1. GENERAL

1.1 Work Included

1.2 Existing Conditions

.1 Take over structures to be demolished based on their condition on date that tender is accepted.

1.3 Demolition Drawings

.1 Where required by authorities having jurisdiction, submit for approval drawings, diagrams or details clearly showing sequence of disassembly work or supporting structures and underpinning.

.2 Drawings for structural elements shall bear signature and stamp of qualified Professional Engineer registered in Province of British Columbia.

1.4 Protection

.1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades or parts of existing structures to remain. Provide bracing, shoring and underpinning as required. Repair damage and make good and be liable for injury caused by demolition.

.2 Take precautions to support structures and, if safety of structure being demolished or adjacent structures or services appears to be endangered, cease operations and notify the Engineer.

.3 Prevent debris from blocking surface drainage inlets. All utilities, gas, mechanical and electrical systems in the vicinity which are not identified for removal must remain in operation.

2. PRODUCTS

Not applicable.

3. EXECUTION

3.1 Work

.1 Dispose of demolished materials except where noted otherwise. Owner may want old seals.

.2 Carefully remove the items as identified for removal:

.1 Bearings

.2 Expansion Joints

3.2 Safety Code

.1 Unless otherwise specified, carry out demolition work in accordance with current Canadian and Provincial Construction Safety Codes.

3.3 Preparation

.1 Disconnect electrical and telephone service lines entering buildings to be demolished as per rules and regulations of authorities having jurisdiction. Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.

.2 Disconnect and cap utility services in accordance with requirements of local authority having jurisdiction.

.3 Do not disrupt active or energized utilities.

3.4 Demolition

.1 Demolish structure elements as indicated.

.2 Demolish parts of existing structure to accommodate construction of addition and remedial work as indicated.

.3 Take precaution not to damage any reinforcing or concrete that are identified to remain on the Drawings.

.4 All materials from demolition work must be removed and disposed off site.

.5 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace same as work progresses.

.6 At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling.

.7 Demolish in a manner to minimize dusting. Keep dusty materials wetted.

.8 Demolish concrete in small sections. Carefully remove and lower structural framing and other heavy and large objects.

.9 Selling or burning materials on site is not permitted.

.10 Remove contaminated or dangerous materials from site and dispose of in safe manner to minimize danger at site or at any time during disposal.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Furnish all labour, materials, tools plant and equipment, temporary facilities, permits and related services necessary to complete design and installation of the mini-piles shown on the drawings and described in this section of the Specifications.

.2 Mobilize and demobilize all equipment for all survey work described in this section of the Specifications.

.3 Supply all labour, materials and equipment for all survey work described in this section of the Specifications.

.4 Performance of Compression Load Test on one mini-pile as indicated on the drawings.

.5 Install mini-piles complete with anchorage devices and confining spiral reinforcement.

.6 Performance of Test Tension Test on one mini-pile and all remaining mini-piles.

1.2 Related Work

.1 Related sections of the Work include:

.1 Concrete Reinforcement Section 03200

This section of the Specification is not necessarily complete in itself and must be read in conjunction with the other sections of the Contract documents.

1.3 Definitions

.1 A mini-pile is a small diameter pile which consists of a central steel threadbar (e.g. Dywidag type or approve equivalent) encased in pressure injected cement grout. The grout cylinder completely encases the central threadbar from the base of the drilled hole to the base of the concrete footing. These mini-piles carry both compression and tension loads.

.2 A test mini-pile is a vertical mini-pile installed for the Performance Compression Load Test to verify pile capacity and test mini-pile will be incorporated, where possible as production piles.

.3 A production mini-pile is an inclined or a vertical mini-pile installed beneath footings or through existing footings.

.4 Performance Compression Load Test is to be completed prior to production min-pile installation to establish mini-pile embedment lengths required to meet design loads.

.5 Acceptance test is a tension test done on each production mini-pile at 150% of design load.

.6 End anchorage is the length of threadbar and assemblage within the concrete footing (see mini-pile head details).

.7 **Mini-pile bond length** is the grouted length to be designed by Owner's engineer between the bottom of the footing and the tip of the mini-pile. On this project the grouted length starts at the underside of the footing.

.8 **Mini-pile development length** is the length from the end anchorage bearing plate to the beginning of the bond length. (Prior to concrete pouring to the footing.)

.9 Free stressing length (if any) is the length of mini-pile located within the footing, from the base of the footing up to and including the end-anchorage assembly.

1.4 Reference Standards

.1 Unless specified otherwise, use the most current edition of the following standards:

.1 Canadian Standards Association

.1 CSA CAN3-A5 Cement grout

.2 CSA G30, 18-M92 Billet-Steel Bars for Concrete Reinforcement

.3 G279-M1982 Steel for Pre-stressed Concrete Tendons

.2 American Society for Testing and Materials:

.1 ASTM A722 – 88 Un-coated High-strength Bar for Pre-stressing Concrete

.3 Post-Tensioning Institute:

.1 Recommendations for pre-stressed Rock and Soil Anchors – 1996

.2 Keep a copy of these Standards on site for the duration of work.

1.5 Site Visit and Acceptance

.1 Visit the site and examine working and access conditions for the proposed mini-piles. Verify that the proposed equipment can access the proposed work areas and check that all work can be performed according to drawings and Specifications.

.2 Notify the Engineer of any discrepancies or errors during the bidding period.

.3 Examine available drawings and check that utilities will not be intercepted by the mini-piles. Confirm location of utilities by hand digging or other means approved by the Owners of the utility.

