

# **PART E**

# **SPECIFICATIONS**

## PART E - SPECIFICATIONS

### 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:

<u>Drawing No.</u>	<u>Sheet No.</u>	<u>Drawing Description</u>
B108-05-01	1	Cover Sheet
B108-05-02	2	General Arrangement and Location of Proposed Works
B108-05-03	3	Detour Works, Existing East Bridge Roadway Widening Plan Sections and Details
B108-05-04	4	Detour Works, Overall Plan
B108-05-05	5	Detour Works, Wellington Avenue at Academy Road Median Removal and Detour Lane Construction
B108-05-06	6	Detour Works, Cornish Avenue
B108-05-07	7	Detour Works, Wolseley Avenue
B108-05-08	8	Utility Conduits
B108-05-09	9	Existing Bridge Deck
B108-05-10	10	Rehabilitated Bridge Deck
B108-05-11	11	Removal and Placing Sequence of Concrete Bridge Deck
B108-05-12	12	Rehabilitated Bridge Deck Reinforcing
B108-05-13	13	Bridge Deck Sections and Details
B108-05-14	14	Expansion Joint 1 of 3
B108-05-15	15	Expansion Joint 2 of 3
B108-05-16	16	Expansion Joint 3 of 3
B108-05-17	17	Proposed Approaches
B108-05-18	18	South Approach Sections and Details
B108-05-19	19	North Approach Sections and Details
B108-05-20	20	Pedestrian Handrail Layout and Sidewalk Finishing Details
B108-05-21	21	Custom Pedestrian Handrail and Sidewalk Finishing Details
B108-05-22	22	Median Traffic Barrier Layout and Details
B108-05-23	23	Shoulder Traffic Barrier Layout and Details
B108-05-24	24	Balanced Shoulder Barrier Layout and Details - Miscellaneous Details
B108-05-25	25	Navigation Lights Plan, Section, and Detail
B108-05-26	26	Existing Precast Concrete Girder Corrosion Protection Works
B108-05-27	27	Aluminum Traffic Barrier Rail Standard Details
B108-05-28	28	Aluminum Pedestrian Handrail Details
B108-05-29	29	Aluminum Pedestrian Handrail Life Preserver Enclosure
B108-05-30	30	Balanced Shoulder Barrier Standard Details
B108-05-31	31	Miscellaneous Approach Works
B108-05-32	32	Reinforcing Steel Schedule
B102-05-01	33	St. James Bridge - Route 90 at Kenaston/Academy Road off Ramp Concrete Median Modification

## **E2. OFFICE FACILITIES**

- E2.1 The Contractor shall supply office facilities meeting the following requirements:
- (a) A field office shall be provided for the exclusive use of the Contract Administrator.
  - (b) The building shall be conveniently located near the site of the Work.
  - (c) The building shall have a minimum floor area of 15 square metres, a height of 2.4 m with two windows (complete with security bars) for cross ventilation and a door entrance with a suitable lock.
  - (d) The building shall be suitable for all weather use. It shall be equipped with a heater and air conditioner so that the room temperature can be maintained at 20 to 22°C at any outside ambient temperature.
  - (e) The building shall be adequately lighted with fluorescent fixtures and have a minimum of two wall outlets.
  - (f) The building shall be furnished with one desk, one drafting table, one meeting table, one stool, one legal size filing cabinet, and a minimum of 8 chairs.
  - (g) A telephone land line for a computer modem should be supplied.
  - (h) A portable toilet shall be located near the field office building. The toilet shall have a locking door and be for the exclusive use of the Contract Administrator and personnel from the City.
  - (i) The field office building and the portable toilet shall be cleaned on a weekly basis immediately prior to each site meeting. The Contract Administrator may request additional cleaning when he deems it necessary.
- E2.2 The Contractor shall be responsible for all installation and removal costs, all operating costs, and the general maintenance of the office facilities.
- E2.3 The field office facilities will be provided from the date of the commencement of the Work to the date of Total Performance unless otherwise approved by the Contract Administrator.

## **E3. NIGHT WORK AND NOISE LIMITATIONS**

- E3.1 Night work may have to be undertaken by the Contractor, as required by his Schedule of Work and by his actual work progress, to ensure timely completion of all Works of this Contract, all at his own cost.
- E3.2 Further to the General Conditions, the Contractor shall show that he has the approval of all applicable authorities in regard to said night work and to the anticipated/actual construction noise levels. In particular, such work shall conform with the Noise Control By-Law No. 2480/79. Also, the Contractor, at his own cost, incidental to these Works, shall supply sufficient lighting to enable all night work to be done in a safe and efficient manner, satisfactory to the Contract Administrator.
- E3.3 The Contractor is advised that possible noise level problems may limit his work activities on Sundays and at night. The Contractor must request and receive approval from the Contract Administrator at least 48 hours in advance of any Contract Work to be undertaken on Sundays or at night. It will be the Contractor's responsibility to schedule work activities to minimize potential problems and/or to employ noise-reduction measures to lower the noise to an acceptable level. Time extension will not be granted on the basis of the Contractor being ordered to limit his activities at night.

#### **E4. MOBILIZATION AND DEMOBILIZATION**

- E4.1 This Specification shall cover all operations relating to the mobilization and demobilization of the Contractor to the site, as specified herein.
- E4.2 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 Works as hereinafter specified.
- E4.3 Materials
- E4.3.1 General
- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification.
- E4.4 Construction Method
- E4.4.1 Section Includes
- (a) Layout of the Work and Office Facilities
- (i) The Work shall include as a minimum, all items associated with Supplementary Conditions D19, "Layout of the Work," and Specification E2, "Office Facilities."
- (b) Cellular Telephone Communication
- (i) The Contractor's site supervisor is required to carry, at all times, a cellular telephone, with voice mail.
- (c) Parking
- (i) The Contractor is advised that the construction workers are not to park their vehicles on adjacent streets while working at the site. The Contractor shall secure at least 25 parking stalls in the immediate area for use by his work force, City and Contract Administrator staff for the duration of the Contract. The Contractor's forces are not permitted to park on the neighbourhood side streets. Any workforce vehicles parked on the local neighbourhood streets shall be immediately removed by the Contractor.
- (d) Miscellaneous
- (i) This section shall also include travel and accommodation, minimum 1.8 m high chain-link secure fencing around the construction yard, set-up, and demobilization of site offices, storage conveniences, and other temporary facilities, construction plant, restoration of existing facilities following demobilization, and other items not required to form part of the permanent Works and not covered by other prices.
- E4.5 Measurement and Payment
- E4.5.1 Mobilization and demobilization will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "Mobilization and Demobilization" performed in accordance with this Specification and accepted by the Contract Administrator. Payment for this item will be in accordance with the following:
- (a) 50% following commencement of the Work on site.
- (b) 20% after the completion of 50% of the Work measured by dollar value.
- (c) 30% after Total Performance.

## **E5. TRAFFIC AND PEDESTRIAN CONTROL AND DETOUR DIVERSION WORKS**

### **E5.1 General**

E5.1.1 This Specification covers the supply, erection, and maintenance of all applicable traffic control devices in accordance with the provision contained in the latest edition of the "Manual of Temporary Traffic Control in Work Areas on City Streets," issued by the City of Winnipeg and as specified herein. It also includes construction of the Works necessary for the detour diversion works as specified herein and shown on the Drawings.

### **E5.2 Materials**

#### **E5.2.1 General**

- (a) The Contractor shall be responsible for the supply, safe storage, and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.
- (b) Unless specified otherwise herein, supply material in accordance with the City of Winnipeg Standard Construction Specifications for the applicable Works.

#### **E5.2.2 Granular Material**

- (a) Granular material shall conform to base course material of the City of Winnipeg Standard Construction Specification CW 3110-R7.

### **E5.3 Construction Methods**

#### **E5.3.1 Signage**

- (a) The Contractor will be required only to erect and maintain road and sidewalk closure barricades at the north and south limits of the worksite and to perform the construction of surface works related to the traffic control diversions. The City will undertake all other temporary traffic control signage works that will include traffic signal modifications, advance signings, signings for the detour across the east structure and maintenance of those temporary traffic control works.

#### **E5.3.2 Detour Construction Works**

- (a) The Contractor will be responsible for the diversion works shown on the Drawings and in accordance but not necessarily limited to the following list:
  - (i) Construct traffic islands at the Maryland-Wolseley, Sherbrook-Wolseley, and Academy-Wellington intersections.
  - (ii) Construct the median crossover at the Academy-Wellington intersection. This includes removal and storage of the G.R.E.A.T. Unit mounted at the south end of the median barrier, removal of a part of the median, modification of a curb inlet, and the construction of an island.
  - (iii) Construct the detour works in front of the Miscericordia Health Centre. This will include the removal of parts of the boulevards and islands, the enlargement of an island, and the permanent relocation of a watermain hydrant and its valve.
  - (iv) Widen the roadway width to 12.2 m (40 feet) over the east structure by removing part of the sidewalk and the approaches to the structure by removing the curb.
  - (v) Restore the above works, except for the east structure widening and the water hydrant, to their original condition and location. The east structure widening will be left as-is for restoration in a future contract. Coordinate these restoration works with the surface works itemized in the Schedule of Prices.
- (b) The following works are to be constructed in accordance with The City of Winnipeg Standard Construction Specifications indicated and as shown on the Drawings.

- (i) Watermain hydrant:
  - CW 2110-R7: Watermains.
- (ii) Granular base:
  - CW 3110-R7: Sub-grade, sub-base, and base course construction.
- (iii) Concrete curbs and miscellaneous slabs:
  - CW 3235-R5; Renewal of Miscellaneous Concrete Slabs.
  - CW 3240-R5: Renewal of Existing Curbs.
- (iv) Asphalt:
  - CW 3410-R6: Asphaltic Concrete Pavement Works.

E5.3.3 Pedestrian Sidewalk

- (a) The Contractor is to close the sidewalk at the bridge approaches to pedestrians. However, pedestrians shall be afforded full and safe access to the west ramp and sidewalk under the north end of the bridge.

E5.3.4 Schedule

- (a) The detour diversion works shall be constructed before the west bridge is closed for the rehabilitation works. The modification to islands and boulevards and the construction of the new islands shall be built on a weekend with the traffic diversion going into effect on the immediately following Monday morning by 07:00 hours. Consult with the City of Winnipeg Traffic Services Department through the Contract Administrator for the details of the signing for and the detailed schedule of Work of the construction of the detour diversion works.

E5.3.5 Work by Others

- (a) The Contractor shall coordinate with his schedule the following Work by others related to this section:
  - (i) Removal of the traffic signals and bases required for the diversion.
  - (ii) Supply and installation of a steel plate to cover the traffic signals pit in the current median that will be removed at the Wellington intersection.
  - (iii) All traffic signing and maintenance of signing except for the immediate closing signs and fencings for the bridge.
  - (iv) Public advertising of the traffic diversion.

E5.3.6 Maintenance

- (a) The Contractor shall maintain all the detour works constructed by him for the duration of the construction works to the satisfaction of the Contract Administrator.

E5.4 Measurement and Payment

- E5.4.1 Traffic and pedestrian control and detour diversion works will not be measured. This Item of Work will be paid for at the Contract Lump Sum Price for "Traffic and Pedestrian Control and Detour Diversion Works" performed in accordance with this Specification and accepted by the Contract Administrator.

## **E6. EXCAVATION**

### **E6.1 Description**

E6.1.1 This Specification shall cover all operations related to removal of existing fill and the concrete encasement of the conduits between each of Manitoba Hydro's manholes MH 511 and MH 512 and the bridge approach sidewalks. It shall also include whatever excavation is necessary to install the new concrete encased ducts to those same manholes, as herein specified.

E6.1.2 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 Works as hereinafter specified.

### **E6.2 Materials**

#### **E6.2.1 General**

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

#### **E6.2.2 Excavation**

- (a) Excavated material shall be unclassified excavation and shall include the excavation and satisfactory disposal of all surplus earth, gravel, sandstone, loose detached rock, shale, cemented gravel or hard pan, disintegrated stone, rock in ledge or mass formation, concrete, and dry or all other material of whatever character that may be encountered.

### **E6.3 Equipment**

#### **E6.3.1 General**

- (a) All equipment, tools, and facilities shall be of a type approved by the Contract Administrator and shall be kept in good working order.

### **E6.4 Construction Methods**

#### **E6.4.1 General**

- (a) The Work shall comprise of:
  - (i) The excavation of fill and the removal of concrete encasement of the conduits between each of Manitoba Hydro's manholes MH 511 and MH 512 and the bridge approach sidewalks.
  - (ii) The excavation of whatever material is required to install the new concrete encased ducts to the two manholes listed above.

#### **E6.4.2 Manitoba Hydro Standby Requirement**

- (a) The Contractor shall notify Manitoba Hydro whenever he is working below grade and within 1 m of the Manitoba Hydro manholes in case Manitoba Hydro wishes to have one of their personnel on-site to observe the Contractor's works.

#### **E6.4.3 Excess Material**

- (a) Excavated material that is unsuitable for, or surplus to, the backfill requirements shall become the property of the Contractor and shall be removed from the site. Excavated material shall not be disposed of in a manner that will obstruct the flow of watercourses. During freezing weather, the excess material shall be disposed of before it freezes.

E6.5 Measurement and Payment

- E6.5.1 Excavation will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "Excavation" performed in accordance with this Specification and accepted by the Contract Administrator.

**E7. STRUCTURAL CONCRETE AND OTHER REMOVALS**

E7.1 Description

- E7.1.1 This Specification shall cover all operations related to removal and disposal of miscellaneous existing bridge components as listed below.
- E7.1.2 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 Works as hereinafter specified.

E7.2 Materials

E7.2.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E7.3 Equipment

E7.3.1 Hydrodemolition Equipment

- (a) The hydrodemolition equipment shall be a self-propelled machine that utilizes a high pressure water jet stream capable of removing concrete to the depths shown on the plans or as directed by the Contract Administrator and be capable of removing rust and concrete particles from reinforcing steel. Pneumatic hammers (15 kg, 35 pound) class maximum, may be used in areas that are inaccessible or inconvenient to the self-propelled machine such as, but not limited to, areas not to exceed 300 mm away from curb or parapets or bridge edges subject to approval of the Contract Administrator.

E7.4 Construction Methods

E7.4.1 General

- (a) This section of Work comprises the removal and disposal of:
- (i) Precast concrete guardrail.
  - (ii) Reinforced concrete bridge sidewalk.
  - (iii) Concrete approach slab sidewalks.
  - (iv) Asphalt surfacing on the bridge deck.
  - (v) Reinforced concrete east side (median) barrier.
  - (vi) Any abandoned electrical cables not removed by others.
  - (vii) Concrete encased electrical conduits/ducts.
  - (viii) Reinforced concrete bridge deck.
  - (ix) Expansion joints.
- (b) Remove concrete and other removal items with appropriate equipment satisfactory to the Contract Administrator. No demolition products are to find their way into the watercourse. Provide sawcuts as shown on the Drawings and where otherwise



necessary to limit the extent of demolition. Repair any over demolition and reinforcing damage to the satisfaction of the Contract Administrator.

