1.

An outline of the quality tests is as follows:

(a) Slump tests shall be made in accordance with CSA Standard test method CAN/CSA-A23.2-5C, "Slump of Concrete". If the measured slump falls outside the limits specified in E2.2.12 or E3.3.3, a second test shall be made.

In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented.

(b) Air content determinations shall be made in accordance with CSA Standard test method CAN/CSA-A23.2-4C, "Air Content of Plastic Concrete by the Pressure Method". If the measured air content falls outside the limits specified in E2.2.12 or E3.3.3, a second test shall be made at any time within the specified discharge time limit for the mix.

In the event of a second failure, the Contract Administrator reserves the right to reject the batch of concrete represented.

(c) The air-void system shall be proven satisfactory by data from tests performed in accordance with CSA Test Method CAN/CSA A23.1-17C. The spacing factor, as determined on concrete cylinders moulded in accordance with CSA Standard test method CAN/CSA A23.2-3C, shall be determined prior to the start of construction on cylinders of concrete made with the same materials, mix proportions, and mixing procedures as intended for the project. If deemed necessary by the Contract Administrator to further check the air-void system during construction, testing of cylinders may be from concrete as delivered to the job site and will be carried out by the Contract Administrator. The concrete will be considered to have a satisfactory air-void system when the average of all tests shows a spacing factor not exceeding 230 microns with no single test greater than 260 microns.

(d) Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method CAN/CSA-A23.2-1C, "Sampling Plastic Concrete".

(e) Test specimens shall be made and cured in accordance with CSA Standard Test Method CAN/CSA-A23.2-3C, "Making and Curing Concrete Compression and Flexure Test Specimens".

(f) Compressive strength tests at twenty-eight (28) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) day strength test, the strength of two companion standard-cured test specimens shall be determined in accordance with CSA Standard Test Method CAN/CSA-A23.2-9C, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the average of the strengths of the two specimens. A compressive strength test at seven (7) days shall be taken, the strength of which will be used only as a preliminary indication of the concrete strength, a strength test being the strength of a single standard cured specimen.

(g) Compressive strength tests on specimens cured under the same conditions as the concrete works shall be made to check the strength of the in-place concrete so as to determine if the concrete has reached the minimum compressive strength as specified in E2.2.12 or E3.3.3 and also to check the adequacy of curing and/or cold weather protection. At least two (2) field-cured test specimens will be taken to verify strength of the in-place concrete. For each field-cured strength test, the strength of a single field-cured test specimen shall be determined in accordance with CSA Standard test method CAN/CSA-A23.2-9C, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the strength of the specimen.

E3.5.5 Corrective Action

If the results of the tests indicate that the concrete is not of the specified quality, the Contract Administrator shall have the right to implement additional testing, as required, to further evaluate the concrete at the Contractor's expense. The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Contract Administrator.

E3.6 Measurement and Payment

E3.6.1 Method Of Measurement

(a) Supply and Placement of Structural Concrete

The supply and placement of structural concrete shall be measured on a volume basis for each type. The volume to be paid for shall be the total number of cubic metres of structural concrete supplied and placed in accordance with this Specification and accepted by the Contract Administrator, as computed from Drawing dimensions. No deductions will be made for chamfers, reinforcing steel, structural steel, bolts or voids of seventy-five (75) mm in diameter or less. All formwork materials and accessories are incidental to the supply and placement of structural concrete and no payment shall be made for this Work unless indicated otherwise.

(b) Heating and Hoarding

The heating and hoarding of concrete, if required, will be considered incidental to supply and placement of structural concrete and no measurement will be made for this Work.

(c) Pigmented Concrete Sealer

The supply and application of the pigmented concrete sealer shall be measured on an area basis. The area to be paid for shall be the total number of square metres of sealer supplied and applied in accordance with this Specification and accepted by the Contract Administrator, as computed from Drawing dimensions.