Notify the Owner of the utility if work is to be done adjacent to and that will possibly affect the utility.

.4 Starting work means acceptance of the site conditions by the Contractor.

1.6 Report and Drawings

.1 It should be noted that ground conditions might vary between test hole locations. Similarly groundwater conditions may vary with time and differ from that indicated in the test hole location.

.2 No additional sums of money will be allowed for any items resulting from lack of understanding of the ground conditions. A claim for extra costs will be considered only if, in the opinion of the Engineer, the claim represents any item which could have not been pre-determined or assessed from the available information or site visit.

1.7 Design

.1 The Owner's Geotechnical Engineer shall be responsible for the mini-pile design and shall meet the following minimum design requirements:

.1 Mini-pile factored design load is 270 kN acting in tension or compression.

.2 Design the mini-piles to suit the Geotechnical information provided, adhering to the following minimum design criteria.

.1	minimum hole diameter	200 mm
.2	minimum anchor bond length	12.85 M
.3	minimum anchor bar length	12.85 M bond length and development length

.3 Design the end-anchorage assembly and confining spiral for ultimate strength of 125% of the yieid capacity of the threadbars chosen to suit the design loads shown on the drawings. Design the end anchorage to resist loads acting in tension or compression.

.4 Provide design drawings for the piles and anchorage signed and sealed by a Professional Engineer registered in the Province of British Columbia.

.5 The Bond lengths specified on the Drawings are a minimum.

1.8 Allowable Tolerances

.1 Deviation in alignment of drill holes for mini-piles shall not exceed 1 in 50.

.2 Straightness shall not deviate more than 20 mm in any 3 M length of drill hole.

.3 Mini-pile centres shall not deviate more than 50 mm from design location.

1.9 Submittals and Records

.1 Submit a reference list of similar mini-pile installation work performed to demonstrate experience on projects of similar magnitude and scope with the submission of the bid

documents. Only specialist contractors who are qualified in the opinion of the Engineer will be approved.

.2 Submit schedule for load testing and production mini-pile installation with the bid documents.

.3 Tenderers shall submit with their bid documents the name and registration of the Professional Engineer engaged by the Contractor for the verification witnessing and sealing of the design and installation of all mini-piles to meet specifications and load capacities.

.4 Submit with the Tender a proposed schedule of work and a list of proposed drilling, grouting and testing equipment that is to be used.

.5 The successful Tenderer shall submit the shop drawings of the mini-piles that includes the following information:

A Professional Engineer registered in British Columbia shall seal the shop drawings.

.1 Specifications of mini-pile materials and design details of mini-piles in sufficient detail to describe components and assemblies.

.2 Proposed Performance Compression Load Test set-up and threadbar strength and dimensions,

.3 Proposed acceptance test set-up.

.4 Method and details of proposed grouting procedures.

.5 Specification of cement grout (e.g. cement type, design strength an additives).

.6 Pile bond length and hole diameter.

.7 Proposed drilling method.

.8 Proposed design of threadbar anchorage in footings,

.6 Submit 21 days prior to mobilization:

.1 Manufacturer's test data including all mill test reports and quality control program.

.2 Calibration and operating data for torque wrenches, hydraulic jacks, load cells and dial gauges to be used for performance load testing and acceptance testing. Ail torque wrenches, hydraulic jacks and dial gauges must be calibrated prior to use, and there after at least once a month using approved calibration procedures. The calibration certificates shall have been issued within two weeks of start of work and shall include serial numbers or equivalent identification of the calibrated equipment to be available on site at the time of testing.

.7 Maintain a record of the following for each mini-pile:

.1 Drilling records showing dates, method of drilling, location, length, diameter, orientation of holes and ground conditions.

.2 Pile number, cement quantity and the installation date for each mini-pile.

.3 Grout pressure for each mini-pile.

.4 Tension load versus displacement of mini-pile for all Acceptance Tests. Measure axial displacement movements of the pile head relative to a datum {approved by the Engineer) with instruments having an accuracy of 0.002 inch or better.

.5 Provide Owner's representatives with three (3) copies of the records.

1.10 Quality Assurance

.1 Employ only personnel that are fully experienced and familiar with the installation of mini-piles.

.2 Each production mini-pile will be subjected to an acceptance test in accordance with the procedures outlined in Section I. The Acceptance Test Loads shall be 150% of the design load. Upon passing the Acceptance Test, the pile will be de-stressed to zero load. Failure of any piles to meet the Acceptance Test criteria will result in rejection of the pile in question. The Contractor shall install replacement pile(s) that subsequently must pass the Acceptance Test.

.3 The Contractor shall retain an independent testing agency for the testing of the cement grout. A minimum of 50.8 mm grout cubes shall be taken for every ten installed piles or taken once per day, whichever is least.

.4 Submit all mill test reports of the steel used to fabricate the central threadbars.

.5 The Contractor's Geotechnical Engineer will monitor the installation and acceptance testing of all mini-piles and provide verification of the installation and testing including his professional seal prior to pouring of concrete foundation.

.6 Monitoring by the Engineer does not relieve the Contractor or the Contractor's Geotechnical Engineer of his sole responsibility for quality of the work and all submittals of information required by this Specification.

2. PRODUCTS

2.1 Threadbar

.1 Mini-piles shall include a central No. 18 threadbar (Dywidag type or approved equivalent) with a nominal diameter of 57 mm in accordance with CSA G30.12. Material yield stress shall be 517 Mpa. Pile length will be finalized after completion of the Performance Compression Load Test,

.1 Ultimate Load 1781 KN (400 kips)

.2 Yield Load 1334 KN (300 kips)

.2 The threadbar shall be contained within a grout-filled corrugated plastic P.V.C. sheath (Dywidag double-corrosion system or approved equivalent). The sheathing shall be capable of withstanding the applied handling stresses, hydrostatic and grouting pressures.