- E7.4.2 Dispose of all surplus and unsuitable material off-site.
- E7.4.3 The removal and salvaging of aluminum balanced barrier railing and posts is covered in CW 3650-R4.
- E7.4.4 The removal and salvaging of aluminum traffic bridge posts and rail is covered in the Specification for the supply and installation of aluminum traffic bridge posts and rail.
- E7.4.5 Remove and dispose of the existing bridge deck expansion joints and seals.
- E7.4.6 Removal of the deck asphalt and top deck concrete up to the top of the top layer of reinforcing steel may be done by rotomilling. The top layer of reinforcing steel is being discarded so that its damage is not a concern. Ensure that the rotomill does not touch and thereby damage any reinforcing steel that is to remain. If any reinforcing is so damaged, replace the reinforcing to the satisfaction of the Contract Administrator at no cost to The City.
- E7.4.7 Remove the deck concrete below the rotomilled depth by hydrodemolition.
- E7.4.8 Prior to the commencement of the removal operation by hydrodemolition, the hydrodemolition equipment shall be calibrated on an area of sound concrete approximately 600 x 1500 as directed by the Contract Administrator. The cost of the calibration procedure shall be included in the unit price bid for hydrodemolition. The Contract Administrator shall verify the following settings:
- (a) Water pressure.
  - (b) Machine staging control (step).
  - (c) Nozzle size.
  - (d) Nozzle speed (travel).
- E7.4.9 During the calibration, any or all of the above settings may be adjusted in order to achieve removal in accordance with the requirements of the plans. When the designated depth of removal is attained, the settings shall be recorded and maintained throughout the removal operation unless otherwise directed by the Contract Administrator. The depth of removal shall be verified periodically and, if necessary, the equipment recalibrated to ensure the plans depth of removal.
- E7.4.10 The Contractor shall take all necessary precautions to ensure that no sound concrete located below the required depth of removal is damaged or removed. Any damage caused to sound concrete or reinforcing steel beyond the required limit of removal or excessive removal of concrete beyond the required depth of removal by the Contractor during any demolition procedure, will be repaired by the Contractor at the Contractor's expense to the satisfaction of the Contract Administrator.
- E7.4.11 Where applicable, any "shadowing" of the reinforcing steel by concrete not removed by the process of hydrodemolition, shall be removed by the Contractor through other approved means.
- E7.4.12 After the hydrodemolition is completed, the deck will be inspected (by sounding) by the Contract Administrator to ensure that all partial depth deteriorated concrete has been removed. Should deteriorated concrete be found, the Contractor shall remove the areas of deteriorated concrete by additional passes of the hydrodemolition equipment or jackhammers. No additional payment will be made for removal of these areas.
- E7.4.13 The Contractor shall prepare and submit a plan detailing the Contractor's hydrodemolition runoff control and disposal methods and procedures to the Contract Administrator at least seven (7) days prior to the scheduled commencement of hydrodemolition. Wastewater

from the hydrodemolition process shall be controlled and filtered to produce a visibly clear water prior to entering the City's land drainage sewer system. Bridge deck drains shall be plugged during the hydrodemolition process.

- E7.4.14 Upon completion of the demolition of the high density concrete overlay, the Contractor shall remove all cuttings, slurry containing the products of hydrodemolition and all other debris from the resulting concrete surface so as to produce a thoroughly clean surface. Cleaning shall be done before debris and water are allowed to dry on the deck surface. All exposed reinforcing steel which is left unsupported by the hydrodemolition process shall be adequately supported and protected from bending by vacuum trucks or any other equipment. All reinforcing steel damaged or dislodged by these operations, as deemed by the Contract Administrator, shall be replaced with new reinforcing of the same size at the expense of the Contractor.
- E7.4.15 None of the existing conduits or their electrical conductors are being salvaged between MH 511 and 512. Manitoba Hydro will remove their conductor prior to construction. The Contractor will be responsible for the removal of whatever other conductors within those limits are encountered.
- E7.4.16 Existing Lamp Standards will be removed by others.
- E7.5 Measurement and Payment
- E7.5.1 Structural concrete and other removals will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "Structural Concrete and Other Removals" performed in accordance with this Specification and accepted by the Contract Administrator. This payment item will not include the hydrodemolition work.
- E7.5.2 Hydrodemolition will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "Hydrodemolition," performed in accordance with this Specification and accepted by the Contract Administrator.

## **E8. ELECTRICAL CONDUIT AND REINFORCED CONCRETE ENCASEMENT**

- E8.1 Description
- E8.1.1 This Specification shall cover the supply and installation of conduit support systems, pull boxes, junction boxes, conduit expansion units, reinforced concrete encasements, all required appurtenances and incidental components. It shall also include the supply of some conduit and the installation of all conduit.
- E8.1.2 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 Works as hereinafter specified.
- E8.2 Materials
- E8.2.1 General
- (a) The Contractor shall be responsible for the supply (as specified), safe storage and handling of all materials as set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.
- E8.2.2 Conduit Materials Supplied by Manitoba Hydro
- (a) Manitoba Hydro will supply the 10 -125 mm diameter conduits identified on the Drawings as Manitoba Hydro ducts. The conduit will be 125 mm IPEX Rigid Super Duct Type DB-2 or equal. The supply of the pipe will include the associated bends and couplings. The pipe will be supplied in standard 3 or 6 m lengths.

- E8.2.3 Conduit Materials Supplied by the Contractor
- (a) The Contractor shall supply all components necessary for a proper installation except for those items identified above as supplied by Manitoba Hydro.
- E8.2.4 The Contractor shall supply the 1- 125 mm diameter conduit identified as the Traffic Signals duct and the 50 mm conduit for both the street lighting and navigation lights. All conduits, pull boxes, and junction boxes for the lighting embedded work shall be Rigid PVC conforming to the requirements of CSA C22.2 No 136. All covers for boxes shall be stainless steel with stainless steel screws. Flexible couplings shall be such as Crouse hinds Type EC or equal as accepted by the Contract Administrator.
- E8.2.5 The Contractor shall also supply the conduit support/anchoring systems and conduit expansion/contraction joints.
- E8.2.6 Concrete for Conduit Encasement
- (a) Concrete for below grade duct encasement shall have a minimum compressive strength at 28 days of 20 MPa using Type 50 cement. It shall have entrained air to a content of 5-8% with a 20 mm nominal size coarse aggregate.
- E8.2.7 Reinforcing Steel
- (a) Reinforcing steel shall meet the requirements of the "Supplying and Placing Reinforcing Steel" section of this Specification.
- E8.2.8 Fish Wire
- (a) Fish wire will be required only for the traffic signals conduit and, at the discretion of the Contractor, for the navigation light conduit for which he will install the conductor. The traffic signals fish wire shall be a minimum of 6 mm diameter nylon rope to the satisfaction of the City of Winnipeg Traffic Signals Department.
- E8.2.9 Conduit Support System
- (a) The conduit support system shall be suitable for use in concrete and compatible with the conduit. It shall adequately support the conduit in its prescribed locations and prevent displacement of the conduit during concrete encasement on and off the structure. The conduit support system shall be engineered and stamped drawing of support system shall be submitted to the Contract Administrator for acceptance. It shall be accepted by the Contract Administrator prior to use. The Contractor may employ the newly installed rebar anchors into the existing concrete deck to keep the ducts from floating as concrete is placed.
- E8.2.10 Miscellaneous Materials
- (a) Miscellaneous materials shall be of a type as indicated on the Drawings and required for a complete and proper installation and as accepted by the Contract Administrator.
- E8.3 Equipment
- E8.3.1 General
- (a) All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.
- E8.4 Construction Methods
- E8.4.1 Manitoba Hydro Standby Requirement
- (a) The Contractor shall notify Manitoba Hydro whenever he is working below grade and within 1 m of the Manitoba Hydro manholes in the event that Manitoba Hydro wishes to have one of their personnel on-site to observe the Contractor's works.

E8.4.2 Placing of Conduit

- (a) The conduit support system shall be firmly anchored in place to prevent movement during placing of the concrete. Extreme care shall be exercised when placing concrete to prevent damage to any conduit support system.
- (b) All conduit connections shall be made in accordance with the manufacturer's instructions.
- (c) The conduit shall be installed with gradual changes in a direction so that fish wire and/or wiring can easily be threaded through.
- (d) Supply or fabricate and install expansion/contraction joints across the expansion/contraction joints of the bridge acceptable to the Contract Administrator.

E8.4.3 Manitoba Hydro Manhole Modifications

- (a) The two manholes of Manitoba Hydro will require modifications in order to accept the new conduits being placed into them. The Contractor will be required to remove the existing bridge crossing conduit from the manholes, and install the new conduit into the manholes in the locations shown on the Drawings. The walls of the existing manholes should be grouted in where necessary to close existing holes and opened up where necessary to install the new conduit. All Work should be done without damaging any of the existing Manitoba Hydro infrastructure.

E8.4.4 Concrete Encased Ducting off the Bridge

- (a) The Contractor shall install the ducts in a reinforced concrete encasement between the bridge sidewalk and the manholes in accordance with the Drawings.

E8.4.5 Obstructions

- (a) Upon completion of the conduit system, the Contractor shall ascertain that no obstructions are blocking any conduit. If any obstruction is encountered, it shall be removed by the Contractor at his own expense.

E8.5 Quality Control

E8.5.1 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 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.

E8.5.2 The Contract Administrator reserves the right to reject materials or works which are not in accordance with the requirements of this Specification.

E8.6 Measurement and Payment

E8.6.1 The partial supply of electrical conduits and their appurtenances and their installation, including concrete encasement below grade, will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "Electrical Conduit and Reinforced Concrete Encasement" performed in accordance with this Specification and accepted by the Contract Administrator.

E8.6.2 The supply and placement of reinforcing steel will be paid for in the Specification section "Supplying and Placing Reinforcing Steel."

## **E9. SUPPLYING AND PLACING REINFORCING STEEL**

### **E9.1 Description**

E9.1.1 This Specification covers the supply, fabrication, and placement of reinforcing steel.

E9.1.2 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 Works as hereinafter specified.

### **E9.2 Materials**

#### **E9.2.1 General**

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

#### **E9.2.2 Handling and Storage of Materials**

(a) 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 the latest edition of CSA Standard CAN3-A23.1, Storage of Materials, except as otherwise specified herein.

#### **E9.2.3 Reinforcing Steel**

- (a) Reinforcing steel shall be deemed to include all reinforcing bars, tie-bars, and dowels.
- (b) All reinforcing steel shall be MMFX Microcomposite (MMFX 2) Steel Rebar Performance Standard Corrosion Resistant, Uncoated Steel Reinforcement for Concrete Construction. MMFX 2 reinforcing steel tensile, elongation, and bending properties shall meet or exceed the minimum requirements of ASTM A615M Grade 75 and AASHTO M31 Grade 75 (520 MPa) "Standard Specification for Deformed and Plain 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 manufacture or fabrication, such material shall be immediately removed from the site and replaced with acceptable reinforcing steel.
- (c) 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 for 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 the latest edition of ASTM A615.

#### **E9.2.4 Bar Accessories**

- (a) Bar accessories shall be of a type approved by the Contract Administrator and shall be non-rusting. They shall be made from Type 316 stainless steel or hot-dip galvanized steel, or, in the case of chairs, from High Performance Concrete (HPC). An approved HPC rebar support is supplied by Con Sys Inc. of Pinawa, Manitoba, phone: 753-2404, fax: 753-8329 or approved equal. They shall not stain, blemish, or spall the concreted surface for the life of the concrete.
- (b) Bar accessories shall include bar chairs, spacers, clips, wire ties, wire (18 gauge minimum), or other similar devices that may be approved by the Contract Administrator. The supplying and installation of bar accessories shall be deemed to be incidental to the supplying and placing of reinforcing steel.

#### E9.2.5 Bonding Agent

- (a) Epoxy resin shall be of a type listed in the approved products list, Specification CW 3710 conforming to the requirements of ASTM Standard C881. Type 1, Grade 3 epoxy shall be used for bonding reinforcing steel into hardened concrete.
- (b) Bonding agents for bonding reinforcing steel into holes in hardened concrete other than epoxy resin may be permitted provided that they develop a minimum pullout resistance of 50 kN within 48 hours after installation. Alternative bonding agents are listed in the approved products list.

#### E9.3 Construction Methods

##### E9.3.1 Fabrication of Reinforcing Steel

- (a) Fabricate reinforcing steel in accordance with CSA Standard G30.18 to the lengths and shapes as shown on the Drawings.

##### E9.3.2 Placing of Reinforcing Steel

- (a) Place reinforcing steel accurately in the positions shown on the Drawings and retain 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.
- (b) Reinforcing steel shall be free of all foreign material in order to ensure a positive bond between the concrete and steel. Remove any dry concrete, which may have been deposited on the steel from previous concrete placement, before additional concrete may be placed. Intersecting bars shall be tied positively at each intersection.
- (c) Make splices in reinforcing steel only where indicated on the Drawings. Obtain prior approval of the Contract Administrator where other splices must be made. Welded splices shall conform to CSA Standard W186, and are subject to prior written approval of the Contract Administrator.
- (d) 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 the prior approval of the Contract Administrator. Give a minimum of twenty-four (24) hours' advance notice to the Contract Administrator prior to the placing of any concrete to allow for inspection of the reinforcement.

##### E9.3.3 Installing Reinforcing Steel into Hardened Concrete

- (a) The Contractor shall drill holes into adjacent concrete of the diameters and depths shown on the Drawings. Drill bits shall have a diameter no larger than 2 mm larger than the nominal dowel or tie bar diameter.
- (b) Holes shall be located to the correct depth and alignment as indicated on the Drawings.
- (c) Drilling equipment shall be operated so as to ensure that no damage to the concrete results from such drilling operation. Coring of holes is not permitted. In the event that existing reinforcing steel bars are hit during the drilling operations, that hole shall be abandoned and a new hole shall be drilled nearby to the correct depth. All abandoned holes shall be filled with non-shrink grout.
- (d) Holes for reinforcing steel shall be blown clean with compressed air. Bonding agent shall be placed in the back of the drilled hole. The reinforcing steel shall be worked back into the holes for complete coverage around the portion of the bar that extends into the hole, such that bonding agent is squeezed from the hole.
- (e) Once all reinforcing steel is in position, it shall be inspected and approved by the Contract Administrator before any new concrete is placed. Otherwise, the concrete

may be rejected by the Contract Administrator and shall be removed by the Contractor at his own expense.

**E9.4 Quality Control**

**E9.4.1 Inspection**

- (a) 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 approval that may have been previously given. The Contract Administrator reserves the right to reject any materials or works that are not in accordance with the requirements of this Specification.

**E9.4.2 Access**

- (a) Afford the Contract Administrator 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.

**E9.4.3 Quality Testing**

- (a) Quality control testing will be used to determine the acceptability of the reinforcing steel supplied by the Contractor.
- (b) 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.

**E9.5 Measurement and Payment**

**E9.5.1 Supplying and Placing Reinforcing Steel**

- (a) The supply and placement 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, acceptable to the Contract Administrator, as computed from the approved reinforcing layout shown on the Drawings, excluding the mass of bar accessories.

**E9.5.2 Install Reinforcing Steel into Existing Concrete**

- (a) The installation of reinforcing steel into existing concrete will be measured on a unit basis and paid for at the Contract Unit Price for "Install Reinforcing Steel into Existing Concrete" performed in accordance with this Specification and accepted by the Contract Administrator. This payment will be made in addition to the mass of steel measured above.

**E10. EXPANSION JOINTS**

**E10.1 Description**

**E10.1.1** This Specification shall cover the supply and installation of expansion joints, as specified herein.

**E10.1.2** 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 other things necessary for and incidental to the satisfactory performance and completion of all Work hereinafter specified.

## E10.2 Materials

### E10.2.1 General

- (a) The Contractor shall be responsible for the supply, safe storage, and handling of all materials set forth in this Specification.
- (b) All materials supplied under this Specification shall be of a type acceptable to by the Contract Administrator, and shall be subject to inspection and testing by the Contract Administrator.

### E10.2.2 Epoxy Adhesive

- (a) Epoxy adhesive shall be ST 431, Dural Duralbond, Copper Capbound E, Sikadur 32 Hi-bond, Concesive 1001 LPL, or equal as accepted by the Contract Administrator.

### E10.2.3 Epoxy Grout

- (a) Epoxy grout shall be Duralcrete as distributed by Specialty Construction Products, Dural 103 Gel, or equal as accepted by the Contract Administrator.

### E10.2.4 Grout

- (a) Grout shall be nonmetallic and nonshrink grout. Acceptable grouts are: Master Builders Set Nonshrink Grout, Sika Grout 212, Sternson M-Bed Standard Grout, CPD Nonshrink Grout, or equal as accepted by the Contract Administrator.