(d) Concrete Removal at Pier 15

Existing concrete removal at pier 15 will be paid for on a lump sum basis, as accepted by the Contract Administrator, and no measurement will be made for this Work.

E3.6.2 Basis Of Payment

(a) Supply and Placement of Structural Concrete

The supply and placement of structural concrete will be paid for at the Contract Unit Price per cubic metre for "Supply and Place Structural Concrete – Pier 15", measured as specified herein, which price shall be payment in full for supplying all materials and for performing all operations herein described relating to this item of Work, and all other items incidental to the Work included in this item of Work.

(b) Heating and Hoarding

The heating and hoarding of concrete, if required, will be considered incidental to supply and placement of structural concrete and no separate payment will be made for this Work.

(c) Pigmented Concrete Sealer

The supply and application of the pigmented concrete sealer will be paid for at the Contract Unit Price per square metre for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for performing all operations herein described relating to these Items of Work, and all other items incidental to the Work included in these Items of Work.

Items of Work:

Pigmented Concrete Sealer

(i) Pier 8
(ii) Pier 15
(iii) Pier 18

(d) Concrete Removal at Pier 15

Existing concrete removal at pier 15 will be paid for at the Contract Lump Sum Price for "Concrete Removal – Pier 15", measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described relating to this item of Work, and all other items incidental to the Work included in this item of Work.

E4. SUPPLYING AND PLACING REINFORCING STEEL

E4.1 Description

This Specification shall cover the supply, fabrication, and placement of reinforcing steel.

The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies, and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

E4.2 Materials

E4.2.1 General

The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.

E4.2.2 Handling and Storage of Materials

All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with the requirements of CSA Standard CAN3-A23.1, Storage of Materials, latest edition, except as otherwise specified herein.

E4.2.3 Reinforcing Steel

Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, and dowels.

All reinforcing steel shall be supplied in accordance with the reinforcing schedules as shown on the Drawings.

All reinforcing steel shall conform to the requirements of latest edition of CSA Standard CAN/CSA G30.18, Grade 400 MPa, Billet-Steel Bars for Concrete Reinforcement. If, in the opinion of the Contract Administrator, any reinforcing steel provided for the concrete works exhibit flaws in the manufacture or fabrication, such material shall be immediately removed from the site and replaced with acceptable reinforcing steel.

All reinforcing steel shall be straight and free from paint, oil, millscale, and injurious defects. Rust, surface seams, or surface irregularities will not be cause of rejection, provided that the minimum dimensions, cross-sectional area, and tensile properties of a hand wire-brushed specimen are not less than the requirements of CSA Standard CAN/CSA G30.18.

E4.2.4 Bar Accessories

Bar accessories shall be of a type acceptable to the Contract Administrator. They shall be made from a non-rusting material or galvanized steel, and they shall not stain, blemish, or spall the concreted surface for the life of the concrete. Bar chairs are to be PVC; galvanized bar chairs are not acceptable.

Bar accessories are not included in the Drawings and shall include bar chairs, spacers, clips, wire ties, wire (18 gauge minimum), or other similar devices and are to be acceptable to the Contract Administrator. The supplying and installation of bar accessories shall be deemed to be incidental to the supplying and placing of reinforcing steel.

E4.3 Construction Methods

E4.3.1 Fabrication of Reinforcing Steel

Reinforcing steel shall be fabricated in accordance with CSA Standard CAN/CSA G30.18, latest edition, to the lengths and shapes as shown on the Drawings.

E4.3.2 Placing of Reinforcing Steel

Reinforcing steel shall be placed accurately in the positions shown on the Drawings and shall be retained in such positions by means of a sufficient number of bar accessories so that the bars shall not be moved out of alignment during or after the depositing of concrete. The Contract Administrator's decision in this matter shall be final.

Reinforcing steel shall be free from all foreign material in order to ensure a positive bond between the concrete and steel. The Contractor shall also remove any dry concrete, which has been deposited on the steel from previous pouring operations before additional concrete may be placed. Intersecting bars shall be tied positively at each intersection.