.1 80 mm outside diameter,

.2 Minimum thickness 1.2 mm,

.3 Compressive strength = 102 Mpa,

.4 Tensile strength = 48 Mpa.

.3 Coupling of the threadbar will be required due to the limited headroom. The Contractor shall minimize the number of couplings. The couplings shall develop at least 125% of the yield strength of the threadbar in both tension and compression under cyclic loading.

.4 Spacers and centralisers will be required at 2.5 M spacing to ensure that the pile is kept in the centre of the drill hole.

2.2 End Anchorages

.1 Anchor plates and anchor nuts for anchoring the mini-pile threadbar within the concrete footing shall be compatible with the mini-pile system.

.2 Anchorage components shall develop at least 125% of the yield strength of the threadbar in both tension and compression.

2.3 Grout

.1 The cement grout shall be composed of the following materials;

.1 Portland cement conforming to CSA CAN3-A5,

.2 Non-shrink additive, Intraplast N or approved equal.

.3 Mixing water clean and free from oil, alkali, organic matter, or other deleterious materials.

.4 Water/cement ratio by weight shall be between 0.38 and 0.45.

.2 The cement grout shall have a minimum compressive strength of 35 Mpa at seven (7) days.

3. EXECUTION

3.1 General

.1 Execute Performance Compression Load Test,

.2 Execute the work on the restricted congested area. The mini-piles shall be installed as per specifications.

.3 Conduct one Performance Test and Tension Test of remaining piles.

3.2 Construction Procedure

.1 At the start of the work, install the first test mini-pile at the location indicated by the owner's representative and upon curing the grout, perform the Compression Test of the mini-pile as indicated below. The intent of the initial mini-pile test is to check, prior to the bulk of the mini-piles being installed, that the Contractor's proposed pile bond length and installation procedures produces adequate capacity. The test mini-pile must meet the specified acceptance criteria prior to the drilling or installation of any other mini-pile holes.

.2 Take care to protect any existing work during the movement of equipment and installation and testing of the piles. Make good any damage at no cost to the Owner. Do not wash grout into drains.

.3 If required by ground conditions, increase the length of the mini-pile to ensure satisfactory performance of the mini-pile. Note that mini-piles will not be measured for payment if they fail to pass acceptance testing. Additional pile lengths have to be approved in writing by the Engineer.

3.3 Performance Load Tests

.1 Conduct Performance Compression Load Test on one vertical mini-pile at locations indicated on drawings. The length of the test mini-pile shall be as per Drawing. A (1) and the minimum diameter shall be 200 mm (8 inches). The test(s) shall be performed on pre-selected production pile. This pile if appropriate shall be used as production piles on completion of testing. The test pile shall include a separate grout line to enable post-grouting measures to be carried out following Performance Compression Test if necessary to utilize this pile as a production pile

.2 Performance Compression Load Test Procedures:

.1 Static Axial Compressive Load shall be applied to the test pile according to a loading sequence based on the following:

.1 <u>Mini-piles:</u>

"Dywidag" 57 mm (#18) diameter threadbar conforming to CSA Standard G30.18 M92, Grade 517/690 Mpa (Gr. 75 ksi) complete with compatible hardware.

Yield Load	=	1334 KN (300 kips)
Ultimate Load	=	1781 KN (400 kips)
Diameter of Bored Hole	-	200 mm

Proposed Design Load (ULS condition)	=	270 KN
Proposed Test Load = 1.5 x Design Load	=	405 KN
Load Increment = 20% of Maximum Test Load	=	80 KN

.2 Each load increment shall be maintained for at least one hour until the rate of settlement was no greater that 0.01 inch (0.25 mm)/hour. Cyclic Test shall be applied at each load increment (10 cycles). The pile shall be tested increment by increment until the maximum test load is attained. The settlement of the pile shall be measured at 1, 2, 3, 4, 5, 10, 20, 30, 40, 50 and 60 -minute intervals to the nearest 0.001 inch.

.3 Use the same drilling procedures and grouting pressure for the test mini-pile for the production mini-piles. The threadbar strength and dimensions shall be such that failure occurs at the grout soil interface, not by rupture of the threadbar. The test threadbar is to be approved by the Engineer.

.4 Submit the raw data and the reduced load displacement data to the Engineer for review. The Engineer will inform the contractor within 48 hours of the acceptability of the test results.

.5 If the Performance Load Test results are not acceptable, in the sole opinion of the Contractor's Geotechnical Engineer, or the Engineer, then a further load test will be conducted using the same procedures and a new pile installation at a location determined by the Geotechnical Engineer.

3.4 Survey

.1 Layout by survey the locations of all production mini-piles as per the drawings.

3.5 Drill Holes

.1 Drill holes of minimum 200 mm (8 inches) diameter at the locations shown on the drawings. Drill the hole in a manner, which will not result in significant loss of ground beyond the hole diameter. Casings are required for drilling and the Contractor shall take appropriate measures to prevent ground water inflow under normal and artesian pressures and to prevent soil piping inside the casing and to prevent any interconnection between drill holes during drilling.

.2 Dispose of excavated materials as directed by the Owner's representatives.

.3 If required by ground conditions, increase the length of the mini-pile to ensure satisfactory performance of the mini-pile. Note that mini-piles will not be measured for payment if they fail to pass acceptance testing. Additional pile lengths will be measured for payment, only if the Geotechnical Engineer has approved the additional length in writing.