### E10.2.5 Expansion Joints

- (a) Expansion joints shall be modular expansion joints.
- (b) The modular expansion joints shall be an equivalent to Wabo Modular Joint System "D" series "box" seals, as specified in the Drawings, and supplied by D.S. Brown, Goodco, or Watson Bowman Acme Corp., or equal as accepted by the Contract Administrator.
- (c) Modular expansion joints shall have fabricated cover plates and slider plates as shown on the Drawings.
- (d) The seals at each joint shall be made out of neoprene, as accepted by the Contract Administrator and shall be supplied in one continuous piece, separate from the steel extrusions or joint. No shop or field splicing will be allowed in the seals.
- (e) All fasteners and hardware of the modular bridge deck expansion joints shall be Grade 316, stainless steel.

### E10.2.6 Steel

- (a) Steel supplied for the fabrication of the bridge deck expansion joints shall conform to CSA Standard CAN/CSA-G40.21-M92, Grade 300W, or equal as accepted by the Contract Administrator. They shall be galvanized after shop fabrication in accordance with CSA Standard CAN/CSA-G164-M92 to a minimum net retention of 600 gm/m<sup>2</sup>.

### E10.2.7 Steel Extrusions

- (a) Steel for the extrusions shall conform to CSA Standard CAN/CSA-G40.21-M92, Grade 230G minimum.

### E10.2.8 Anchor Studs

- (a) Anchor studs shall conform to the requirements of ASTM Specification A108-99, Grade Designation 1020 and shall be galvanized.

### E10.2.9 Miscellaneous Steel Items

- (a) Rods, cover plates, brackets and washer plates, slider plates, and all other associated steel items shown on the Drawings shall be fabricated from steel conforming to CSA



Standard CAN/CSA-G40.21-M92, Grade 300W and shall be galvanized in accordance with CSA Standard CAN/CSA-G164-M92 to a minimum net retention of 600 gm/m<sup>2</sup>.

E10.2.10 Galvalloy

- (a) Galvalloy shall be as supplied by Metalloy Products Company, P.O. Box #3093, Terminal Annex, Los Angeles, California. Locally, this is available from Welders Supplies Ltd., 25 McPhillips Street.

E10.2.11 Welding

- (a) Welding shall be of a low oxygen classification. Manual electrodes shall be E7016 or E7018. All welding shall be in accordance with CSA Standard W59-MI989.

E10.2.12 Preformed Neoprene Joint Seals

- (a) Preformed joint seal shall be manufactured from a vulcanized elastomeric compound using crystallization resistant polychloroprene (neoprene) as the only polymer.
- (b) The preformed neoprene joint seal shall meet the requirements of Ontario Provincial Standard Specification (OPSS) 1210 "Material Specification for Preformed Neoprene Joint Seals," latest edition, and as amended herein; and of Table E10.1 of this Specification. All tests will be made on specimens prepared from the extruded seals.

E10.3 Equipment

- E10.3.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be kept in good working order.

E10.4 Fabrication

- E10.4.1 Shop drawings consisting of five (5) prints and one (1) reproducible sepia showing the fabrication details and proposed field splice details of the steel components of the bridge deck expansion joints shall be provided to the Contract Administrator for acceptance at least twenty-one (21) days prior to scheduled commencement of fabrication. No fabrication shall commence until acceptance of the shop drawings from the Contract Administrator has been obtained. The complete expansion joint shop fabrication and installation shall be done by or under the direct supervision of a trained factory representative, who shall be responsible for the joint installation procedure.

- E10.4.2 Care shall be taken to ensure that all members are straight and flat and free from twists, bends, and distortions due to welding. The units shall be shop assembled and checked for matching of sliding surfaces, correct cross-fall and skew, as well as accurate positioning and alignment of supporting brackets. The Contractor shall exercise care in the handling of all units to prevent twists, bends, and warping.

- E10.4.3 Matching expansion joints shall be assembled and bolted together for shipping.

- E10.4.4 Expansion joint assemblies shall be shop checked for fit and match marked.

- E10.4.5 All metal surfaces to be galvanized shall be cleaned thoroughly of rust, rust scale, mill scale, dirt, paint, and other foreign material by commercial sand, grit or shop blasting, and pickling prior to galvanizing. Heavy deposits or oil and grease shall be removed with solvents prior to blasting and pickling.

- E10.4.6 In no case shall weldments be substituted for extrusion shapes.

E10.5 Construction Methods

E10.5.1 Installation

- (a) The Contractor shall install expansion joints as shown on the Drawings and shall be responsible for the correct matching and seating of parts. The expansion joints shall

be checked for accurate matching of sliding plates with the bridge deck expansion joints installed at the specified skews and crossfalls. One field splice in the length of the expansion joint is permitted.

E10.5.2 Galvanizing Touch-up Prior to Placement of Concrete

- (a) Any areas of damaged galvanizing and field welds are to receive field applied galvanizing.
- (b) Surfaces to receive field-applied galvanizing shall be cleaned using a wire brush, a light grinding action, or mild blasting to remove loose scale, rust, paint, grease, dirt, or other contaminants. Preheat the surface to 315°C and wire brush the surface during preheating. Rub the cleaned preheated area with the repair stick to deposit an evenly distributed layer of zinc alloy. Spread the alloy with a wire brush, spatula, or similar tool. Field-applied galvanizing shall be blended into existing galvanizing of surrounding surfaces and shall be buffed and polished if required to match the surrounding surfaces. Care shall be taken to not overheat surfaces beyond 400°C and to not apply direct flame to the alloy rods.
- (c) The process is to be repeated as required to achieve a thickness comparable to original galvanizing.

E10.5.3 Placement of Concrete at Expansion Joints

- (a) The assemblies shall be set in position such that they will remain true to line and elevation during and after concreting.
- (b) Care shall be taken during compaction of the concrete to ensure that there are no voids in the concrete under and around the structural steel components.
- (c) Before concreting, the expansion joint opening shall be set to give the correct width for the mean concrete temperature of the deck. The width shall be obtained from the installation temperature table given on the accepted shop drawings.
- (d) Immediately prior to placement of concrete at the expansion joints, all metal contact surfaces between the expansion joint and concrete shall be coated with epoxy adhesive.
- (e) Epoxy grout shall be used to fill any bolt holes left after the removal of manufacturer's clamping channels.

E10.5.4 Installation of Seal

- (a) The seal at each expansion joint unit shall be installed as one continuous piece after completion of all concreting operations, to the satisfaction of the Contract Administrator, and shall not be installed prior to casting of the expansion joints into the concrete.

E10.5.5 Watertight Verification of Joint Seal

- (a) Prior to installing the expansion joint and walkway cover plates, the Contractor shall dyke off the bridge deck expansion joints and maintain a minimum of 75 mm of water over all areas of the seal for a period of not less than four (4) hours, with no leakage. Any and all leaks shall be corrected, using mechanical or other adjustment of the bridge deck expansion joints to the satisfaction of the Contract Administrator. In no case shall caulk or other temporary devices or materials be used to seal leaks in the expansion joints. The Contract Administrator's decision in this regard shall be final.
- (b) Prior to commencing the test, the Contractor shall remove all expansion joints forming materials and debris from the deck and from the substructure units below. The Contractor shall provide safe access, acceptable to the Contract Administrator, to the pier tops for inspection of the expansion joints during the testing.

## E10.6 Fabrication Warranty

E10.6.1 Before final acceptance of the expansion joints by the Contract Administrator, the bridge deck expansion joints supplier shall provide the City with a written warranty stating that they will perform satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the date of issuance of the Certificate of Acceptance, provided that the expansion joints have been properly installed. The supplier shall state that they have reviewed the installation procedures and find them in accordance with their recommendations. The supplier shall warranty the replacement of the expansion joints, including removal of the defective expansion joints assembly and supply and installation of the replacement expansion joint, at no cost to the City, in the event that the joint does not perform satisfactorily within the design range of movement and under the design loads for a period of five (5) years from the date of issuance of the Certificate of Acceptance.

## E10.7 Installation Warranty

E10.7.1 The Contractor shall ensure that the expansion joints are installed in such a manner that will not void the fabrication warranty.

E10.7.2 Similar to the expansion joint supplier, and before final acceptance by the Contract Administrator, the Contractor shall warranty, in writing, the performance of the expansion joints for a period of five (5) years from the date of issuance of the Certificate of Acceptance. Provide in the warranty for the replacement of the expansion joints at no cost to the City, including all direct and indirect costs in the event that the expansion joints do not perform satisfactorily in the range of design movement and under the design loads for a period of five (5) years from the date of issuance of the Certificate of Acceptance.

## E10.8 Quality Control

### E10.8.1 General

(a) All workmanship and all materials furnished and supplied under this Specification are subject to the 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 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.

### E10.8.2 Joint Seal Markings

(a) All joint seals shall be identified as to the manufacturer by means of a continuous permanent mould mark. The mould marks shall be registered with the Contract Administrator and shall be used on all seals produced by the respective manufacturer. The seal shall also be permanently marked, on the side of the seal, with the date of production and the batch/lot, at intervals of not more than 1.2 m.

(b) The Contractor shall supply to the Contract Administrator a summary of the seals identifying the date of manufacture, the batch/lot, and the proposed installation location.

### E10.8.3 Joint Seal Samples and Testing Procedures

(a) The Contractor shall supply seal sample material at no charge to The City for quality control testing purposes. The samples will each be 1½ m long. Each sample will represent not more than three expansion joint seals of the same size, lot, and make and shall be continuous with same until sampled by the Contract Administrator. As soon as the seals to be used in the joint assemblies have been manufactured, they shall be available to the Contract Administrator for sampling.

- (b) Testing procedures will be in accordance with the latest revisions of the methods indicated on Table E10.1, Physical Requirements.
- (c) All materials failing to meet the Specification requirements will be rejected.
- (d) Lots rejected may be culled by the supplier and, upon satisfactory evidence of compliance with the Specifications, will be accepted.

**Table E10.1: Physical Requirements**

Property	Physical Requirements	Test Procedure*
1. Tensile Strength	Minimum 13.5 MPa	ASTM D412 OPSS 1210.07.03.01.02
2. Elongation at Break	Minimum 250%	ASTM D412 OPSS 1210.07.03.01.02
3. Hardness, Type A Durometer	55: +7 Points -5 Points	ASTM D2240 OPSS 120.07.03.01.03
4. Oven aging Test 70 Hours at 100°C Reduction in Tensile Strength Reduction in Elongation Increase in Hardness	Maximum 20% Maximum 20% Maximum 10 Points	ASTM D573
5. Permanent Set at Break	Maximum 10%	ASTM D412
6. Low Temperature Stiffening Hardness, Type A Durometer	Maximum 15 Points	ASTM D2240 OPSS 1210.07.03.01.03
7. Oil Swell, ASTM Oil No. 3 70 H at 40°C (wipe with toluene to remove surface contamination)	No Cracks	ASTM D1149
8. **Safe Compressibility Test (Z min.) Bridge Seal - ≤ 63.5 mm > 63.5 mm	Minimum 50% Minimum 55%	OPSS 1210.07.03.01.04
9. **Pressure Generation at 15% Deflection	Minimum 20 kPa	OPSS 1210.07.03.01.04
10. **Recovery 22 h at -28°C 70 h at -10°C 70 h at +100°C	Minimum 80% No Cracking Minimum 88% Splitting or Minimum 85% Sticking	OPSS 1210.07.03.01.05

\* ASTM - American Society for Testing and Materials  
 OPSS - Ontario Provincial Standard Specification  
 \*\* This physical requirement not applicable to lock-in type joint seals

**E10.9 Measurement and Payment**

**E10.9.1** The supply and installation of expansion joints will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for “Supply and Installation of Expansion Joints” performed in accordance with this Specification and accepted by the Contract Administrator.

## **E11. STRUCTURAL CONCRETE**

### **E11.1 Description**

E11.1.1 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.

E11.1.2 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 Works as hereinafter specified.

### **E11.2 Materials**

#### **E11.2.1 General**

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

#### **E11.2.2 Handling and Storage of Materials**

(a) All materials shall be handled and stored in a careful and workmanshiplike manner, to the satisfaction of the Contract Administrator. Storage of materials shall be in accordance with CSA Standard CAN/CSA-A23.1-00.

#### **E11.2.3 Testing**

- (a) All materials supplied under this Specification 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.
- (b) All materials shall conform to CSA Standard CAN/CSA-A23.1-00.
- (c) All testing of materials shall conform to CSA Standard CAN/CSA-A23.2-00.
- (d) All materials shall be accepted 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 specifications detailed herein or are found to be defective in manufacture or 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.

#### **E11.2.4 Aggregates**

- (a) The Contractor shall furnish in writing to the Contract Administrator the location of the sources where aggregate will be obtained in order that same may be inspected and tentatively accepted 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.
  - (i) 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, loam, or other deleterious substances.
    - The fine aggregate shall be well-graded throughout and shall conform to the grading requirements in Table E11.1.

<b>TABLE E11.1 GRADING REQUIREMENTS FOR FINE AGGREGATE</b>	
<b>Canadian Metric Sieve Size (mm X 10<sup>-3</sup>)</b>	<b>Total Passing Sieve Percentage By Weight</b>
10 000	100%
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 than 2.2 nor more than 3.1 unless otherwise approved by the Contract Administrator.
- (ii) Coarse Aggregate - Granite
  - Crushed granite aggregate shall be used for the structural concrete of this section.
  - Coarse aggregate shall be 100 percent crushed, washed granite, low in quartz, clean and free from alkali, organic, or other deleterious matter, shall have two fractured faces, and shall have an absorption not exceeding 3 percent.  
 The coarse aggregate granite shall be well graded and shall conform to the grading requirements in the following table.

<b>TABLE E11.2 GRADING REQUIREMENTS FOR COARSE AGGREGATE - GRANITE</b>							
<b>Nominal Size of Aggregate (mm)</b>	<b>Percent of Total Dry Weight Passing Each Sieve (mm)</b>						
	<b>28</b>	<b>20</b>	<b>14</b>	<b>10</b>	<b>5</b>	<b>2.5</b>	<b>1.25</b>
20- 5	100	85- 100	60- 90	25- 60	0-10	0-5	--

E11.2.5 Cement

- (a) All cement unless hereinafter specifically stated, shall be Type 10 Normal Portland Cement, conforming to requirements of CSA Standard CAN/CSA-A5-98.
- (b) Cement for use in the deck concrete shall be Type 10SF silica fume cement, consisting of 8% silica fume interground or blended with normal Portland Cement, conforming to the requirements of CSA Standard CAN/CSA-A362-98 and CAN/CSA-A23.1-94. The silica fume Portland type 10SF cement shall have a specific surface not exceeding 650 m<sup>2</sup>/kg, measured in accordance with ASTM Standard C204-00.

E11.2.6 Fly Ash

- (a) Use of fly ash will be permitted for use in Structural Concrete supplied under this Specification, to a maximum of 10% of cement content. The use of fly ash to reduce cement content is not permitted.

E11.2.7 Water

- (a) Water used for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances, and in accordance with CSA Standard CAN3-A266.2M. It shall be equal to potable water in physical and chemical properties. The Contractor shall not use water from shallow, stagnant, or marshy sources.

E11.2.8 Admixtures

- (a) No admixtures, other than air-entraining agent, water-reducing agent, and superplasticizer, 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 any admixture is compatible with all other constituent materials.
  - (i) Air-Entraining Agent
    - The air-entraining agent shall conform to the requirements of CSA Standard CAN3-A266.1-M78 and shall produce a satisfactory air-void system and an air content within the ranges specified in C.S.A. Standard CAN/CSA-A23.1-00 for each class of concrete.
  - (ii) Water-Reducing Agent
    - The water-reducing agent shall be Type WN and shall conform to the requirements of CSA Standard CAN3-A266.2-M78. An approved product is Master Builders' Poly 997 or equal as approved by the Contract Administrator.
  - (iii) Superplasticizing Agent
    - If the Contract Administrator authorizes the use of a superplasticizing agent, the superplasticizing shall conform to the requirements of CSA Standard CAN3-A266.5 and CAN3-A266.6, but must be compatible with the air-entraining agent and be included in the mix design for approval. The agent shall be free of chlorides and shall not affect the air-entraining agent's ability to produce a satisfactory air-void system. The sequence of batching the superplasticizing agent in with the other constituent materials shall also accompany the approved mix design for approval.
  - (iv) Other Admixtures
    - No other admixtures will be authorized for use in Portland Cement Concrete, unless authorized in writing by the Contract Administrator.