Splices in reinforcing steel shall be made only where indicated on the Drawings. Prior approval of the Contract Administrator shall be obtained where other splices must be made. Welded splices will not be permitted.

Place abutment and pier reinforcing to provide a clear space between the reinforcing bars as shown on the Drawings to accurately place preformed holes.

Reinforcing steel shall not be straightened or rebent in a manner that will injure the metal. Bars with bends not shown on the Drawings shall not be used. Heating of reinforcing steel will not be permitted without prior approval of the Contract Administrator. A minimum of twenty-four (24) hours advance notice shall be given to the Contract Administrator prior to the pouring of any concrete to allow for inspection of the reinforcement.

E4.4 Quality Control

E4.4.1 Inspection

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Contract Administrator including all operations from the selection and production of materials through to final

acceptance of the specified Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or acceptance that may have been previously given. The Contract Administrator reserves the right to reject any materials or works, which are not in accordance with the requirements of this Specification.

E4.4.2 Access

The Contract Administrator shall be afforded full access for the inspection and control testing of reinforcing steel; both at the Site of Work and at any plant used for the fabrication of the reinforcing steel, to determine whether the reinforcing steel is being supplied in accordance with this Specification.

E4.4.3 Quality Testing

Quality control testing will be used to determine the acceptability of the reinforcing steel supplied by the Contractor.

The Contractor shall provide, without charge, the samples of reinforcing steel required for quality control tests and provide such assistance and use of tools and construction equipment as is required.

E4.5 Measurement and Payment

E4.5.1 Method of Measurement

The supplying and placing of Reinforcing Steel will be measured on a mass basis. The mass to be paid for shall be the total number of kilograms of reinforcing steel installed in accordance with this Specification, accepted by the Contract Administrator, as computed from the approved reinforcing layout shown on the Drawings or the reviewed shop drawings, excluding the mass of bar accessories.

E4.5.2 Basis Of Payment

The supplying and placing of Reinforcing Steel shall be paid for at the Contract Unit Price per kilogram for “Supply and Place Reinforcing Steel” measured as specified herein, which price shall be payment in full for supplying all materials and for performing all operations herein described and all other items incidental to the work included in this Specification.

E5. EMBEDDED GALVANIC ANODES

E5.1 General

E5.1.1 Description

This Section shall cover the supply and installation of embedded galvanic anodes for corrosion mitigation of surface concrete repairs and for corrosion mitigation in mechanically sound concrete.

The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

E5.1.2 References

(a) ACI/ICRI 1999 Concrete Repair Manual

(b) ACI Guideline No. 222 – Corrosion of Metals in Concrete

(c) CAN/CSA A23.1 Standard for Repair Mortars, Concrete and Bonding Agents

(d) CAN/CSA G30.18-M92 (R1998) Billet-Steel Bar for Concrete Reinforcement

(e) ASTM B418-95a Standard Specification for Cast and Wrought Galvanic Zinc Anodes

(f) G30.3-M1983 (R1998) Cold-Drawn Steel Wire for Concrete Reinforcement

E5.2 Embedded Anodes for Concrete Surface Repairs

E5.2.1 Materials

Embedded galvanic anodes will be Galvashield® XP by Vector Corrosion Technologies (204) 489-6300. Anodes will be supplied by the City of Winnipeg, for pickup by the Contractor at the City of Winnipeg Bridge Yard, 849 Ravelston Ave. West. Upon completion of the Work, any extra anodes shall be returned to the City, and the Contractor will be required to deliver the extra anodes to the City of Winnipeg Bridge Yard.

Repair mortars, concrete and bonding agents shall be Portland cement-based materials with suitable electrical conductivity, supplied by the Contractor. Non-conductive repair materials such as epoxy, urethane, or magnesium phosphate shall not be permitted.

Deliver, store, and handle all materials in accordance with manufacturer's instructions.