.4 Support drill holes with steel casing for the full depth.

.5 Flush drill holes clean using water or air on completion of drilling with the opening protected or sealed to prevent the entry of foreign matter.

.6 Drill deeper hole if, in the opinion of the Contractor's Professional Engineer and the Geotechnical Engineer, mini-pile of design length would not pass acceptance testing because of poor ground conditions.

3.6 Mini-pile Installation

.1 All aspects of installation to be verified, warranted and sealed by the Professional Engineer representing the Contractor.

.2 Install threadbar to the full length of the pile hole plus anchorage with spacers or centralizers with spring action to ensure that the pile assembly is centred.

3.7 Grouting

.1 Inject grout into the cased hole through a grout line at the lowest point of the bond length of the threadbar until the casing is filled.

.2 Inject grout with minimum 1.5 Mpa pressure through a top casing cap and simultaneously extract the casing. Maintain injection pressure during pressure grouting.

.3 After grouting, maintain anchors in an undisturbed condition until the grout has gained the necessary strength to maintain the mini-pile in a stable condition.

.4 Use grouting pressure that will not damage or affect the existing buildings and foundation.

3.8 End-Anchorage

.1 Design and install the end-anchorage assembly. Provide design drawings for the anchorage signed and sealed by a Professional Engineer registered in the Province of British Columbia.

3.9 Acceptance Testing

.1 After doing the Performance Compression Load Test, Performance Test on one other production mini-pile and Proof Test all the remaining piles.

.2 In the event that the test mini-pile does not pass the Performance Test, performance testing of additional mini-piles may be required.

.3 Test mini-pile after the grout has reached a strength of at least 25 Mpa. Failure of pile to meet the acceptance criteria will result in rejection of the pile.

.4 Supply cribbing, beams, threadbar extensions, calibrated jack, dial gauges, load cell for test load measurement, and any other hardware as necessary to conduct the Load Test.

Install temporary cribbing, beams, etc. for reaction as needed for testing. Locate bearing surfaces of the temporary reaction frame at least 20 inches clear of the pile.

.5 Performance Test

Performance Test as per PTI "Recommendations For Prestressed Rock And Soil Anchors" section 3.7.1. But using a maximum test tension load (1.5P) for the Performance Test where P = 270 kN.

.6 Proof Test

Proof Test as per PTI "Recommendations For Prestressed Rock And Soil Anchors" section 3.7.2. Use a maximum test tension load (1.5P) for the Performance Test where P = 270 kN.

.7 Acceptance Criteria

Acceptance Criteria in accordance with PTI "Recommendations For Prestressed Rock And Soil Anchors" section 3.8 and as follows:

.1 The total elastic movement obtained from a test should be between:

.1 80% of the theoretical elastic elongation of the free stressing length under the test load; and

.2 100% of the theoretical elastic elongation of the stressing length plus 50% of the bond length.

.2 The total elastic movement obtained from a load test, measured between 50% of the test load and the full test load should exceed 80% of the theoretical elastic elongation of the free stressing length for this respective load range.

.3 The creep should not exceed 0.08 inches during the final time increment of the test, regardless of thread length and load.

.8 If the mini-pile fails to meet the Acceptance Criteria, replace the failed mini-pile and re-test until the Acceptance Criteria are met.

.9 The Owner's representative will determine whether a mini-pile that fails to meet the above minimum Acceptance Criteria can be incorporated into the work or must be replaced by the Contractor. Replacement of failed mini-piles is the responsibility of the Contractor at no cost to the Owner.

.10 Remove the load from the pile after the load test.

.11 Proof load in tension each mini-pile to 150% of the design load. The mini-pile will be accepted only if the total pile extension under the test load over a period of five (5) minutes is less than 6 mm.

.12 Distress pile after Proof Load Test. Failure of any piles to meet the Acceptance Criteria in above will result in rejection of the pile.

3.10 Made Good

.1 Make good at no cost to the Owner, any damage to the new of existing structures, property of services caused by the movement of equipment, or by installation and testing of the mini-piles.

3.11 Clean-up

.1 Remove all surplus materials, equipment and debris from the site on completion of the work. Leave the site clean.

END OF SECTION

1. GENERAL

1.1 Intent

.1 Section 02223 refers to those portions of the work that are related to excavating and backfilling of bridge foundations. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.

.2 The geotechnical investigation report is included in the tender documents only for information, guidance and independent interpretation by the tenderers. It shows the approximate nature of the strata as known to the Owner. This report was prepared for use by Owner's Engineer only and is not intended to provide all information which may be required by the Contractor. The Owner shall not be liable for the accuracy of the data given and the Contractor may carry out his own soil investigation to obtain additional information.

1.2 Definitions

.1 Common Excavation: excavation of materials of whatever nature, including dense tills, hardpan, partially cemented materials, clay or frozen materials which can be ripped and excavated with heavy construction equipment.

.2 Over-excavation: excavation below design elevation of bottom of specified bedding, and including backfilling of resultant excavation with specified material, as authorized by the Engineer.

.3 Removals: removal and disposal at an approved location off-site of surface concrete structures and walks, curbs, gutters, manholes, catchbasins, pipes, culverts, endwalls, and any other structures on surface or underground specifically designated on Contract Drawings for removal. Removals to include backfilling of resultant excavation with specified material.

1.3 Disposal

.1 Dispose of all surplus spoil from excavations on-site and/or off-site as shown on Contract Drawings or as specified in Contract Documents. Suitability of excavated material for use as native bedding or trench backfill will be governed by Part 2 of this Section. Dumping of spoil on private property will be permitted only upon written approval from property owner and provided all necessary permits and approvals have been obtained.