E11.2.9 Polypropylene Fibres

- (a) The polypropylene fibres for the deck concrete only, shall consist of 100% virgin polypropylene as supplied by Grace (Microfibre) or Master Builders (Fibre Mesh MD), or equal as accepted by the Contract Administrator. The minimum dosage rate shall be  $1.5 \text{ kg/m}^3$ .

E11.2.10 Curing Compound

- (a) Curing compounds shall be liquid membrane-forming and conform to the requirements of ASTM Standard C309-98a. Rate of application shall be the rate required to meet the requirements of ASTM C309-98a for the texture of concrete the curing compound is being applied to.
- (b) Curing compound for approach slabs and structural sidewalks shall be resin-based and white-pigmented.

E11.2.11 Flexible Joint Sealant

- (a) Flexible joint sealant for all horizontal, vertical, and sloping joints shall be guaranteed non-staining, grey polyurethane, accepted by the Contract Administrator and applied in strict accordance with the details shown on the Drawings and the manufacturer's

instructions including appropriate primers if recommended. Accepted products are Vulkem 116 by Mameco, Sonolastic NP 1 by Sonneborn, Sikaflex-1a by Sika, or equal as accepted by the Contract Administrator.

E11.2.12 Latex Bonding Agent

- (a) Latex bonding agent shall be SCP Concrete Bond, as supplied by Specialty Construction Products, Surfacrete Concentrate by Sternson, or equal as accepted by the Contract Administrator. Polyvinyl acetate-based latexes will not be permitted.

E11.2.13 Form Coating

- (a) Form coating shall be "Sternson C.R.A." by Sternson, "SCP Strip Ease" by Specialty Construction Products, or equal as accepted by the Contract Administrator.

E11.2.14 Fibre Joint Filler

- (a) Fibre joint filler shall be rot-proof and of the preformed, nonextruding, resilient type made with a bituminous fibre such as Flexcell and shall conform to the requirements of ASTM Standard D1751-99 or equal as accepted by the Contract Administrator.

E11.2.15 Patching Mortar

- (a) 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 1 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.

E11.2.16 Bonding Grout

- (a) The grout for bonding the plastic concrete to existing hardened concrete shall be mixed in an agitating hopper slurry pump and shall consist of the following constituents, by weight:
  - (i) 1 part water
  - (ii) 1 part latex bonding agent
  - (iii) 1½ parts Type 10SF Portland cement
- (b) The consistency of the bonding grout shall be such that it can be applied with a standard spray nozzle to the existing concrete surface in a thin, even coating that will not run or puddle in low spots.
- (c) For sealing vertical joints between adjacent lanes and at the curbs, a modified bonding grout, thinned to paint consistency, shall be used. The modified bonding grout shall consist of 1 part water and 1½ parts Type 10SF Portland cement.

E11.2.17 Formwork

- (a) Formwork materials shall conform to CSA Standard CAN/CSA-A23.1-00, and American Concrete Publication SP:4, "Formwork for Concrete."
- (b) No "stay-in-place" formwork or falsework is permitted.
- (c) Form sheeting plywood to be covered with form liner or to be directly in contact with soil shall be exterior Douglas Fir, concrete form grade, conforming to CSA Standard O121-M1978, a minimum of 20 mm thick.
- (d) Where formliner is not being used, form sheeting shall be Douglas Fir, overlay formliner type conforming to CSA Standard O121-M1978. Approved manufacturers are "Evans" and "C-Z".



- (e) Boards used for formwork shall be fully seasoned and free from defects such as knots, warps, cracks, etc., which may mark the concrete surface.
- (f) No formwork accessories will be allowed to be left in place within 50 mm of the surface following form removal. Items to be left in place, must be made from a nonrusting material or galvanized steel; and they shall not stain, blemish, or spall the concrete surface for the life of the concrete.
- (g) Forms for exposed surfaces that do not require a formliner may be either new plywood or steel as authorized by the Contract Administrator.
- (h) 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.
- (i) 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.
- (j) Stay-in-place forms are not acceptable and will not be accepted unless shown on the Drawings.
- (k) 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.

E11.2.18 Form Liner

- (a) Form Liner shall be "Drainaform," or equal as accepted by the Contract Administrator. This form liner shall be used on all exposed formed surfaces, except soffit surfaces and the short side of the curb under the pedestrian rail, or where a normal form finish is specified.
- (b) Paper-lined forms or GIS plywood shall be used on all soffit surfaces.

E11.2.19 Galvanized Dowels and Expansion Sleeves

- (a) Dowels and expansion sleeves shall be fabricated in accordance with CSA Standard CAN/CSA-G30.18-M92.
- (b) The dowels shall be plain 25 mm diameter bars, 550 mm in length, and shall be epoxy-coated.
- (c) The expansion sleeves shall be 1.6 mm gauge, 32 mm in outer diameter, 300 mm in length, and shall be galvanized in accordance with CSA Standard G164-M92, to a retention of 600 g/m<sup>2</sup>.

E11.2.20 Curing Blankets

- (a) Curing blankets for wet curing shall be 100 percent polyester, 3 mm thick, curing blankets, white in colour. An approved product is "Mirafi Geotextile P150" or equal as accepted by the Contract Administrator.

E11.2.21 Benchmark

- (a) Benchmark plugs as supplied by the City.

E11.2.22 Epoxy Adhesive

- (a) Where epoxy adhesive for concrete to concrete and to steel is used, it shall be Sternson ST432 or ST433, Dural Duralbond, Capper Capbond E, Sikadur 32 Hi-bond, Concessive 1001 LPL, or equal as accepted by the Contract Administrator.

E11.2.23 Non-Shrink Cementitious Grout

- (a) Where non-shrink cementitious grout is used, it shall be Sternson M-bed Standard, Specialty Construction Products CPD Non-Shrink Grout, Sika 212 Non-Shrink Grout, or equal as accepted by the Contract Administrator. The minimum compressive strength of the grout at 28 days shall be 40 MPa.

- E11.2.24 Epoxy Grout
- (a) Where epoxy grout is used, it shall be Sternson Talygrout 100, Sika Sikadur 42, CPD Epoxy Grout by Specialty Construction Products, or equal as accepted by the Contract Administrator.
- E11.2.25 Backup Rod
- (a) Backup rod shall be preformed compressible polyethylene, urethane, neoprene, or vinyl foam backer road, extruded into a closed cell form and oversized 30 to 50%.
- E11.2.26 Low Density Styrofoam
- (a) Low density styrofoam shall be the type specified on the Drawings or as accepted by the Contract Administrator.
- E11.2.27 Precompressed Foam Joint Filler
- (a) Precompressed foam joint filler shall be compressed to 20% of its expanded width and be a polyurethane foam, impregnated throughout with a latex modified asphalt. Approved products are "Emseal," by Emseal Corporation or "Willseal." Manufacturer's recommended primer and top coat are to be used.
- E11.2.28 BR1 Post Anchor Bolts
- (a) Rail post anchor bolts shall be 250 mm x 16 mm diameter stainless steel; each complete with one stainless steel hex nut, one stainless steel lock washer, one stainless steel flat washer, and one 50 mm diameter galvanized flat washer with 18 mm diameter hole. The anchor bolts shall be threaded for 65 mm and shall be prebent as shown on the Drawings (where applicable). The stainless steel hex head and socket head cap screws shall conform to ASTM A276 Type 430 and the dimensional requirements of ANSI B18.3.
- E11.2.29 Pedestrian Handrail Anchor Units
- (a) Pedestrian handrail anchor units shall be stainless steel Acrow-Richmond Type DGR-1 anchor insert, complete with stainless steel high tensile anchor bolts and washers, all conforming to the requirements and dimensions as shown on the Drawings.
- E11.2.30 Lamp Standard Anchor Units
- (a) Lamp standard anchor units shall be hot-dip galvanized Acrow-Richmond Type DGR-2S anchor inserts conforming to the requirements and dimensions shown on the Drawings.
- E11.2.31 Waterstop
- (a) Waterstop shall be PVC, flat ribbed, and a minimum of 100 mm x minimum 5 mm thick. An approved product is Vinylex R4-316T.
- E11.2.32 Miscellaneous Materials
- (a) Miscellaneous materials shall be of the type specified on the Drawings or as accepted by the Contract Administrator.
- E11.3 Concrete Design Requirements
- E11.3.1 Mix Design Statement
- (a) 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:
    - (i) 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.
- (ii) 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.
  - (iii) 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.
  - (iv) Supply recent test information on sieve analysis of fine and coarse aggregates in accordance with Standard Test Method A23.2A. Results should be within acceptable limits specified herein.
  - (v) Supply recent test information on tests for organic impurities in fine aggregates for concrete, in accordance with CSA Standard Test Method A23.2-7A.
  - (vi) Supply recent test information on relative density and absorption of coarse aggregate, in accordance with CSA Standard Test Methods A23.2-12A.
  - (vii) Supply recent test information on petrographic examination of aggregates for concrete, in accordance with CSA Standard Test Methods A23.2-15A. The purpose of the petrographic analysis is to ensure the aggregates provided are of the highest quality for use in the production of concrete and will produce a durable overlay. An acceptable aggregate will have an excellent rating as judged by an experienced petrographer, with a (weighted) petrographic number typically in the range of 100 to 120.
  - (viii) Supply recent test information on resistance to degradation of large-size coarse aggregate by abrasion and impact in the Los Angeles Machine, in accordance with Standard Test Method A23.2-16A.
  - (ix) Supply recent test information on potential alkali reactivity of cement aggregate combinations (mortar bar method), in accordance with CSA Standard Test Method A23.2-20A.
  - (x) Supply recent information on tests performed on the interground or blended silica fume Portland cement to be used, including the specific surface.
  - (xi) 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.
- (b) 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.
- (c) 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) All testing shall be carried out by a CSA certified concrete testing laboratory.
  - (e) Determine the water soluble chloride ion content of the hardened concrete in accordance with CSA Standard Test Method A23.2-4B prior to the start of construction.
  - (f) Supply any other information deemed applicable by the Contract Administrator.
  - (g) 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.
  - (h) 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.
  - (i) No changes in the Job Mix Formula will be permitted without following the above procedure.

#### E11.3.2 Concrete Strength and Workability

- (a) Type 1 - Structural Concrete (all concrete except as specified as Type 2)
  - (i) Proportioning of fine aggregate, coarse aggregate, cement, water, and air-entraining agent shall be such as to yield concrete having the required strength and workability, as follows:
    - 35 MPa Concrete:
    - Minimum Compressive Strength @ 28 days = 35 MPa
    - Maximum Water/Cement Ratio = 0.40
    - Minimum Cement Content = 365 kg/m<sup>3</sup>
    - Slump = 75 mm ± 25 mm
    - Coarse Aggregate Maximum Size = 20 mm Nominal
    - Air Content for Hardened Concrete = 20 mm Aggregate = 5.0% to 8.0%
    - Cement = Type 10
  - (ii) The minimum compressive strength of the in-place concrete shall be 20 MPa before it may be subjected to freezing temperatures.
  - (iii) The minimum compressive strength of approach slabs, and approach roadway slabs before opening them to traffic shall be 25 MPa.

- (b) Type 2 –Structural Concrete (for bridge roadway deck concrete)
- (i) The constituent materials shall be proportioned and combined in accordance with the approved Job Mix Formula, such as to yield a fibre-reinforced silica fume concrete, meeting the following design and performance requirements:
- 35 MPa minimum compressive strength at 28 days
  - 20 mm maximum coarse aggregate size
  - minimum cementitious content (including silica fume) shall be 380 kg/m<sup>3</sup>
  - minimum 1.5 kg polypropylene fibres per cubic metre
  - 6.5 " 1% plastic entrained air content
  - 0.38 maximum water/cementitious ratio (including silica fume)
  - mix must be workable with a maximum slump 60 ± 20 mm at discharge
  - temperature of concrete mix at discharge shall not exceed 18EC
  - slump retention after 45 minutes shall be a minimum of 75% of initial batching slump
  - minimum specific surface, measured in accordance with Ontario Provincial Standard Specification 1350, shall be 25 mm<sup>-1</sup> in hardened concrete
  - Permeability: Maximum of 1000 coulombs as a charge passed in a 6-hour test, in accordance with ASTM C1202, on a sample cured for 28 days
- (ii) The Contractor is also required to achieve a Performance Index, which is based upon the hardened air content and air voids spacing factor, of not less than 80. Hardened air content and air-void spacing factor shall be determined through core samples tested in accordance with ASTM C457, "Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete." The number and location of tests will be determined by the Contract Administrator in the field. The Contractor is reasonable to repair the test locations to the satisfaction of the Contract Administrator.
- (iii) A failure of the approved Job Mix Formula to produce concrete meeting the above-specified requirements will be grounds for the Contract Administrator to immediately reject the Job Mix Formula, and will necessitate the Contractor to provide the Contract Administrator with an updated Mix Design Statement in accordance with this Specification. No further concrete placement will be undertaken until a replacement Job Mix Formula is accepted by the Contract Administrator.

#### E11.4 Concrete Supply

##### E11.4.1 General

- (a) All structural concrete supplied under this Specification shall be produced using a certified ready-mix concrete plant, except for the upper lift concrete, which may be site batched upon acceptance by the Contract Administrator.

##### E11.4.2 Ready-Mix Concrete Supply

- (a) 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-A23.1-00, "Production of Concrete", except that the transporting of ready-mixed concrete in nonagitating equipment is not permitted without the written permission of the Contract Administrator.
- (b) 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.
- (c) The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

#### E11.4.3 Bridge Deck Concrete

- (a) Deck concrete may be batched on-site or produced by a certified ready-mix concrete plant. An acceptable construction or stationary mixer of the rotating paddle type, or a continuous mixer using volumetric proportioning must be used if batched on-site, and the device for proportioning water must be accurate to within one percent.

#### E11.5 Equipment

##### E11.5.1 General

- (a) 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.
- (b) The Contractor shall have sufficient standby equipment available on short notice at all times.

##### E11.5.2 Placing and Finishing Equipment for Bridge Deck Concrete

###### (a) Placing Equipment

- (i) Concrete placing methods and equipment shall be such that the concrete is conveyed and deposited at the specified slump, without segregation, and without changing or affecting the other specified qualities of the concrete. Concrete placing methods and equipment shall also meet minimum production levels as specified herein.
- (ii) Adjacent exposed deck reinforcing steel shall be adequately protected during concrete placement.
- (iii) Equipment for conveying concrete, such as buckets, buggies, belt conveyors, etc., shall be of such design, size and condition to ensure a continuous and adequate supply of concrete of the specified mix and slump, without segregation at the point of deposition, or other detrimental impact on the quality of concrete or finishing product.
- (iv) Pumping of the fibre-reinforced silica fume concrete will not be permitted.

###### (b) Finishing Machine

- (i) Unless otherwise specified, an approved finishing machine complying with the following requirements shall be used.
- (ii) A mechanical strike-off shall be required to provide a uniform thickness of concrete in front of the oscillating screed.
- (iii) At least one oscillating screed shall be designed to consolidate the concrete to 98 percent of the unit weight, determined in accordance with ASTM C138-71T, by vibration. A sufficient number of identical vibrators shall be effectively installed, such that at least one vibrator is provided for each 1500 mm of screed length. The bottom face of this screed shall be at least 125 mm wide and with a turned up or rounded leading edge to minimize tearing of the surface of the plastic concrete. Each screed shall have an effective weight of at least 325 kg for each square metre of bottom face area. Each screed shall be provided with positive control of the vertical position, the angle of tilt, and the shape of the crown.
- (iv) Design of the finishing machine, together with appurtenant equipment, shall be such that positive machine screening to the plastic concrete will be obtained within 25 mm of at least 150 mm beyond the line where a sawcut is intended to form the edge of a subsequent placement section and shall overlap the sawn edge of a previously-placed course at least 150 mm.