E5.2.2 Construction Methods

(a) Cleaning and Repair of Reinforcing Steel

Clean exposed reinforcing steel of rust, mortar, etc. to provide sufficient electrical connection and mechanical bond.

If significant reduction in the cross section of the reinforcing steel has occurred, replace or install supplemental reinforcement as directed by the Contract Administrator.

Secure loose reinforcing steel by tying tightly to other bars with steel tie wire.

(b) Galvanic Anode Installation

Galvanic anodes shall be installed along the perimeter of the repair or interface with spacing as specified on the Drawings. Anode spacing will vary with changes in the reinforcing steel density, the level of chloride in the structure and the corrosivity of the local environment, etc. In no case shall the distance between anodes exceed 610 mm.

Provide sufficient clearance between anodes and substrate to allow repair material to encase the anodes.

Secure the galvanic anodes as close as possible to the patch edge using the anode tie wires. The tie wires shall be wrapped around the cleaned reinforcing steel and twisted tight to allow little or no free movement.

If the anode is to be tied onto a single bar, or if less than 25 mm of concrete cover is expected, place anode beneath the bar and secure to clean reinforcing steel.

If sufficient concrete cover exists, the anode may be placed at the intersection between two bars and secured to each clean bar.

(c) Electrical Continuity

Confirm electrical connection between anode tie wire and reinforcing steel by measuring DC resistance (ohm, Ω) with a multi-meter.

Confirm electrical continuity of the exposed reinforcing steel within the repair area. If necessary, electrical continuity shall be established with steel tie wire.

Electrical continuity is acceptable if the DC resistance measured with multi-meter is less than 5 Ω.

Concrete Replacement

Following normal concrete repair procedures, complete the repair with the repair material, taking care not to create any air voids within the repair. Refer to Section E3 for concrete surface repair specifications.

E5.3 Embedded Anodes for Mechanically Sound Concrete

E5.3.1 Materials

Embedded galvanic anodes will be Galvashield® CC by Vector Corrosion Technologies (204) 489-6300. Anodes will be supplied by the City of Winnipeg, for pickup by the Contractor at the supplier's facility within the City of Winnipeg. Upon completion of the Work, any extra anodes shall be returned to the City, and the Contractor will be required to deliver the extra anodes to a City of Winnipeg Yard within the city limits.

Repair material shall be Galvashield® Embedding Mortar available from Vector Corrosion Technologies (204-489-6300), or approved equivalent.

Galvanic anode mortar shall be a Portland cement-based material with a consistency as required for anode installation.

Deliver, store, and handle all materials in accordance with manufacturer's instructions.

E5.3.2 Construction Methods

(a) Applicators

The embedded galvanic anodes shall be installed by applicators qualified by the anode supplier.

(b) Anode Layout

Using a suitable rebar locator, the location of the reinforcing grid shall be determined and marked out in areas where anodes are to be installed.

The anodes shall be installed in a grid pattern, at intervals specified on the Drawings or by the Contract Administrator and not exceeding 700 mm on centre, in each direction.

(c) Drill Holes

Rebar Connection - Holes must be drilled or chipped down to the reinforcing steel to enable electrical connection of the anodes to the steel. These holes typically need not be larger than 19 mm in diameter. Rebar continuity shall be verified between adjacent holes using an appropriate meter.

Anode Location - Drill or core a hole 50 mm in diameter by 100 mm deep in close proximity to the rebar connection hole to accommodate the anode.

Cut a groove in the concrete between the rebar connection and anode location holes to conceal the anode lead wire.

All holes shall be cleaned of debris and concrete dust.

(d) Anode Installation

Holes shall be in a saturated, surface-dry condition prior to anode placement.

Anodes shall be pre-soaked in a small volume of water immediately prior to installation, and for not longer than 5 minutes.

The anode lead wire should be fastened to the reinforcing steel in the rebar connection hole; the other end is connected to the anode.

Place a small quantity of mortar in the base of the anode hole.