1.4 Limitations of Open Trenches and Excavations

.1 Excavate trenches only as far in advance of pipe laying operation as safety, traffic, and weather conditions permit and, in no case, to exceed 30 m. Before stopping work on last day of work before each weekend or holiday, completely backfill every trench.

.2 If circumstances do not permit complete backfilling of excavations, adequately protect all open excavations with approved fencing or barricades and, where required, with flashing lights.

2. PRODUCTS

2.1 General

.1 Unless shown otherwise on Contract Drawings the materials specified in 2.2 following are approved for their respective uses.

2.2 Use of Specified Materials

.1 Backfill for over-excavated trench or structure excavations to be one of the following:

.1 Granular pipe bedding and surround material.

.2 Pit run sand.

.3 Drain rock (only where approved by Engineer).

.4 Concrete.

.5 Engineered fill

.2 Excavation backfill to be one of the following:

.1 Approved native material.

.2 Pit run gravel.

.3 Pit run sand.

.4 Engineered fill

.3 Surface treatment to be:

.1 Restoration to match existing conditions.

2.3 Materials

.1 Granular materials approved for roadwork (subbase, base) also acceptable for trench backfill subject to approval of Engineer.

.2 Concrete: to Section 03300, to be minimum 20 MPa.

.3 Engineered fill: Engineered fill shall consist of 75 mm minus crushed or angular pit run sand and gravel, or equivalent, with a grain size distribution that fall within the envelope shown in table 2.3-1.

TABLE 2.3-1: Recommended Gradation for Engineered Backfill

Sieve Size (mm)	75	37.5	19	4.75	1.18	0.3	0.075

Percent Passing (%)	100	30-100	20-100	10-60	6-32	4-15	0-5

3. EXECUTION

3.1 Site Preparation

.1 Remove all brush, weeds, grass and accumulated debris to an approved offsite location.

.2 Where excavation passes through lawn, neatly cut and remove sod before excavation. Save sod for replacement upon backfilling trench.

.3 Widths of excavation at ground level will depend on method of excavation support utilized by contractor

.4 Strip topsoil after area has been cleared and stockpile. Stockpile height not to exceed 2 m. Avoid mixing topsoil with subsoil. Dispose of unused topsoil. Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.

.5 Provide dewatering to excavations if needed. The need to dewater will depend on water levels.

.6 The contractor will carry out an independent assessment of site conditions to determine the temporary excavation and dewatering requirements to suit the techniques and equipment proposed.

3.2 Stockpiling

.1 Stockpile fill materials in areas designated by Engineer. Stockpile granular materials in manner to prevent segregation.

3.3 Excavation

.1 Prior to or at commencement of construction, check existing utilities for line and elevation within the area of the works and provide and install identification marks to positively locate utilities at ground surface, especially within the demarcated zones of excavations and their possible increased widths should open excavations be employed. If found different from Contract Drawings report such difference to Engineer immediately.

.2 Surface drainage:

.1 Provide suitable temporary ditches or other approved means of handling drainage prior to excavation and during construction to protect construction area and adjacent and other affected properties. Provide siltation controls to protect natural watercourses or existing municipal drainage facilities.

.3 Disposal of surplus soil: dispose of surplus excavated soil off-site. Side-casting not allowed in restricted areas where, in opinion of the Engineer, side-casting would create interference with flow of traffic. In such case, temporarily store materials or dispose to an approved site. Provisions of Provincial Contaminated Sites Legislation must be met prior to disposal of soil

off-site.

.4 Where native backfill is approved for re-use, and side-casting not allowed, transport approved material to other locations where material is required or temporarily store at approved site. Protect stored material from contamination, segregation and weather.

.5 Maintain roads used for transporting materials and equipment in clean condition. Clean, flush and/or sweep on daily basis and more frequently if directed by Engineer.

3.4 Backfill and Compaction

.1 General: Place backfill carefully to prevent damage to installed pipe in trench and to utilities in excavations.

.2 Backfill Materials:

.1 Foundations: for backfill around foundations or other areas not subjected to vehicle loading and backfill with approved native material.

.2 Roads, driveways and shoulders: for trenches in paved or gravelled roads, driveways, shoulders or other areas subjected to vehicle loading, backfill with imported granular material or approved native material as specified on Contract Drawings.

.3 Ditches: backfill with imported granular material or approved native material.

.4 Engineer may permit native material for all above uses subject to suitability of native material for said use. Native material approved for re-use to be handled, stockpiled and compacted using construction method appropriate for given moisture content and weather conditions.

.3 Compaction: place backfill and compact to following Modifier Proctor densities in compliance with ASTM D1557. (All following references to density imply compliance with ASTM D1557).

.1 Foundations to minimum 90%.

3.5 Surface Restoration

.1 General:

.1 Restore all disturbed surfaces to condition at least equal to that which existed prior to construction.

.2 Make good any damage to adjacent lands or improvements.

.3 Resolve all reasonable claims arising from Contractor's actions and obtain written releases from land owners following final restoration.

.2 Boulevards and easements:

.1 Restore surface to minimum 100 mm depth.

.2 Restore unimproved surfaces with material equal to that removed at surface.

.3 Restore gardens with approved topsoil or bark mulch to match existing conditions.

.4 Restore lawns with approved topsoil and seed or sod to match existing lawn.

.5 Restore gravel surfaces with matching granular materials.

.6 Complete final restoration immediately upon completion of trench backfilling.