- (v) The only finishing machine which will be approved for placing the bridge deck upper lift concrete are:
    - GOMACO, Model LS300
    - BIDWELL, Model OF400
    - BIDWELL, Model OF500
  - (vi) The finishing machine shall be capable of forward and reverse motion under positive control. Provision shall be made for raising the screens to clear the screened surface for travelling in reverse.
  - (vii) Supporting rails upon which the finishing machine travels will be required on all projects. The support for these rails shall be fully adjustable (not shimmed) to obtain the correct profile.
  - (viii) When placing concrete in a lane abutting a previously-completed lane, the side of the finishing machine adjacent to the completed lane shall be equipped to travel on the completed lane.
  - (ix) Vehicles for transporting fresh concrete from the mixer to the mechanical screed shall not travel on the reinforcing steel.
- (c) Movable Work Bridge
- (i) At least two moveable work bridges will be required (one for finishing and one for curing operations), independent of the finishing machine.
  - (ii) These movable work bridges shall travel guided on rails supported clear of the finished deck.
  - (iii) The Contractor shall install a sturdy walkway with safety railing on each side of the Work area for the purpose of providing access to the work bridge.
- (d) Movable Deck Hoarding
- (i) Shop drawings (three [3] prints and one [1] reproducible sepia) showing the fabricated details of the movable deck hoarding shall be provided to the Contract Administrator for review at least twenty-one (21) days prior to the scheduled commencement of fabrication. Such drawings shall show design loads, method of construction, type and grade of materials, and any further information that may be required by the Contract Administrator.
  - (ii) The movable deck hoarding shall be designed by a Professional Engineer registered in the Province of Manitoba and constructed to the following requirements:
    - Sufficient clearances shall be provided to enable the placing and finishing of the concrete to proceed unhindered inside the hoarding.
    - The minimum length of the hoarding shall be 25 m or the length of the structure, whichever is shorter.
    - The hoarding shall have a clear, unsupported span of at least the clear deck width, plus room for the finishing machine.
    - The roof and sides of the hoarding shall be covered with waterproof and insulated material, with all joints overlapping and rendered waterproof and not subjected to heat loss. The material shall be strong enough to withstand the force of "driving" rain or snow, and at least two thirds of the roof and the entire sides shall be opaque in order to prevent the deck concrete from being exposed to direct sunlight.
    - The sides of the hoarding at the junction of the hoarding with the deck forms shall be constructed to prevent the entrance of rain from the sides.
    - Provisions shall be made for enclosing the ends of the hoarding on short notice in the event that closing of the ends proves necessary during the concrete placing operations.
    - The roof of the hoarding shall be checked for damage and water tested before each concrete pour, and all repairs shall be made, as required, before concrete placing will be allowed to begin.

- The hoarding shall be constructed on wheels or rollers for ready mobility. Another acceptable method is to have stationary sides, with the roof on wheels or rollers.
- The rail system for the movable deck hoarding shall be independent of the rail system used for the screeding machine and the work bridge.
- The hoarding shall not be removed from overtop of a newly- completed deck slab without first obtaining permission from the Contract Administrator.
- The supply, setup, operation and takedown of the movable deck hoarding shall be considered incidental to the placement of the Bridge Deck Upper Lift, and no separate measurement or payment will be made for this Work.

#### E11.5.3 Vibrators

- (a) The Contractor shall have sufficient numbers of internal 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.
- (b) The Contractor shall use rubber coated vibrators for consolidating concrete containing epoxy-coated reinforcing steel.
- (c) The Contractor shall have standby vibrators available at all times during the concrete placement.

#### E11.5.4 Miscellaneous Equipment

- (a) 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.

### E11.6 Construction Methods

#### E11.6.1 Scope of Work

- (a) It is intended that this Specification cover the construction of the following items, as indicated on the Drawings:
  - (i) Bridge Sidewalk
  - (ii) Bridge Deck
  - (iii) Median and Shoulder Safety Barriers, complete with Waterstop
  - (iv) Approach Slab Sidewalks
  - (v) Expansion Joint Concrete Nosings

#### E11.6.2 Form Liner

- (a) Form liners shall be used on all exposed surfaces, except soffit surfaces, or where a normal form finish is specified.
- (b) The supply and use of the plain formliner finish shall be considered incidental to the works of this Specification, and no additional payment will be made.
- (c) The form liner may be used for a maximum of two (2) applications if the Contractor can prove a clean finish can be achieved, as accepted by the Contract Administrator prior to the liner's second use.

#### E11.6.3 Formwork and Shoring

- (a) The Contractor shall submit detailed shop drawings of the proposed falsework and formwork to the Contract Administrator at least twenty-one (21) days prior to the date for the first concrete to be placed. Falsework must be designed to carry all loads associated with construction of the overhangs, placement of concrete, hoarding, construction live loads and any other loads that may occur. Shop drawings shall show





- (n) 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.
- (o) 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.
- (p) 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.
- (q) 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.
- (r) Forms shall be sufficiently tight to prevent leakage of grout or cement paste.
- (s) Forms for the concrete barriers shall be accordingly aligned to each other and to the geometry shown on the Drawings so as to provide a smooth, continuous barrier. Any misalignments in the barrier shall be cause for rejection and removal of same. No snap ties within the barriers shall be placed below 250 mm above the top of the upper lift elevation.
- (t) Form panels shall be constructed so that the contact edges are kept flush and aligned.
- (u) 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.
- (v) Where prefabricated panels are used, care shall be taken to ensure that adjacent panels remain flush. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provide a smooth, plane surface.
- (w) 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.
- (x) It shall be permissible to use the forms over again where possible to a maximum of three 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.

#### E11.6.4 Preparation of Hardened Concrete

- (a) All hardened concrete against which new concrete is to be placed shall be prepared in the following manner:
  - (i) Concrete is to be removed to sound concrete or to the limits as shown on the Drawings, whichever is greater. The resulting surface is to be rough with a minimum amplitude of 6 mm and maximum frequency of 15 mm.
  - (ii) All existing surfaces and exposed reinforcing steel are to be gritblasted to reveal a clean substrate and kept clean until concrete placement. Gritblasting shall be followed by a high pressure water wash to remove all residue.
  - (iii) Immediately prior to placing new concrete, cement slurry bonding grout shall be applied to the entire surface of the existing concrete.

#### E11.6.5 Setting Deck Joints

- (a) The Contractor shall adjust all deck joints to the required elevations and gaps as accepted by the Contract Administrator prior to placement of concrete adjacent

thereto. The adjustment shall be done in accordance with the procedures for adjusting of the deck joints as recommended by the manufacturer or as directed by the Contract Administrator.

#### E11.6.6 Structural Concrete Other Than Deck Concrete

##### (a) General

- (i) 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, deck joints, mechanical screed setup, movable hoarding, and related works. Placement without required prior notification will not be allowed.

##### (b) Placing Structural Concrete

- (i) 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 for all substructure concrete. All equipment and processes are subject to acceptance by the Contract Administrator.
- (ii) 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.
- (iii) Runways for concrete buggies and all pumping equipment shall be supported directly by the formwork and not on reinforcement.
- (iv) 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.
- (v) Form liners shall be cooled immediately prior to placing concrete by spraying with cold water.
- (vi) 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 or "cold joints" within the section. If placing must be interrupted, construction joints shall be located where shown on the Drawings or as accepted by the Contract Administrator.
- (vii) Concrete shall be placed as nearly as possible in its final position. Rakes or mechanical vibrators shall not be used to transport concrete.
- (viii) The maximum free drop of 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.
- (ix) 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.
- (x) 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 good working condition shall be kept on the job site during all placing operations.
- (xi) Concrete shall not be placed during rain or snow unless adequate protection is provided for formwork and concrete surfaces.

- (xii) Before any concrete is placed in the approach slabs, roadway approach slabs, expansion slab, or bridge deck, the Contractor shall demonstrate to the satisfaction of the Contract Administrator before each pour that all necessary adjustments have been made to provide the required camber, crown, slab thickness, and concrete cover. This demonstration may be carried out by means of an attachment securely fastened to the finisher's strike-off machine and moving the machine and the strike-off across the deck over the reinforcing steel with a minimum 3 mm clearance between the steel and attachment.
  - (xiii) After verification that the surface meets acceptable limits and after final floating, the top surface shall be given Type 2 Finish – Unformed Surfaces.
- (c) Bridge Sidewalk Trial Section
- (i) The Contractor will be required to cast a concrete trial section of bridge sidewalk concrete so that his finishing methods and techniques can be demonstrated and proven. The sample concrete panel may be placed at the same time as the actual sidewalk.
  - (ii) The Contractor shall furnish a 1 m x 1 m sample panel for approval by the Contract Administrator prior to blast finishing of the designated sidewalk areas. The sample panel shall initially be given the Type 3 broom finish. Following curing of the concrete, the panel shall receive a portion of the sandblast pattern that includes both light and medium blasting. If the sample is rejected, additional sample panels shall be made until approval is obtained. The approved sample panel will be kept at the job site, and will become the quality standard for on-site blasting.
  - (iii) The light and medium blast are to be clearly distinguishable. Blasted depth is not to exceed 2.5 mm.
  - (iv) The Contractor shall obtain approval of the method used to mask off blasted areas. Disposable or re-usable forms will be considered provided they result in crisp, straight edges in keeping with the pattern shown on the Drawings.
- (d) Finishing of Concrete Surfaces
- (i) Type 1 Finish – Exposed Formed Surfaces
    - Form liner finish shall be applied to all exposed formed surfaces including all exposed concrete surfaces not included in Type 2, Type 3, Type 4, and Type 5 finishes.
    - Exposed surfaces imply all surfaces exposed to view including surfaces to 300 mm below finish grade elevations.
    - All surfaces to receive a form liner finish shall be formed using Form Liner.
    - The surfaces shall be patched as specified in this Specification. The surface shall be rubbed with a carborundum brick or other abrasive, to achieve a smooth-rubbed finish.
  - (ii) Type 2 Finish – Unformed Surfaces
    - All unformed concrete surfaces except (where applicable) the bearing seats, pier caps, approach slabs, approach roadway slabs, expansion slab, and deck concrete 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 form 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.

(iii) Type 3 Finish - Bridge Sidewalk

- The top surface of the sidewalks shall initially be given a broom finish. Upon completion of finishing operations, and when excessive moisture has evaporated, the plastic surface of the concrete shall be given a textured finish by means of broom finishing with a steel or fibre broom of a type accepted by the Contract Administrator at right angles to the direction of traffic. Surface depressions introduced by the broom strands in the brooming operations shall not be more than 3 mm deep.
- Following curing, the sidewalk is to receive light and medium grit blasting to match the approved sample panel quality.
- The Contractor shall obtain approval of the method used to mask off blasted areas. Disposable or re-usable forms will be considered provided they result in crisp, straight edges in keeping with the pattern shown on the Drawings.

(e) Curing

(i) General

- The use of curing compound will not be allowed on concrete areas that are to receive additional concrete or waterproofing.
- Freshly finished concrete shall have either a curing compound applied or covered and kept moist by means of wet polyester blankets immediately following finishing operations and shall be maintained at above 10°C for at least seven (7) consecutive days thereafter. Construction joints shall only be covered and kept saturated by means of wet polyester blankets for the curing period.
- Curing compounds shall be applied at the rate required by ASTM P198 for the accepted product. The compound must be applied uniformly and by roller. Spraying of the compound will not be permitted.
- Concrete shall be protected from the harmful effects of sunshine, drying winds, surface dripping, 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.
- Formed surfaces shall receive, immediately after stripping and patching, the same curing as finished surfaces, with the exception of the bridge deck soffit surfaces.

(f) Form Removal

- (i) The Contract Administrator must be notified at least 24 hours prior to form removal and give acceptance prior to beginning work.
- (ii) All forms shall remain in place and the concrete shall not be loaded for a minimum of seven (7) days after initial concrete placement, unless otherwise accepted by the Contract Administrator or noted otherwise on the Drawings.
- (iii) Notwithstanding the above, the minimum strength of concrete in place for safe removal of soffit forms for horizontal or inclined members as well as vertical forms for piers and abutments 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. Bridge deck soffit forms shall remain in place to support construction live loads during the placement of lower lift, upper lift, barriers, median, and sidewalks, as indicated on the Drawings.
- (iv) 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.

(g) Patching of Formed Surfaces

- (i) 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.
- (ii) All formed concrete surfaces shall have bolts, ties, struts, and all other timber or metal parts not specifically required for construction purposes cut back 75 mm from the surface before patching.
- (iii) Minor surface defects caused by honeycomb, air pockets greater than 5 mm in diameter, 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.
- (iv) 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.
- (v) Concrete shall be cast against forms which will produce plane surfaces with no bulges, indentations, or protuberances other than those shown on the Drawings.
- (vi) 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.

E11.6.7 Bridge Deck Upper Lift Concrete

(a) General

- (i) The deck upper lift concrete shall be constructed using fibre-reinforced silica fume concrete in accordance with the requirements of this Specification.
- (ii) Falsework, if any, erected for placement of the lower lift shall remain in place during fibre-reinforced silica fume concrete placement over that falsework.
- (iii) The finished bridge deck grades shown on the Drawings are preliminary only and are subject to revision during construction by the Contract Administrator.
- (iv) Any patches to the bridge deck lower lift concrete shall reach a minimum compressive strength of 35 MPa, as determined by field-cured test cylinders, before the bridge deck upper lift concrete is placed.

(b) Surface Preparation

- (i) The concrete surface over which the deck concrete placing are to be applied, shall be thoroughly cleaned to remove all laitance, dirt, or other deleterious material. The cleaning shall be accomplished by high-pressure waterblasting only and/or other means deemed necessary and accepted by the Contract Administrator. The cleaning shall remove laitance and oil-contaminated areas and expose the upper portion of the fine aggregate and the top surface of the coarse aggregate. The cleaning operations shall be completed and acceptable to the Contract Administrator prior to the placement of reinforcing steel for Stage 2.

- (ii) The time interval between the surface preparation and the placing of the upper lift deck concrete shall be kept to a minimum, and utmost care shall be taken to keep the prepared surfaces clean during the interval.
  - (iii) Immediately before proceeding with each placement, the prepared surface shall be inspected for dirt and other deleterious materials that may have been deposited after the completion of cleaning. All such dirt and deleterious material shall be cleaned off in a manner and by procedures satisfactory to the Contract Administrator.
- (c) Bridge Deck Upper Lift Concrete Trial Section
  - (i) The Contractor will be required to conduct a fibre-reinforced silica fume concrete trial for his finishing operations using the accepted finishing machine. The trial shall be conducted on a sloped surface similar to the existing maximum slopes and crossfalls on the bridge. It shall be constructed 8.0 m wide by 4.0 m long, by minimum 140 mm depth. This trial may be conducted at a suitable location at the bridge, if available, or at a location selected by the Contractor.
  - (ii) The trial section shall confirm the Contractor's finishing equipment and operations can produce a surface meeting the finish tolerances as hereinafter specified. In the event that the trial section fails to satisfy the specified surface finish tolerances, additional trial sections shall be constructed and tested. No bridge deck upper lift concrete shall be placed on the bridge deck until the Contractor produces a trial section that satisfies the specified surface finishing tolerances, unless otherwise accepted by the Contract Administrator, shall become the minimum standard of acceptance for the flatness of the finish.
  - (iii) The cost for the construction and subsequent removal of the trial section shall be incidental to the supply and placement of bridge deck upper lift concrete. No measurement or separate payment will be made for this Work.
- (d) Setting Up and Operation of Movable Deck Hoarding
  - (i) The Contractor will be required to provide a movable deck hoarding in conjunction with all bridge deck upper lift concrete placement during all weather conditions.
  - (ii) Prior to placing any bridge deck upper lift concrete, the Contractor shall erect the hoarding and shall demonstrate to the satisfaction of the Contract Administrator that the hoarding can be moved along the entire length of bridge deck upper lift concrete to be placed.
  - (iii) During bridge deck upper lift concrete placement and finishing, the hoarding shall be moved along the bridge deck, keeping pace with the approved finishing machine. The leading edge of the hoarding shall be kept at a distance of at least 10 m in front of the approved finishing machine at all times during concrete placement, and the back edge shall, at all times, cover and protect from direct sunlight any finished concrete that has not yet been covered by wet polyester curing blankets and polyethylene film. The hoarding shall be long enough to ensure that no uncovered finished concrete extends beyond the back edge of the hoarding or is exposed to direct sunlight.
  - (iv) Following completion of any bridge deck upper lift concrete, the hoarding shall remain in place over the freshly-placed concrete until such time as the concrete has set up or as directed by the Contract Administrator.
- (e) Mixing of Upper Lift Deck Concrete
  - (i) The upper lift deck concrete shall be provided using a certified ready-mix concrete plant or proportioned and mixed at the project site upon acceptance of the Contract Administrator.