Any connections between dissimilar metals should be encased in silicone or two-part epoxy to seal out moisture.

Insert an anode into each hole, pushing the anode to the bottom of the hole forcing the mortar to fill the annular space from the bottom up.

Electrical continuity shall be verified between the anode and reinforcing steel prior to repairing the connection groove.

(e) Concrete Replacement

The rebar connection, anode location and connection groove shall be filled with mortar so that the wires and all connections are embedded. Strike off mortar flush with the surface of the concrete and cure as per the requirements of Section E3.

E5.4 Measurement and Payment

E5.4.1 Method of Measurement

(a) Embedded Anodes for Surface Repairs

The installation of embedded anodes for surface repairs shall be measured on a unit basis. The number of embedded anodes for surface repairs to be paid for shall be the total number of embedded anodes for surface repairs installed in accordance with the Drawings and this Specification and accepted by the Contract Administrator.

(b) Embedded Anodes for Mechanically Sound Concrete

The installation of embedded anodes for mechanically sound concrete shall be measured on a unit basis. The total number of embedded anodes for mechanically sound concrete to be paid for shall be the total number of embedded anodes for mechanically sound concrete installed in accordance with the Drawings and this Specification and accepted by the Contract Administrator.

E5.4.2 Basis of Payment

(a) Embedded Anodes for Surface Repairs

Embedded anodes for surface repairs will be paid for at the Contract Unit Price for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for performing all operations herein described relating to these Items of Work, and all other items incidental to the Work included in these Items of Work.

Items of Work:

Install Embedded Anodes for Surface Repairs

(i) Pier 8
(ii) Pier 18

(b) Embedded Anodes for Mechanically Sound Concrete

Embedded anodes for mechanically sound concrete will be paid for at the Contract Unit Price for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for performing all operations herein described relating to these Items of Work, and all other items incidental to the Work included in these Items of Work.

Items of Work:

Install Embedded Anodes for Mechanically Sound Concrete

(i) Pier 8
(ii) Pier 18

E6. EXCAVATION AND BACKFILL

E6.1 Description

This Specification shall cover all operations relating to excavation to expose existing pier footings and backfilling after construction.

The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

E6.2 Materials

E6.2.1 General

The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Section.

E6.2.2 Testing and Approval

All materials supplied under his Section shall be subject to inspection and testing by the Contract Administrator or by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.

All materials shall be approved by the Contract Administrator at least twenty-one (21) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials, in whole or in part, do not conform to the specification detailed herein or are found to be defective in manufacture of have become damaged in transit, storage or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at his own expense.

E6.2.3 Granular Backfill

Granular backfill shall be Granular Base Course material supplied by the Contractor in accordance with the requirements of the City of Winnipeg Standard Construction Specification CW 3110-R5.

E6.3 Equipment

All equipment, tools and facilities used shall be of a type accepted by the Contract Administrator. The Contractor shall have sufficient standby equipment available at all times.

E6.4 Construction Methods

E6.4.1 Excavation

Excavation shall include the required excavation to the limits indicated on the Drawings, as well as loading, hauling and off-site disposal of all excavated materials. Excavation shall include removal of all encountered materials including, but not necessarily limited to, topsoil, clays, silts, rock, gravel, boulders, rubble and rubbish.

Any materials dropped or spilled on City streets during hauling operations shall be promptly cleaned up by and at the expense of the Contractor to the satisfaction of the Contract Administrator.

The Contractor shall excavate to stable side slopes. Side slopes shall be no steeper than those indicated on the Drawings. Side slopes shown on the Drawings indicate only the maximum allowable slopes, and such slopes may not necessarily be stable depending on the actual soil conditions at the site. It is the responsibility of the Contractor to ensure that

the excavated side slopes are stable. If necessary, the Contractor shall put in place such bracing and shoring as may be required to safely support the sides of the excavation. All excavation side slopes and/or bracing and shoring shall be designed by a Professional Engineer registered in the Province of Manitoba and shall be installed in accordance with the latest revision of the Manitoba Workplace Safety and Health Act, satisfactory to the Contract Administrator. This Work shall be considered incidental to excavation and no separate payment will be made.