.3 Gravelled roads and driveways:

.1 Restore surface with minimum 75 mm to 100 mm thick lift of 19 mm granular road base material.

.2 Compact to minimum 95% Modified Proctor density.

.3 Complete final restoration immediately upon completion of trench backfilling.

.4 Ditches:

.1 Re-shape ditches to specified lines, grades and sections and restore surface with minimum 300 mm of specified material to ensure stability of ditch slopes and bottom.

.2 Compact to minimum 95% Modified Proctor density.

.3 Complete final restoration immediately upon completion of trench backfilling.

.5 Base preparation for paved surfaces:

.1 Paved surfaces to include all paved roads, driveways, sidewalks and parking areas.

.2 If native material used for backfill provide specified depth of subbase as shown on Contract Drawings.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Forms and supporting falsework design.

.2 Wood or steel forms for all cast-in-place concrete.

.3 Void forms.

.4 Shoring, bracing and anchorage.

.5 Taping of form joints for special finishes.

.6 Form openings for other trades.

.7 Coordinate installation of concrete accessories.

.8 Set anchor bolts, anchors, sleeves, frames and other items supplied by other trades.

.9 Clean erected formwork prior to concrete placement.

.10 Remove forms and supporting falsework.

.11 Reshoring.

1.2 Related Work

.1	Concrete Reinforcement:	Section O3201
.2	Concrete Accessories:	Section 03250
.3	Cast-in-Place Concrete:	Section 03300

1.3 Reference Standards

.1 Design, construct and erect supporting falsework in accordance with the current National Building Code of Canada, CSA-A23.1M, ACI 347 and applicable construction safety regulations.

.2 Design to be done by a Professional Structural Engineer registered in the Province of British Columbia. Same Engineer to inspect the erected formwork and certify, in writing, that it is in accordance with the design.

1.4 Shop Drawings

.1 Submit shop drawings for review.

.2 Clearly indicate sizes, methods of construction, materials, arrangement of joints, ties and shores, location and size of falsework, jacking locations, jack sizes, schedule of erection and stripping.

.3 Shop drawings and design briefs are to bear the seal of a Professional Engineer registered in the Province of British Columbia.

2. PRODUCTS

2.1 Materials

.1 For Exposed Surfaces: square-edged, smooth surfaced panels true in plane, free of holes, surface markings or defects.

.2 For Unexposed Surfaces: square-edged T&G lumber, plywood or other material suitable to retain concrete without leakage or distortion.

.3 Wood Materials:

.1 Plywood: Douglas Fir, conforming to CSA 0121-M, solid one side select sheathing - tight face grade. Sound, undamaged sheets with clean true edges.

.2 Lumber: conforming to CSA 0141-M.

.3 Nails, Spikes and Staples: galvanized or phosphatized; conforming to CSA B111.

.4 Prefabricated Forms:

.1 Steel Type: minimum 1.6 mm steel thickness; well matched, tight fitting and adequately stiffened to support the weight of concrete without deflection detrimental to structural tolerance and appearance of finished concrete surface.

.2 Tubular Column Type: round, spirally wound laminated fibre material, internally treated with release agent; sizes indicated on the Drawings.

.5 Accessories:

.1 Form Ties: removable or snap-off metal type with metal form spacers, fixed or adjustable length; minimum working strength of 13 kN. When assembled, free of defects that will leave metal closer than 40 mm from concrete surface. Wire ties are not permitted. Use plastic cone snap type on exposed surfaces.

.2 Form Release Agent: colourless mineral oil which will not stain concrete or impair natural bonding or colour characteristics of coating intended for use on concrete.

.3 Corner or Chamfer Fillets: extruded plastic or mill finish pine, 20 mm width, maximum possible lengths, mitre ends.

.4 Sealing Tape: reinforced, self-adhesive polyvinyl-chloride.

3. EXECUTION

3.1 Examination

.1 Before starting this work examine work done by others which affects this work.

.2 Rectify all conditions which would prejudice proper completion of this work.

.3 Commencement of work implies acceptance of existing conditions.

3.2 Erection

.1 Verify lines, levels and centers before proceeding with formwork. Ensure dimensions agree with the Drawings.

.2 Construct formwork and falsework to meet design and regulatory requirements and to produce finished concrete conforming to surfaces, shapes, lines and dimensions indicated on the Drawings. Ensure visible lines of the curbs, barriers, walls and walks follow a smooth profile both vertically and horizontally. Construct formwork for these items with vertical and horizontal adjustments relative to the concrete deck.

.3 Arrange and assemble formwork to permit removal without damage to concrete. Set shores supporting forms for girders, beams, slabs and other horizontal members on wedges or other approved adjustable supports.

.4 Do not weld formwork to steel superstructure.

.5 Align joints and make watertight to prevent leakage of cement paste and disfiguration of concrete. Keep form joints to a minimum. Tape form joints for surfaces to receive sandblast finish.

.6 Do not use earth surfaces to form concrete without written approval of Engineer.

.7 Arrange forms to allow removal without removal of principal shores where these are required to remain in place.

.8 Obtain the Engineer's permission before framing openings in concrete beams and columns. Provide temporary openings at the base of wall and shaft forms and other places where necessary to facilitate cleaning and inspection.

.9 Provide falsework to ensure stability of formwork. Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

.10 Position form joints to suit any expressed lines required in exposed concrete. Arrange form board panels in a regular symmetrical pattern to the approval of the Engineer.

.11 Provide 20 mm chamfer on all internal and external corners and edges of exposed concrete.