- (ii) A water-reducing admixture for improving workability will be required. The admixture must be accepted by the Contract Administrator and shall be used in strict accordance with the manufacturer's instructions.
  - (iii) Unless otherwise specified herein, the slump measured in accordance with AASHTO T119 shall be  $60 \pm 20$  mm.
  - (iv) The slump will be measured at the point of mixing, 5 minutes after batching in the case of site batched concrete, or after the amount of concrete specified in CSA A23.2 has been discharged, in the case of ready-mix concrete.
- (f) Dry Run of Finishing Machine
- (i) The Contractor is responsible for properly setting the screed rails to ensure compliance with the specified longitudinal and transverse deck grades, without creating potential ponding areas or "bird baths."
  - (ii) Sufficient screed guide rails to provide the required coverage for the entire pour, as approved by the Contract Administrator, shall be set out and adjusted for height the day prior to the pour. The Contract Administrator will then check the deck grades, as follows:
    - That the screed rail system upon which the finishing machine will travel has been placed outside the area to be concreted. Arrangements for positive anchorage of supporting rails shall provide for horizontal and vertical stability. Hold-down devices shot into the concrete will not be permitted.
    - That the finishing machine and guide rails have been adjusted so that the height of the screed above the existing concrete at each point meets the Contract Administrator's requirements. To confirm the Contractor's adjustment of the machine and guide rails, the finishing machine shall be "dry run," and screed clearance measurements taken at each support point, by the Contractor. Resetting of the machine and/or guide rails shall be done by the Contractor as required by the Contract Administrator.
- (g) Placing Deck Concrete
- (i) The Contractor shall take every precaution necessary to secure a smooth-riding bridge deck, within the tolerances indicated in "Flatness Tolerances" in this Specification.
  - (ii) Concrete shall be placed so as to avoid segregation of constituent materials. The concrete finishing machine shall provide sufficient vibration to properly compact the mix. Excess vibration which may cause segregation shall be avoided. If over 75 mm in thickness, or if reinforcing steel is in the lift, the concrete shall be internally vibrated in advance of machine finishing.
  - (iii) The temperature of the concrete shall not be less than 10°C, nor more than 18°C, at the time of placing, and shall be maintained below this maximum temperature by the inclusion of ice in the mix in place of a portion of the mix water, as approved by the Contract Administrator, taking care to maintain the design water/cementitious ratio.
  - (iv) The overall combination of labour and equipment for proportioning, mixing, placing, and finishing new concrete shall be of such minimum capability as to meet the following requirements, as shown on Table E14.3, Minimum Requirement for Placing Deck Concrete, except when noted otherwise on the Drawings.



<b>TABLE E14.3</b>	
<b>MINIMUM REQUIREMENT FOR PLACING DECK CONCRETE</b>	
<b>TOTAL CONCRETE AREA PER BRIDGE (Square Metre)</b>	<b>MINIMUM REQUIREMENTS (Cubic Metres/Hour)</b>
0 - 275	1.0
276 - 410	1.5
411 - 550	2.0
Over 550	2.5

- (v) The finishing machine shall be so designed that, when concrete is mixed and placed at the specified minimum rate, under normal operating conditions, the elapsed time between depositing the concrete on the floor and final screeding shall not exceed 10 minutes. Similarly, the placing equipment and operations shall be such that in no case shall the elapsed time between batching on site or batching of ready-mix concrete and final screeding exceeds 60 minutes.
- (vi) Placement of the concrete shall be a continuous operation throughout the pour. In the event of equipment breakdown, such that concrete placement is stopped or delayed for a period of 60 minutes or more, further placement shall be discontinued and may resume only after a period of not less than 12 hours. This restriction does not prohibit continuation of placement provided that a gap is left in the lane or pour strip. The gap shall be sufficient in length for the finishing machine to clear the previously placed concrete. The fill-in section shall be placed after a period of not less than 12 hours. The edge of any discontinued overlay shall be sawcut vertically to a depth of 50 mm and then shall be chipped down to expose polypropylene fibres and reinforcing and thoroughly cleaned before placing further overlay material.
- (vii) The edge of the initial deck pour shall be bulkheaded at least 150 mm beyond the actual location of the longitudinal joint. Bulkheads shall be at least 10 mm lower than the finished lift surface. Prior to placing subsequent sections, the surface course previously placed shall be sawcut to a maximum depth of 50 mm in a straight line for the full length of the longitudinal joint, and the excess deck chipped off carefully so as not to damage reinforcing steel. The exposed vertical edge shall be thoroughly cleaned.
- (viii) The subsequent course shall match the adjacent previously placed course, and shall not be placed until the course initially placed is at least 72 hours old.
- (ix) Screed guides shall be placed and fastened in position to ensure finishing of concrete to the required profile. Supporting rails upon which the finishing machine travels shall be placed outside the area to be concreted. Provisions for anchorage of supporting rails shall provide for horizontal and vertical stability; positive anchorage may be required by the Contract Administrator. A hold-down device shot into the lower lift deck concrete will not be permitted. Plans for anchoring support rails shall be submitted to the Contract Administrator for acceptance. The Contract Administrator's acceptance must be received by the Contractor prior to the installation of any anchorage devices.
- (x) No longitudinal or transverse joints will be allowed, unless detailed on the Drawings or authorized in writing by the Contract Administrator. Where transverse and longitudinal joints are allowed, the upper lift concrete previously placed shall be saw-cut to straightedge and vertical edge before the adjacent concrete lift is placed.
- (xi) After the surface has been cleaned and immediately before placing concrete, a thin coating of bonding grout shall be scrubbed into or sprayed on the dry prepared surface. Care shall be exercised to ensure that all parts received a

- thorough, even coating with no shadowing, and that no excess of grout is permitted to collect in pockets. The rate of progress in applying grout shall be limited so that the grout does not become dry before it is covered with new concrete.
- (xii) The vibratory screed of the finishing equipment shall be moved slowly and at a uniform rate, such that screeding shall be completed in no more than two passes. The screed vibrators shall not be allowed to run except when screeding is actually in progress. The screeded surface shall not be walked on or otherwise damaged.
  - (xiii) The concrete surface produced behind the finishing machine shall be magnesium floated the minimum amount necessary to ensure that the surface is free from open texturing, plucked aggregate or projecting polypropylene fibres and local projections or depressions.
  - (xiv) During the concrete finishing operations, the Contractor shall utilize a 3.05 m (10 ft.) straightedge with a 75 mm (3 inch) semicircular shape, as supplied by Bidwell Inc., and as accepted by the Contract Administrator. It shall be used both for flattening the plastic concrete surface and for checking and verifying the surface flatness before applying the transverse score and commencing curing of the surface. The entire surface shall be checked and any areas not within the surface flatness tolerances specified under the Quality Control section of this Specification shall be corrected using the straight edge. Care shall be taken to preserve the crown and cross section of the roadway.
  - (xv) After verification that the surface meets acceptable limits and after final floating, the top surface shall be given a coarse, transverse-scored texture, by drawing a steel roller, as approved by the Contract Administrator, uniformly across the surface.
  - (xvi) Upon completion of the straight-edge checking, final floating and texturing of the pour, the joint with any previous placement (or any transverse joints) shall be sealed by the application of the modified bonding grout.
- (h) Curing Deck Concrete
- (i) **Immediately following finishing of the concrete, apply fog misting until the concrete has enough strength to support the placement of the predampened blankets. The misting device shall not be used to apply water to the concrete's surface for finishing purposes. The misting device shall not be directed towards the concrete surface. Only a fine coating or sheen should be applied with the misting device.**
  - (ii) After the transverse score and joint painting are completed, the surface shall be promptly covered with a single layer of clean, presoaked, polyester curing blanket.
  - (iii) Care shall be exercised to ensure that the polyester curing blanket is well drained and that it is placed as soon as the surface will support it without deformation. The Contractor shall ensure that water from the polyester curing blankets does not run into areas where concrete placement and finishing operations are underway. If this occurs, concrete placement shall stop until the problem is corrected to the satisfaction of the Contract Administrator.
  - (iv) The predampened polyester curing blankets shall be a temperature of 20°C, " 5°C, when applied to the deck.
  - (v) Failure to apply wet polyester curing blankets within 30 minutes after the deck concrete has been deposited shall be cause for rejecting the works so affected; however, if the concrete is revibrated because of failure to meet density requirements within initial vibration, this time will be extended by 15 minutes. Concrete in the rejected area shall be removed and replaced at no additional cost to the City.

- (vi) It is intended that the surface receive a wet polyester blanket cure for at least seven (7) days. Water shall be applied as necessary to keep the concrete and polyester curing blankets saturated. The Contractor must ensure the concrete and polyester curing blankets are kept saturated with water for the entire seven (7) days.
- (vii) As soon as the deck concrete can be walked on without damaging the surface, as approved by the Contract Administrator, the polyester curing blankets shall be covered with a layer of minimum 4-mil polyethylene film and a layer of insulated tarps (during cold weather) in order to maintain the concrete temperature of 10EC.
- (viii) If, in the opinion of the Contract Administrator, curing has not been maintained sufficiently, the currying period will be extending as directed with no additional payment made.
- (i) Limitation of Operations
  - (i) No concrete shall be placed unless the air and deck temperatures are above 5°C and rising. If at an ambient temperature of 25°C or above, hot-weather concreting requirements shall apply.
  - (ii) No concrete placement shall occur at ambient temperature above 32°C.
  - (iii) During hot weather conditions when temperatures greater than 25EC are expected, deck concrete placement shall commence after the sun begins to set and should be completed by 10 a.m.
  - (iv) Lighting will only be permitted for the purposes of placement of deck concrete with provision of adequate lighting installed by the Contractor.
  - (v) No traffic shall be permitted on a finished surface until after the first 48 hours of the curing period. In addition, no preparation work shall be performed in the adjacent lane or areas adjoining new concrete during the specified curing period. At temperatures below 12°C, the Contract Administrator may require a longer waiting time.
  - (vi) If loading equipment is used, its speed shall be limited to minimized vibration of the superstructure.

#### E11.6.8 Cold Weather Concreting

- (a) The requirements of this section shall be applied to all concreting operations during cold weather, i.e., if the mean daily temperature falls below 5°C during placing or curing.
- (b) The Contract Administrator will advise the Contractor, in writing, as to the degree of heating of water and aggregates.
- (c) Supplementary equipment as required below shall be at the job site if concrete is likely to be placed in cold weather.
- (d) Formwork and reinforcing steel shall be heated to at least 5°C before concrete is placed.
- (e) Concrete footings shall not be placed on frozen soil or soil which has frozen and thawed. Other concrete members may be placed on subgrades which have been thawed with prior permission from the Contract Administrator.
- (f) 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 7 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.

- (g) 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-A23.1-00 for the thickness of the section being placed.
- (h) When the mean daily temperature may fall below 5°C, a complete housing of the Work, together with supplementary heat, shall be provided.
- (i) 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.
- (j) 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.
- (k) 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.
- (l) 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.
- (m) 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.
- (n) 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.
- (o) Combustion-type heaters may be used if their exhaust gases are vented outside the enclosure and not allowed to come into contact with concrete surfaces. Fire extinguishers must be readily at hand whenever combustion-type heaters are used.
- (p) 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.

#### E11.6.9

#### Hot Weather Concreting

##### (a) General

- (i) The requirements of this section shall be applied during hot weather, i.e., air temperatures above 25°C during placing.
- (ii) 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.
- (iii) Ice may be substituted for a portion of the mixing water, provided it has melted by the time mixing is completed.
- (iv) The Contractor shall use cold water and/or ice in the mix to keep the temperature of the fresh concrete down, if required. Ice may be substituted for

- a portion of the mixing water, providing it has melted by the time mixing is completed.
- (v) 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.
- (vi) Sun shades and wind breaks shall be used as required during placing and finishing.
- (vii) Work shall be planned so that concrete can be placed as quickly as possible to avoid "cold joints".
- (viii) 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.
- (ix) Curing shall follow immediately after the finishing operation.

E11.6.10 Hot-Weather Curing

- (a) When the air temperature is at or above 25°C, curing shall be accomplished by fog misting and by using saturated absorptive fabric, in order to achieve cooling by evaporation. Fog misting is mandatory for deck concrete at all temperatures.
- (b) Mass concrete shall be water cured for the basic curing period when the air temperature is at or above 20°C, in order to minimize the temperature rise of the concrete.

E11.6.11 Job Preparation

- (a) 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, the formwork, reinforcement, and concreting equipment shall be protected from the direct rays of the sun or cooled by mist fogging and evaporation.

E11.6.12 Concrete Temperature

- (a) 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		
1	10	27
1.2	5	25

E11.6.13 Protection From Drying

- (a) Placement of deck concrete will not be permitted when the surface moisture evaporation exceeds 0.75 kg/m<sup>2</sup>/h. Fog misting is mandatory regardless of drying conditions. The Contractor shall use fog misting operations as accepted by the Contract Administrator. The nomograph, Figure D1, Appendix D of CSA Standard CAN/CSA-A23.1-00 shall be used to estimate surface moisture evaporation rates.

E11.6.14 Installation of Dowels and Galvanized Expansion Sleeves in Barriers

- (a) Dowels and galvanized expansion sleeves shall be installed across contraction joints exactly parallel to the direction of movement and each other.
- (b) The galvanized sleeves shall be installed in the side of the joint which is cast first.

- (c) The sleeves and dowels shall be positioned as shown on the Drawings and shall be held in place by positive and satisfactory means, such as a template, so that their correct position will be maintained after the concrete has been placed, vibrated, and finished. If sleeves and/or dowels are displaced during concrete placing operations, concrete placement shall cease and shall not resume until the displaced dowels and/or sleeves have been reset to the correct alignment.

E11.6.15 Bridge Lighting Pole, Pedestrian Handrail, and BR1 Post Anchor Units

- (a) Install the bridge lighting pole, pedestrian handrail, and BR1 post anchor units where shown on the Drawings.

E11.6.16 Benchmarks

- (a) The Contractor shall install a benchmark plug(s) supplied by the Contract Administrator at the locations on each structural item shown on the Drawings, and at any other locations as may be directed by the Contract Administrator.

E11.6.17 Structure Identification Date

- (a) The Contractor shall indent into the exposed concrete a structure identification date at the location on each end of the structure as shown on the Drawings in accordance with the detail shown on the Drawings or as otherwise directed by the Contract Administrator.

E11.7 Quality Control

E11.7.1 Inspection

- (a) 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.

E11.7.2 Access

- (a) 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.

E11.7.3 Materials

- (a) All materials supplied under this Specification shall be subject to testing and acceptance by the Contract Administrator in accordance with this Specification.

E11.7.4 Concrete Quality

- (a) Quality control tests will be used to determine the acceptability of the concrete supplied by the Contractor.
- (b) 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.
- (c) The frequency and number of concrete quality control tests shall be in accordance with the requirements of CSA Standard CAN/CSA-A23.1-00.