Excavation beyond the limits shown on the Drawings shall be backfilled with compacted granular backfill at the Contractor's expense.

The Contractor shall have sufficient pumping equipment on site to dewater the excavations and keep them in a dry condition throughout construction. This shall be considered incidental to excavation and no separate payment will be made for dewatering.

Damage to the existing pier structure caused by the Contractor's operations during excavation, as determined by the Contract Administrator, shall be repaired at the Contractor's expense to the satisfaction of the Contract Administrator.

The Contractor is responsible for locating any and all buried utilities or other underground structures that may exist within the area of excavation, prior to commencing Work. Any damage to existing underground structures or utilities is the sole responsibility of the Contractor.

E6.4.2 Placement of Granular Backfill

The Contractor shall supply, place and compact granular backfill following construction to restore the original ground profile at the site.

Granular backfill shall be deposited in horizontal and uniform layers not exceeding 200 mm in thickness prior to compaction. Each layer shall be compacted to a relative density of not less than 95% of Standard Proctor Density. No backfill shall be placed against pier 15 until permission has been given by the Contract Administrator, and not until the concrete has attained at least 70% of its specified 28-day compressive strength.

E6.5 Measurement and Payment

E6.5.1 Method of Measurement

Excavation and backfill will be paid for on a lump sum basis, as accepted by the Contract Administrator, and no measurement will be made for this Work.

E6.5.2 Basis of Payment

Excavation and backfill will be paid for at the Contract Lump Sum Price for the "Items of Work" listed here below, measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described and all other items incidental to the Work included in this Specification.

Items of Work:

Excavation and Backfill

(i) Pier 8
(ii) Pier 15
(iii) Pier 18

E7. TEMPORARY SHORING

E7.1 Description

This Specification shall cover all operations relating to supply and installation of temporary shoring works to support the bridge superstructure during construction.

The Work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

E7.2 Materials

E7.2.1 Structural Steel

Structural steel shall conform to CSA G40.21, latest edition, Grade 300W or 350W.

E7.2.2 Bolts

Bolts shall be ASTM grade A325. All bolts specified to be cast into concrete shall be hot-dip galvanized in accordance with CSA G164.

E7.2.3 Non-shrink Grout

Non-shrink grout shall be CPD non-shrink grout or Sika 212 non-shrink grout or equivalent as approved by the Contract Administrator. Grout shall have a minimum compressive strength of 40 MPa at 28 days.

E7.2.4 Neoprene Bearing Pads

Neoprene bearing pads shall be Goodco Series E or equivalent as approved by the Contract Administrator. Bearing pads shall be 50 durometer Shore A hardness at 20 °C.

E7.3 Construction Methods

E7.3.1 Shoring Design

The shoring arrangements shown on the drawings are suggested methods only. The Contractor may propose alternate methods of shoring the bridge superstructure.

The shoring design shown on the drawings is a general design. Design of all shoring details including all connections is the responsibility of the Contractor. The Contractor is responsible for designing all jacking assemblies and procedures.

All temporary shoring and jacking assemblies shall be designed to carry the vertical loads indicated on the drawings. Shoring shall be braced to resist lateral loads in all directions and ensure the stability of the assembly. Design of bracing and determination of design lateral loads is the responsibility of the Contractor. Note that bracing is not shown on the shoring arrangement suggested on the drawings, however bracing is required for this configuration (if used), the design of which is the responsibility of the Contractor.

The Contractor shall engage a Professional Engineer licensed to practice engineering in the Province of Manitoba to undertake all shoring design.

If temporary shoring is required for the cantilever portions of piers 8 and 18, the Contractor’s professional engineer shall determine the design loads for the shoring and shall design the shoring.