.12 Form chases, slots, openings, drips and recesses as detailed on the Drawings.

.13 Set screeds with top edge level to required elevations.

.14 Check and re-adjust formwork to required lines and levels during placing of concrete.

.15 If form sheathing is to be re-used, remove nails and clean surfaces in contact with concrete before re-using.

3.3 Tolerances

.1 Construct formwork and all supporting or bracing members to within the following deflection limitations under the weight or pressure of wet concrete and other loadings incidental to construction. Deflections are not cumulative.

.1 Forms: 1/270 of span between supporting studs.

.2 Studs: 1/270 of backing wale space.

.3 Wales: 1/270 of span between ties or other support points.

.2 Construct formwork to produce concrete with dimensions, lines and levels within the following tolerances. Tolerances are not cumulative.

.1 Deviation From Vertical Line, for Columns, Piers and Walls: 6 mm in 3 m, 9 mm in 6 m, and 20 mm in 12 m or more.

.2 Deviation From Flat Surface, for Deck Slab, Sidewalks and Top of Walls and Barriers: 3 mm in 3 m.

.3 Deviation from Horizontal Line: 6 mm in 3 m.

.4 Deviation from Position of Columns, Piers and Walls: 6 mm.

.5 Deviation in Cross-sectional Dimensions of Columns, Piers and Walls or Thickness of Slabs: +6 mm / -0 mm.

.3 If tolerances are exceeded, remove, replace or modify placed concrete as directed by the Engineer at no cost to the Owner.

.4 Provide for settlement, closure of joints and elastic shortening of forms and shoring. Camber slabs and beams as shown on the Drawings. Maintain beam depth and slab thickness from cambered surface.

3.4 Construction Joints

.1 Locate joints not indicated on the Drawings so as to least impair the strength of the structure. Obtain the Engineer's approval before proceeding.

.2 Construct joints in accordance with CSA-A23.1-M.

3.5 Form Ties

.1 For exposed concrete fit ties with cones approximately 20 mm diameter and not longer than 50 mm. Coat ties with cup grease or other approved material if ties are to be removed. Loosen ties twenty four hours after concrete has been placed. Ensure sufficient numbers of ties remain to hold form in place. Cutting ties back from the face of the wall is not permitted.

.2 Below grade or below water level and all non-exposed concrete, fill all holes left by withdrawal of rods or holes left by removal of tie ends with solid mortar as outlined in the concrete section.

.3 Remove all cones from exposed concrete surfaces. If surface is to be sandblasted, leave cones in place until after sandblasting is complete. Fill cone holes with small amount of grey sealant to cover metal rod.

.4 The holes left by withdrawal of rods or the holes left by removal of ends of ties shall be filled solid with mortar after first being thoroughly wetted. For holes passing entirely through the wall a plunger-type pressure gun or other device shall be used to force the mortar through the wall starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside and when the hole is completely filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing entirely through the wall shall be filled with a small tool that will permit packing the hole solid with mortar. Any excess mortar at the wall shall be struck off flush with the surface.

3.6 Embedded Items

.1 Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through the concrete members.

.2 Accurately locate and set in place, items which are to be cast directly into concrete.

.3 Coordinate the work of other Sections and cooperate with trades involved in forming openings, slots, recesses, chases and setting sleeves, bolts, anchors and other inserts.

.4 Coordinate installation of concrete accessories specified in Section 03250.

.5 Set anchor bolts, sleeves and inserts accurately at the positions designated. Secure in position by means of wooden templates and ties to prevent shifting and floating during concrete placement.

.6 Do not set anchor bolts, sleeves and inserts into placed concrete.

.7 Core holes and grout anchor bolts for bearings.

3.7 Quality Control

.1 Inspect and check complete formwork, falsework, shoring and bracing to ensure that the work is in accordance with formwork design and that supports, fastenings, wedges, ties and parts are secure.

.2 Inform Engineer when formwork is complete and has been cleaned to allow for inspection. Engineer's inspection will be for verification that forms are clean and free from debris.

.3 For all exposed concrete surfaces. Do not patch formwork.

.4 Allow the Engineer to inspect each section of formwork prior to reuse. Formwork may be re-used if approved by the Engineer.

3.8 Cleaning

.1 Clean forms as erection proceeds to remove foreign matter. Remove cuttings, shavings and debris from within the forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

.2 During cold weather, remove ice and snow from within the forms. Do not use de-icing salts. Do not use water to clean out completed forms unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.9 Preparation

.1 Apply form release agent in accordance with the manufacturer's recommendations prior to placing reinforcing steel, anchoring devices and embedded parts.

.2 Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings which are affected by the agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces moist prior to placing the concrete.

3.10 Form Removal

.1 Notify Consultant prior to removing formwork.

.2 The following Table is to be used as a guide for the removal of forms and supports:

	Minimum Period of Time	Minimum Concrete Strength (based on 28 Day Strength)
Columns	3 days	70%
Pier shafts, walls and critical vertical faces	2 days	50%
Deck	5 days	70%
Footings	1 day	--

.3 Remove falsework progressively in accordance with regulatory requirements and ensure that no shock loads or imbalanced loads are imposed on the structure.

.4 Loosen forms carefully. Do not apply tools to exposed concrete surfaces.

.5 Leave forms loosely in place for protection until complete removal is approved by the Engineer.

.6 Removal of forms subject to approved on-going curing procedures.

3.11 Reshoring

.1 Prepare a schedule of reshoring and submit to the Engineer for review.

.2 Reshore structural members where required due to design requirements or construction conditions, or where subject to additional loads during construction.