- (d) An outline of the quality tests is as follows:
  - (i) Slump tests shall be made in accordance with CSA Standard Test Method CAN/CSA-A23.2-00-5C, "Slump of Concrete". If the measured slump falls outside the limits specified in this Specification, a second test shall be made.
  - (ii) In the event of a second failure, the Contract Administrator reserves the right to refuse the use of the batch of concrete represented.
- (e) Air content determinations shall be made in accordance with CSA Standard Test Method CAN/CSA-A23.2-00-4C, "Air Content of Plastic Concrete by the Pressure Method". If the measured air content falls outside the limits specified in this Specification, 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.
- (f) The air-void system shall be proven satisfactory by data from tests performed in accordance with CSA Test Method CAN/CS- A23.1-00-17C. The spacing factor, as determined on concrete cylinders moulded in accordance with CSA Standard Test Method CAN/CSA-A23.2-00-3C, 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.
- (g) Samples of concrete for test specimens shall be taken in accordance with CSA Standard Test Method CAN/CSA-A23.2-00-1C, "Sampling Plastic Concrete".
- (h) Test specimens shall be made and cured in accordance with CSA Standard Test Method CAN/CSA-A23.2-00-3C, "Making and Curing Concrete Compression and Flexure Test Specimens".
- (i) 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-A23.2-00-9C, "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.
- (j) 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 allowable working compressive strength as specified in Clause E11.3.2 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-A23.2-00-9C, "Compressive Strength of Cylindrical Concrete Specimens", and the test result shall be the strength of the specimen.
- (k) Notwithstanding CSA A23.2, cores taken from deck must achieve the concrete design strength as a minimum.

E11.7.5 Corrective Action

- (a) 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 acceptable manner to the satisfaction of the Contract Administrator.

E11.7.6 Surface Flatness Requirements

- (a) The surface of the upper lift of deck concrete (fibre-reinforced silica fume concrete) shall be finished to a flatness tolerance as specified herein. The surface flatness of the finished concrete will be determined by measuring the elevation difference between equidistant points spaced 305 mm apart, along straight or curved lines running parallel or perpendicular (radial) to the direction of travel on the bridge deck. An acceptable surface flatness, as measured along any such line on the finished surface, will have the absolute difference between any two consecutive readings (a reading being the difference in elevation between two consecutive points) not exceeding 5 mm.
- (b) At each location(s) where the absolute difference of 5 mm is exceeded, further detailed contour survey(s) will be conducted by and at the discretion of the Contract Administrator to determine the extent of the area requiring corrective action, all at the Contractor's expense. Corrective measures shall involve immediate removal of the surface in the areas not meeting the specified surface flatness tolerance and/or acceptable rideability, in the judgement of the Contract Administrator, and replacement of same to a minimum depth of 50 mm, with the perimeter of the area saw-cut to a depth of 25 mm (the cut face to be sloped to key-in the replacement concrete), as directed by the Contract Administrator. If more than 20 percent of the surface is rejected by the Contract Administrator based on the flatness tolerance and/or any other defect, the Contractor shall immediately remove and replace the entire area of the applicable pour.
- (c) This criteria will not apply across the crown or at any deck drains, which must be constructed to meet design grades as shown on the Drawings or as directed by the Contract Administrator.
- (d) The Contract Administrator will take readings and determine the acceptability for the surface flatness within thirty-six (36) hours after completion of each pour. The Contractor shall remove and replace the curing blankets, as required by the Contract Administrator, to undertake the necessary flatness testing and shall restore same immediately upon completion of the testing in each area to the satisfaction of the Contract Administrator.

E11.8 Measurement and Payment

E11.8.1 Structural Concrete

- (a) The supply and placement of structural concrete will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for each of the "Items of Work" listed herebelow performed in accordance with this Specification and accepted by the Contract Administrator. Include the supply and installation of the waterstop and sealants.
  - (i) Items of Work:
    - Supply and Place Concrete
    - Bridge Sidewalk
    - Bridge Deck Upper Lift
    - Safety Barriers



- Bridge Approach Sidewalks
- Expansion Joint Concrete Nosings

E11.8.2 Bridge Lighting Pole, Pedestrian Handrail, and BR1 Post Anchor Units

- (a) The supply and installation of bridge lighting pole, pedestrian handrail, and BR1 post anchor units will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for the "Supply and Installation of Anchor Units for Bridge Lighting Poles, Pedestrian Handrail, and BR1 Posts" performed in accordance with this Specification and accepted by the Contract Administrator.

E11.8.3 Epoxy Coated Dowels and Galvanized Expansion Sleeves

- (a) The supply and installation of epoxy coated dowels and galvanized expansion sleeves will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for the "Supply and Installation of Epoxy Coated Dowels and Galvanized Expansion Sleeves" performed in accordance with this Specification and accepted by the Contract Administrator.

**E12. BACKFILL**

E12.1 Description

E12.1.1 This Specification shall cover all operations related to backfill work as herein specified.

E12.1.2 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 works as hereinafter specified.

E12.2 Materials

E12.2.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials as set forth in this Specification. All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Contract Administrator.

E12.2.2 Suitable Site Backfill

- (a) Suitable site backfill material shall be of a type approved by the Contract Administrator.

E12.2.3 Granular Backfill

- (a) Granular backfill shall conform to the requirements of the City of Winnipeg Specification CW 3110-R7 for Sub-base material of maximum 50 mm size.

E12.2.4 Base Course Material

- (a) Base course material shall be supplied in accordance with City of Winnipeg Specification CW 3110-R7 and may be either granular or crushed limestone.

E12.3 Construction Methods

E12.3.1 General

- (a) The Work shall comprise of supply and placement of:
- (i) Granular backfill with sub-base material of the excavation for the buried and concrete encased conduit systems.
  - (ii) Sub-base and base course for the concrete sidewalks.

- (b) Backfill in accordance with the requirements of the City of Winnipeg Specification CW 3110-R7.
- (c) Backfill for pavement repairs and detour works is covered elsewhere.

E12.4 Measurement and Payment

- E12.4.1 Backfill will be measured and paid for in accordance with the City of Winnipeg Specification CW 3110-R7.

**E13. PRECAST CONCRETE GIRDER CORROSION PROTECTION WORKS**

E13.1 Description

- E13.1.1 This Specification shall cover all operations relating to the precast concrete girder corrosion protection works, as herein specified.
- E13.1.2 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.

E13.2 Materials

E13.2.1 General

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

E13.2.2 Handling and Storage of Materials

- (a) 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.

E13.2.3 Testing and Approval

- (a) All materials supplied under this Specification 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.
- (b) 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.

E13.2.4 Epoxy

- (a) The epoxy for epoxy injection of girder cracks shall be Kemko 068 by Chemco Systems, Inc. of Redwood City, California or approved equal.

E13.2.5 Water

- (a) 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.

E13.2.6 Migratory Corrosion Inhibitor

- (a) The migratory corrosion inhibitor shall be MCI 2020 for vertical and overhead applications by Cortec Corporation of St. Paul, Minnesota.

### E13.3 Construction Methods

#### E13.3.1 General

- (a) Some of the existing girders of the structure are displaying longitudinal cracks on their sides for all or part of the length of the girders. Prior investigation has revealed that some of the cracks have developed over lengths of the metal corrugated ducting in which the post-tensioning cables exist. The purpose of the Work of this section is to halt or at least slow the rate of corrosion of the metal ducts.
- (b) This Specification will cover two (2) types of corrosion protection works. They are:
  - (i) Epoxy injection of wide cracks. This will be on one (1) girder displaying the widest cracks, as shown on the Drawings.
  - (ii) Application of a liquid migratory corrosion inhibitor to designated girder surfaces.

#### E13.3.2 Epoxy Injection of Girder Cracks

- (a) General
  - (i) Epoxy injection shall be carried out according to manufacturer's directions and as indicated herein.
- (b) Preparation
  - (i) Where applicable, girder webs shall be pressure washed/sand blasted to remove anti-graffiti paint. Concrete surfaces may be dry, damp, or wet (no free standing water), but must be free of all bond-inhibiting substances. Prepare cracks by inhibiting substances. Prepare cracks by blowing clean with oil-free compressed air or by flushing clean with an appropriate cleansing solution as required to remove foreign substances and contaminants.
  - (ii) Application
    - Application shall be in accordance with manufacturer's recommendations. Following epoxy injection of cracks, the Contractor shall remove port holes, grind off excess epoxy, and ensure that the girder surface is smooth.

#### E13.3.3 Migratory Corrosion Inhibitor

- (a) General
  - (i) Apply the corrosion inhibitor according to manufacturer's directions and as indicated herein. Apply the product at the rate of 3.7 L/m<sup>2</sup>.
  - (ii) Preparation
    - Where applicable, girder webs shall be pressure washed/sand blasted to remove anti-graffiti paint.
    - Concrete surfaces should be dry, clean, and free of all dirt, oil, grease, efflorescence, sealers, coatings, curing compounds, and membranes.
    - If using an air compressor, use with a water and oil trap to ensure the cleaning method does not apply to materials intended for removal.
    - Use brush, broom, sweeper, or air compressor on surfaces as final cleaning before application.
    - Use brush, broom, sweeper, or air compressor to chase cracks as final cleaning before application.
    - Do not apply if the ambient temperature near the applied concrete surface is expected to be below freezing water temperature within 12 hours of application.
  - (iii) Surface Application
    - Use MCI - 2020 V/O for vertical or overhead surface applications.
    - Apply the solution by spray (conventional airless or hand pressure spray equipment), roller, squeegee, or paintbrush.
    - Apply first coat at a rate of 7.4 m<sup>2</sup>/L.

- Allow to dry a minimum of eight hours.
- Apply a second coat at a rate of 7.4 m<sup>2</sup>/L. (Total application rate for both coats is therefore 3.7 m<sup>2</sup>/L).

#### E13.4 Measurement and Payment

##### E13.4.1 Epoxy Injection of Girder Cracks

- (a) Epoxy injection of girder cracks will be measured on a unit basis and paid for at the Contract Unit Price per metre length for "Epoxy Injection of Girder Cracks," performed in accordance with this Specification and accepted by the Contract Administrator.

##### E13.4.2 Migratory Corrosion Inhibitor

- (a) Migratory corrosion inhibitor will be measured on an area basis and paid for at the Contract Unit Price per square metre for "Migratory Corrosion Inhibitor" performed in accordance with this Specification and accepted by the Contract Administrator.

### **E14. SUPPLY AND INSTALLATION OF ALUMINUM PEDESTRIAN HANDRAIL AND LIFE PRESERVER ENCLOSURE**

#### E14.1 Description

E14.1.1 This Specification shall cover the supply and installation of aluminum pedestrian handrail and life preserver enclosure.

E14.1.2 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 other things necessary for and incidental to the satisfactory completion of all Work as hereinafter specified.

#### E14.2 Materials

##### E14.2.1 General

- (a) The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification.
- (b) All materials supplied under this Specification shall be of a type accepted by the Contract Administrator.

##### E14.2.2 Handling and Storage of Materials

- (a) All materials shall be handled and stored in a careful and workmanshiplike manner, to the satisfaction of the Contract Administrator.

##### E14.2.3 Testing

- (a) All materials supplied under this Specification 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.

##### E14.2.4 Material for the Aluminum Pedestrian Handrail and Life Preserver Enclosure

- (a) Extruded Shapes or Drawn Tubing for Rails and Posts: shall conform to CSA Aluminum Alloy and Temper HA.5 SG 11R-T6 (ASTM B221M-83 Alloy 6351-T6), or HA.7 GA 11M-T6 (ASTM B221 M-83 Alloy 6061-T6).
- (b) Aluminum sheet, bar, support pin, angle, and plate shall conform to ASTM B221-M-83 Alloy 5083, ATM B209M-83 Alloy 6061-T6 or Alloy 6351-T6.
- (c) Bolts and cap screws, nylon lock nuts, and washers - stainless steel conforming to ASTM A276, Type 316.

- (d) Life preserve enclosure front panels shall be 13 mm Lexan glazing.
- E14.2.5 Bituminous Paint
  - (a) Bituminous paint shall be an alkali-resistant coating and conform to CGSB 31-GP-3M. Supply of bituminous paint shall be considered incidental to the supply of aluminum pedestrian handrail.
- E14.2.6 Handrail Anchorage System
  - (a) The handrail anchorage system is specified and paid for in the Specification section on Structural Concrete.
- E14.2.7 Aluminum Shims
  - (a) Aluminum shims shall conform to ASTM Standard B221, Alloy 6061-T6, and shall be supplied as required to facilitate the installation of the rail posts as shown on the Drawings. Supply of shims will be considered incidental to the supply of aluminum pedestrian handrail.
- E14.2.8 Attachments
  - (a) Anodized aluminum components in contact with copper shall be isolated by way of neoprene pads and vandal proof nylon bolts.
- E14.2.9 Aluminum Filler Alloys for Welded Construction
  - (a) Aluminum filler alloys for welded construction shall be one of the following: ER4043, ER5183, ER5356, ER5554, ER5556, or ER5654.
- E14.2.10 Hinges
  - (a) Hinges shall be stainless steel and manufactured by Angama, Type STBB 460, or equal as approved by the Contract Administrator.
- E14.3 Equipment
- E14.3.1 All equipment shall be of a type acceptable to the Contract Administrator and shall be in good working order.
- E14.4 Construction Methods
- E14.4.1 Layout
  - (a) Before fabrication and/or installation of the aluminum pedestrian handrail and life preserver enclosure, the Contractor shall satisfy himself as to the dimensions of all rail and enclosure sections required, by field measurements.
- E14.4.2 Fabrication
  - (a) General
    - (i) Shop Drawings (five (5) prints and one (1) reproducible sepia copy) showing fabrication details of the aluminum pedestrian handrail and life preserver enclosure shall be provided to the Contract Administrator for acceptance at least fourteen (14) days prior to scheduled commencement of fabrication.
    - (ii) The fabricator shall fabricate the entire aluminum pedestrian handrail and life preserver enclosure, in sections, to permit the installation of the rail sections onto the concrete.
    - (iii) All fabrication shall be carried out in accordance with this Specification and the Drawings.
    - (iv) The punching of identification marks on the members will not be allowed.

- (v) Any damage to members during fabrication shall be drawn to the attention of the Contract Administrator in order that the Contract Administrator may accept remedial measures.
  - (vi) Dimensions and fabrication details which control the field matching of parts shall receive very careful attention in order to avoid field adjustment.
  - (vii) Components of the hand railings and enclosures shall be joined by means of bolt, cap screws, and welds as called for on the Drawings.
- (b) Sample Panel
- (i) The Contractor shall be required to supply one completely fabricated sample panel, including at least two posts to the Contract Administrator and receive acceptance of the sample panel from the Contract Administrator prior to proceeding with the fabrication of the remainder. The sample, once accepted, shall be identifiable for the duration of the project, but may be incorporated into the rail system. It shall become the standard for acceptance of all aluminum pedestrian handrail and life preserver enclosure.
- (c) Cutting
- (i) Material 13 mm thick or less may be sheared, sawn, or cut with a router. Materials more than 13 mm thick shall be sawn or routed. Cut edges shall be true and smooth and free from excessive burrs or ragged breaks. Re-entrant cuts shall be avoided whenever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.
- (d) Welding
- (i) Welded construction shall conform to the requirements of CSA Standard W59.2-M1991, Welded Aluminum Construction and W47.2-M1987, Certification of Companies for Fusion Welding of Aluminum.
  - (ii) Welding will be done by qualified welders using the Metal Inert Gas (MIG) process. All areas to be welded should be thoroughly cleaned with a suitable solvent followed by wire brushing if surfaces are heavily oxidized. The size of fillet for equal leg fillet welds is defined as the leg length of the largest isosceles right angle triangle which can be inscribed within the fillet weld section. Welds must penetrate into the root corner. All butt welds should have full penetration to ensure maximum strength. Defective welds should be repaired by chipping out the defective area and rewelding. Particular care must be paid to the elimination of craters and cold starts.
  - (iii) Welders and procedure should be qualified as agreed between the Contract Administrator and the fabricator. The minimum requirements for mechanical test results of joints butt welded with Alcan 56S filler alloy shall be 259 MPa for Alcan D45S-H11A and 165 MPa for Alcan B51S-T4 alloy. In addition to the mechanical tests, soundness tests should be made as follows:
  - (iv) Guided Bend Test: All bend tests should be fully guided through an angle of 180°. Root, face, and side bend tests in Alcan D54S parent alloy welded in Alcan 56S filler wire require a bend radius of 2T where T is the thickness of the material. For Alcan B51S parent alloy welded with 56S filler wire, a bend radius of 4T is required. Root bend and face bend specimens on material 10 mm thick and less should be 305 mm long and a minimum of 25 mm in width and cut from a plate having a minimum butt weld length of 450 mm. No test piece should be taken within 25 mm of the ends of the weld. Side bend tests should be carried out on material over 10 mm in thickness.
  - (v) Specimens should be 10 mm in width. Longitudinal edges should be given in 2 mm radius. There should be no crack greater than 3 mm in length. If a crack starts from an edge, the specimen should be disregarded.