E7.3.2 Submittals

The Contractor shall submit drawings of all shoring designs and installation procedures to the Contract Administrator for review at least 14 days prior to shoring installation. All shoring drawings shall bear the seal of the Contractor's professional engineer.

If specifically requested by the Contract Administrator, the Contractor shall also submit design calculations bearing the professional engineer's seal for information only.

Review of shoring drawings and design calculations by the Contract Administrator does not relieve the Contractor or the Contractor's professional engineer of full responsibility for the design of the shoring works.

E7.3.3 Installation and Removal

Pier 15 temporary shoring suggested procedure:

Construct the proposed concrete jacket up to the level of the construction joint as indicated on the Drawings. Install jack base plates at jacking points. Do not jack at any other location without the approval of the Contract Administrator. Install temporary shoring and jacking assemblies. **Do not jack the bridge superstructure until the concrete jacket has attained at least 75% of its specified 28-day strength.** Jack the bridge superstructure just enough to remove the load from the bridge bearings. Note that there will be traffic using the bridge during jacking and throughout construction. Remove the rocker bearings and shoe plates and store safely for re-installation. Demolish the top portion of the pier as required for installation of the top slab. Block out around the jack assemblies and construct the top slab and re-install the bearings. Lower the bridge superstructure to transfer the load back to the bridge bearings. **Do not lower the bridge superstructure until the top slab has attained at least 75% of its specified 28-day strength.** Remove temporary shoring, jack base plates and grout pads and fill in block-outs with concrete.

All welding shall conform to the requirements of CSA W59 and shall be done by a welder approved by the Canadian Welding Bureau for the particular category. Welder qualifications must be current and available for examination by the Contract Administrator.

For shop-fabricated components, the Contractor shall be fully approved by the Canadian Welding Bureau as per CSA W47.1.

Any rocker bearings or bearing shoe plates that are damaged during demolition of the top portion of the existing pier as a result of the Contractor's operations, as determined by the Contract Administrator, shall be replaced by the Contractor at his own expense.

The Contract Administrator will provide bearing setting information and instructions at the time of re-installation of the bearings.

All temporary shoring materials not remaining in place shall become the property of the Contractor when the Work is finished, and shall be removed from the site by the Contractor, free of extra charge, and the entire site left in a neat and clean condition.

E7.4 Measurement and Payment

E7.4.1 Method of Measurement

a) Temporary Shoring – Pier 8

Temporary shoring for the Pier 8 cantilevers shall be paid for on a Lump Sum basis, as accepted by the Contract Administrator, and no measurement will be made for this Work.

b) Temporary Shoring – Pier 15

Temporary shoring and jacking for the superstructure at Pier 15 shall be paid for on a Lump Sum basis, as accepted by the Contract Administrator, and no measurement will be made for this Work.

c) Temporary Shoring – Pier 18

Temporary shoring for the Pier 18 cantilevers shall be paid for on a Lump Sum basis, as accepted by the Contract Administrator, and no measurement will be made for this Work.

E7.4.2 Basis of Payment

a) Temporary Shoring – Pier 8

Temporary shoring for the Pier 8 cantilevers will be paid for at the Contract Lump Sum Price for "Temporary Shoring – Pier 8", measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described, and all other items incidental to the Work included in this Specification. This item will be deleted from the Contract if the Contract Administrator does not require installation of the shoring.

b) Temporary Shoring – Pier 15

Temporary shoring will be paid for at the Contract Lump Sum Price for "Temporary Shoring – Pier 15", measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described, including removal and re-installation of the existing bridge bearings, and all other items incidental to the Work included in this Specification.

c) Temporary Shoring – Pier 18

Temporary shoring will be paid for at the Contract Lump Sum Price for "Temporary Shoring – Pier 18", measured as specified herein, which price shall be payment in full for supplying all materials and performing all operations herein described, and all other items incidental to the Work included in this Specification. This item will be deleted from the Contract if the Contract Administrator does not require installation of the shoring.