(vi) Fracture Test: The butt-welded joint shall have a notch not exceeding 2 mm in depth sawn on the four sides of the weld bend and the weld broken. Inspection of the fracture should reveal no gas pockets or inclusions greater than 2 mm in diameter and the area lost due to scattered gas, porosity or voids should not exceed 3% of the area under inspection.

(e) Bolting

- (i) Bolt holes in 10 mm or thinner material may be drilled or punched to finished size. In material thicker than 10 mm, the holes shall be drilled to finished size or subpunched smaller than the normal diameter of the fastener and reamed to size.
- (ii) The finished diameter of the holes shall be not more than 7 percent greater than the nominal diameter of the fastener, except:
  - Slotted holes for expansion purposes shall be provided as required on the Drawings.
  - Holes for anchor bolts may be up to 50 percent greater than the nominal bolt diameter with a maximum of 13 mm greater than the nominal bolt diameter.
- (iii) Holes shall not be drilled in such a manner as to distort the metal, but holes only slightly misaligned may be reamed to render a reasonable fit.
- (iv) In all bolts, the finished shank shall be long enough to provide full bearing, and washers shall be used under the nuts to give full grip when the nuts are tightened.

E14.4.3 Aluminum Pedestrian Handrail and Life Preserver Enclosure Installation

- (a) The aluminum pedestrian handrail and life preserver enclosure posts and sections shall be brought on-site and accurately installed as shown on the Drawings.
- (b) The rails shall be set true to the line and grade as shown on the Drawings or as required by the Contract Administrator.
- (c) The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the member is not permitted. The Contractor shall report to the Contract Administrator any corrective measures.
- (d) Except where shown on the Drawings, field welding will not be permitted unless acceptable to the Contract Administrator. The rail posts shall be set on aluminum shims, as required, to achieve the correct elevation and grade. Additional aluminum shims shall be installed as required to achieve the correct elevation and grade. The surface of the bottom shim that is in contact with concrete shall be separated with a minimum of two (2) coats of bituminous paint. A minimum 3 mm aluminum shim shall be installed under each post.

E14.5 Quality Control

E14.5.1 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 Work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspecting 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.

E14.6 Measurement and Payment

E14.6.1 The supply and installation of aluminum pedestrian rail and life preserver enclosure will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for

“Supply and Installation of Aluminum Pedestrian Rail and Life Preserver Enclosure,” performed in accordance with this Specification and accepted by the Contract Administrator.

## **E15. TRANSITION CURB INSTALLATION**

### **E15.1 Description**

#### **E15.1.1 General**

(a) This Specification supplements CW 3240-R5 and covers the installation of “transition” curb adjacent to the bridge shoulder barrier as shown on the contract drawings. This curb transitions between the dowelled barrier curb and the shoulder barrier.

#### **E15.1.2 Referenced Standard Construction Specifications**

(a) CW 3240-R5 – Renewal of Existing Curbs

#### **E15.1.3 Referenced Standard Details**

(a) SD-205 – Barrier Curb (Dowelled)

### **E15.2 Materials**

E15.2.1 As per CW 3240-R5, Section 2.

### **E15.3 Construction Methods**

#### **E15.3.1 Transition Curb Installation**

(a) Dowelled transition curb with dimensions as shown on the contract drawings is to be installed as per CW 3240-R5, Section 3.3 and SD-205, complete with reinforcement.

### **E15.4 Measurement and Payment**

#### **E15.4.1 Transition Curb Installation**

(a) Transition Curb Installation will be measured on a length basis and paid for at the Contract Unit Price per metre for “Transition Curb Installation” performed in accordance with this Specification and accepted by the Contract Administrator.

## **E16. NAVIGATION LIGHTS**

### **E16.1 Description**

E16.1.1 This Specification shall cover all operations relating to the supply and installation of the navigation lights.

E16.1.2 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.

### **E16.2 Materials**

#### **E16.2.1 General**

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

#### **E16.2.2 Lighting Fixtures**

(a) Lighting fixtures shall be Crouse-Hinds Model VDA-22 (Pendant Type), 150-watt, complete with clear globe (G23), guard (P20), and long-life bulbs. The bulbs shall be



28 watt compact fluorescent lamps or equal as approved by the Contract Administrator. Ensure the lamps are compatible with the fixture and fit into them.

E16.2.3 Miscellaneous Structural Steel

- (a) Structural steel shall conform to CSA Standard CAN3-G40.21-M98, Grade 300W. All structural steel shall be hot-dip galvanized to a minimum weight of zinc coating of 600 g/m<sup>2</sup>.

E16.2.4 Welding Electrodes

- (a) Welding electrodes (low hydrogen type) shall be compatible with steel grades to be welded and shall conform to CSA Standard W58.1-M1980.

E16.2.5 Touch-up for Galvanizing

- (a) Touch-up for galvanizing shall be done using Galvalloy, supplied in accordance with the Specification for "Expansion Joints."
- (b) All fasteners, including bolts, nuts, washers, concrete anchors/inserts, etc., shall be as shown on the Drawings and shall be stainless steel.

E16.2.6 Electrical Cable

- (a) Electrical cable shall be 12-2 Cabtyre Type SOW cable (two #12 wires and one #12 ground wire). Incidental to this item shall be all miscellaneous electrical hardware necessary for a proper installation. Include 90° cable fitting at junction box to prevent cable sheering.

E16.2.7 Rigid Steel Conduit

- (a) Rigid steel conduit shall be 40-mm I.D. and 19-mm I.D., and shall be hot-dip galvanized to a minimum weight of zinc coating of 600 g/m<sup>2</sup>.

E16.2.8 Standby Materials

- (a) Incidental to the Work of this Specification the Contractor shall supply the City the following standby materials in accordance with Clause E19.2.2:
  - (i) six clear globes (G23)
  - (ii) two guards (P20)
  - (iii) six 28-watt compact fluorescent lamps

E16.3 Construction Methods

E16.3.1 Permits, Codes and Regulations

- (a) The Contractor shall be responsible to obtain and pay for all electrical permits, inspections, etc., required by the authorities having jurisdiction over this Work, and he shall provide a copy of each permit to the Contract Administrator before commencing any work at the site.
- (b) The Work shall be carried out in accordance with the latest regulations of the Canadian Electrical Codes and all applicable municipal and provincial codes and regulations. In no instance, however, shall the standard established by the Drawings and Specifications be reduced by any of the codes referred to above.

E16.3.2 Installation of Navigation Light Fixtures

(a) General

- (i) Navigation lights shall be installed at the locations shown on the Drawings. It shall be the responsibility of the Contractor to ensure that the navigation lights are functional following their installation and connection to the power source (street lighting system).

- (ii) All structural components of the navigation lights, including the deck plate, frame c/w studs, and the rigid steel conduits shall be shop fabricated and assembled. All structural steel including rigid conduit shall be hot-dip galvanized prior to the installation at the bridge site.
- (b) Conduits
  - (i) Conduits from the bridge lighting poles shall be installed and paid for under the Specification for "Electrical Conduit and Reinforced Concrete Encasement."
- (c) Electrical Cable Conductor
  - (i) The Contractor will be responsible to supply and install the electrical cable conductors for the navigation lights from the bridge lighting poles, as shown on the Drawings. The connection at the bridge lighting poles will be made by Manitoba Hydro.
- (d) Inspection and Acceptance
  - (i) After the installation of the navigation lights has been completed satisfactory to the Contract Administrator, the Contractor shall arrange for the final electrical inspection by Manitoba Hydro. Once the installation is approved by Hydro, Hydro will make the connection to the service. Thereafter, a final inspection will be made by the Contract Administrator with the Contractor present to ensure that the navigation lights are functioning satisfactorily.

#### E16.4 Measurement and Payment

- E16.4.1 The supply and installation of navigation lights will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "Navigation Lights" performed in accordance with this Specification and accepted by the Contract Administrator.

### **E17. ROADWAY LIGHTING**

- E17.1 As described elsewhere in this Specification, the Contractor will be responsible to supply and install the conduit and the anchors for the roadway lighting poles. The roadway lighting conductor and poles will be supplied and installed by Manitoba Hydro. The Contractor shall coordinate the work of Manitoba Hydro with his and ensure that Hydro has enough time to complete their works before the opening of the bridge to the public.

### **E18. INSTALLATION OF ALUMINUM BALANCED BARRIER AND ALUMINUM BRIDGE BARRIER**

#### E18.1 Description

- E18.1.1 This Specification shall cover the installation of the aluminum balanced barrier and aluminum bridge barrier in accordance with Standard Construction Specification CCW 3650-R4 and as specified herein.

#### E18.2 Materials

##### E18.2.1 General

- (a) Materials shall be supplied in accordance with Standard Construction Specification CW 3650-R4 and as specified herein.
- (b) Some of the components are to be fabricated by the Contractor from material supplied by the City.
- (c) Much of the aluminum materials and assembly hardware will be supplied to the Contractor by the City f.o.b. the City Bridge Yard. The Contractor is to supply other materials necessary for the installation. In the case of the terminal end, the

Contractor is to supply the aluminum plate and The City will supply the rail. Refer to the bill of materials on the Drawings for supply responsibility.

E18.2.2 Traffic Barrier Rails Posts - BR1 Type C

- (a) Aluminum traffic barrier bridge rail posts shall be supplied conforming to the requirements of the Drawings.
- (b) The traffic barrier rail posts shall conform to the requirements of ASTM B221M-83 Alloy 6061-T6 or Alloy 6351-T5 for extrusions, sheet, and plate. Aluminum Filler Alloy for welded construction shall be one of the following: ER4043, ER5183, ER5356, ER5554, ER5556, or ER5654. Welded construction shall conform to the requirements of CSA Standard S244-1969 and CSA Standard W47.2-M1987.
- (c) All edges and corners of traffic barrier rail post extrusions and plates shall be rounded smooth as shown on the Drawings. Rounded edges damaged during installation shall be repaired by the Contractor to the satisfaction of the Contract Administrator.

E18.2.3 Rail Post Anchor Bolts

- (a) Rail post anchor bolts are specified and paid for in the Specification for "Structural Concrete."

E18.2.4 Rail Post Shims

- (a) Rail post shims shall conform to ASTM Standard B221, Alloy 6061-T6, and shall be supplied as required to facilitate the installation of the rail posts as shown on the Drawings. Supply of shims will be considered incidental to the supply of bridge rail posts.

E18.2.5 Bituminous Paint

- (a) Bituminous paint shall be an alkali-resistant coating and conform to CGSB 31-GP-3M. Supply of bituminous paint shall be incidental to the supply of aluminum traffic barrier rail posts.

E18.2.6 Antiseize Coating

- (a) The antiseize coating to be applied to all threaded components when being assembled shall be LPS-3, manufactured by Holt-Lloyd (Canada) Ltd., Markham, Ontario, L3R 2Z3.

E18.3 Construction Methods

E18.3.1 General

- (a) Installation of aluminum balanced barrier shall be done in accordance with Standard Construction Specification CW 3650-R4.
- (b) The Contractor shall load the City supplied aluminum barrier materials at the City Bridge Yard at Ravelstone and Plessis.
- (c) The Contractor shall supply and use an approved anti-seize component on all of the fasteners and install hot-mix asphalt at the openings in the sidewalk for the buried posts and rail.

E18.3.2 Supply of Traffic Barrier Rail Posts - BR1 Type C

- (a) Traffic barrier rail posts shall be supplied by the Contractor, completely fabricated, as shown on the Drawings.
- (b) Welded construction shall conform to the requirements of CSA Standards W592-M91 "Welded Aluminum Construction" and W47.2-M1987, "Certification of Companies for Fusion Welding of Aluminum."

E18.3.3 Installation of Traffic Barrier Rail Posts

- (a) The traffic barrier rail posts shall be installed in a careful, workmanshiplike manner onto the anchor bolts to the grade and alignment on the Drawings or as directed by the Contract Administrator.
- (b) The grade of the rail posts must be averaged over irregularities in the grade of the concrete in order to ensure a smooth and uniform grade on the barrier rail. The rail posts shall be set on aluminum shims, as required, to achieve the correct elevation and grade. Additional aluminum shims shall be installed as required to achieve the correct elevation and grade. The surface of the bottom shim that is in contact with concrete shall be painted with a minimum of two (2) coats of bituminous paint. Each coat shall have a minimum thickness of 1.0 mm.

E18.3.4 Replacement of Damaged Materials

- (a) In the event of damage to any materials, the Contractor shall immediately notify the Contract Administrator and make all necessary repairs or replacements, at his own expense, to the satisfaction of the Contract Administrator. In no case shall the Contractor install a damaged component on the barrier.

E18.4 Quality Control

- E18.4.1 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 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 that are not in accordance with the requirements of this Specification.

E18.5 Measurement and Payment

E18.5.1 General

- (a) Except as noted below, all other work and materials of this section will be paid for in accordance with Standard Construction Specification CW 3650-R4.

E18.5.2 Supply Non-City Supplied Aluminum Barrier Components

- (a) The supply of non-City supplied aluminum barrier components will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "Supply Non-City Supplied Aluminum Barrier Components" performed in accordance with this Specification and accepted by the Contract Administrator.

E18.5.3 Install Traffic Barrier Rail Posts - BR1 Type C

- (a) The installation of traffic barrier rail posts BR1 Type C will be measured on a unit basis and paid for at the Contract Unit Price for "Install Barrier Rail Posts BR1: Type C" performed in accordance with this Specification and accepted by the Contract Administrator.

**E19. ST. JAMES BRIDGE SOUTHBOUND MEDIAN BULL-NOSE WORKS**

E19.1 Description

- E19.1.1 This Specification shall cover the renewal of the concrete bull-nose at the St. James Bridge Southbound where shown on the Drawings in accordance with this Specification and Standard Construction Specification CW 3235-R5.

- E19.1.2 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.

E19.2 Materials

E19.2.1 Materials shall be supplied in accordance with Standard Construction Specification CW 3235-R5.

E19.3 Construction Methods

E19.3.1 General

(a) Work shall be done in accordance with Standard Construction Specification CW 3235-R5, except as amended herein.

E19.3.2 Schedule

(a) This Work will be required to be done before the detour of traffic takes place at the Maryland Bridge project. This is so that traffic is not disrupted at the St. James Bridge while traffic disruption takes place through the detour operation at the Maryland Bridge.

E19.3.3 Traffic Control

(a) The Contractor may close only one lane at a time of the lanes each side of the median outside of rush hours. Otherwise, all lanes are to be open. For the purposes of this work site, rush hours are defined as between 06:30 to 09:00 and 15:30 to 17:30 hours on weekdays only. It is expected that whenever the Contractor does not have the Academy ramp lane closed, for safety reasons, he will have the lane on the west side of the median closed.

E19.3.4 Bull-nose Works

(a) The Work of existing concrete slab removal, base construction, concrete slab installation, supply and placement of reinforcing steel, and formed concrete safety shape construction shall be done in accordance with Standard Construction Specification CW 3235-R5. Concrete supply shall be that for bull-noses as specified in Standard Construction Specification CW 3310-R9.

E19.4 Measurement and Payment

E19.4.1 The removal of the existing bull-nose and curbs and the construction of the proposed reinforced monolithic bull-nose will not be measured. This item of Work will be paid for at the Contract Lump Sum Price for "St. James Southbound Median Bull-nose Works" performed in accordance with this Specification and accepted by the Contract Administrator.