.3 Install reshoring as required to permit progressive construction.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Reinforcing steel bars for cast-in-place concrete complete with tie wire.

.2 Support chairs, bolsters, bar supports and spacers for reinforcing.

.3 Epoxy coated reinforcing steel bars.

1.2 Related Work

.1 Cast-in-Place Concrete: Section 03300.

1.3 Reference Standards

.1 Perform concrete reinforcing work in accordance with CSA-A23.1-M and CAN/CSA-S6 except where otherwise specified.

1.4 Test Reports

.1 If requested by the Engineer, submit certified copies of mill test report of reinforcement supplied, indicating physical and chemical analysis.

1.5 Shop Drawings

.1 Submit concrete reinforcement shop drawings.

1.6 Delivery/Storage

.1 Deliver, handle and store concrete reinforcement in a manner so as to prevent damage and contamination.

.2 Use padded bundling bands and multiple supports to prevent bar abrasion for epoxy coated bars.

2. PRODUCTS

2.1 Materials

.1 Reinforcing Steel: 400 MPa yield grade; deformed billet steel bars conforming to CSA G30.18-M, plain finish and epoxy coated finish.

.2 Epoxy Coated Material: Scotchcote 213, Fusion bonded epoxy coating, thickness 215 ± 85 micrometres as manufactured by the 3M Company, or approved equal meeting the following requirements:

.1 ASTM A775/A775M - 89a - Standard Specification for Epoxy Coated Reinforcing Steel Bars.

2.2 Accessory Materials

.1 Tie Wire: minimum 1.6 mm annealed type or patented system approved by the Engineer or plastic coated for epoxy reinforcement.

.2 Chairs, Bolsters, Bar Supports, Spacers: adequately sized for strength and support of reinforcing steel during construction. Metal chairs shall be galvanized.

.3 Concrete Bricks: acceptable for support of bottom layer of bars in slabs on fill. Broken concrete blocks and wood supports are not acceptable.

.4 Special Chairs, Bolsters, Bar Supports, Spacers: where adjacent to exposed concrete surfaces, plastic coated type.

2.3 Fabrication

.1 Fabricate reinforcing steel in accordance with CSA-A23.1-M and Drawings.

.2 Locate reinforcing splices not indicated on the drawings at points of minimum stress. Obtain the Engineer's approval. Unless otherwise noted, provide tension lap splices, Class C.

.3 All bars to be bent cold.

.4 Fabricate within the following tolerances:

.1 Sheared Length: $\pm$25 mm.

.2 Depth of Truss Bars: +0/ $\pm$13 mm.

.3 Stirrups, Ties and Spirals: $\pm$13 mm.

.4 Other Bends: $\pm$25 mm.

.5 Welding not permitted without written approval of the Engineer.

2.4 Epoxy Coating

.1 Check epoxy coating visually for continuity after cure. Ensure coating is free from holes, voids, contamination, cracks and damaged areas.

.2 Coating not to have more than two holidays (pinholes not visible to the unaided eye) in 300 mm of the coated bars. Perform holiday checks with a 67 1/2 volt d.c. detector in accordance with the manufacturer's instructions.

.3 Check coating cure and certify coated bars supplied are in the fully cured condition.

.4 Evaluate adhesion of coating by bending production coated bars 120° (after rebound). Test specimen to be at thermal equilibrium between 20° and 30°C. Ensure that no cracking or debonding is visible to the unaided eye on the outside radius of the bent bar.

.5 Patch straight areas of bar only if damage is less than 1% of the coated area within the total straight portion of the coated rebar. Where coating repair is required, patch all damage on straight areas of the bar.

.6 Patch bent areas of bar only if bond loss and damage exceeds 6% of the coated area within each bent area. Where coating repair is required clean and patch all damage within each bent area. Hairline cracks without bond loss or other damage on fabrication bends need not be patched.

.7 Patch as soon as possible before visible oxidation appears. Patching to be done at manufacturer's plant using the manufacturer's specified material.

3. EXECUTION

3.1 Installation

.1 Place reinforcing steel in accordance with CSA-A23.1-M.

.2 Adequately support reinforcing and secure against displacement within the tolerances permitted.

.3 Protect steel reinforcement by the thickness of concrete indicated on the Drawings. Where not otherwise shown, provide concrete cover as follows:

.1 Surfaces in Cast against Earth: 75 mm.

.2 Precast Surfaces: 25 mm.

.3 All Other: 50 mm.

.4 Maintain alignment as follows:

Item	Tolerance ±
Slabs:	5 mm
Other Structural Members:	10 mm
Rebar Bends and Ends:	15 mm

.5 If damage to installed epoxy coating exceeds 3% of the coated area, repair all damage as soon as possible after each span is placed.

3.2 Inspection

.1 Notify the Engineer when steel installation is complete and before forms are closed.

3.3 Cleaning

.1 Ensure all loose scale, loose rust and other deleterious matter from surfaces of reinforcing is removed in a manner which is acceptable to the Engineer.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Premoulded Joint Fillers

.2 Resilient Filler

.3 Joint Sealants

.4 Sealing Compounds

.5 Inserts

.6 PVC rigid duct

.7 Backer rods

.8 Polyethylene (Debonding) Tape

.9 Epoxy Bonding Agent

1.2 Related Work

.1 Concrete Formwork and Falsework: Section 03100.

.2 Cast-in-Place Concrete: Section 03300.

2. PRODUCTS

2.1 Materials

.1 Premoulded joint fillers or resilient filler: conforming to ASTM D1752, Type 1, sizes as indicated on drawings, 90% + recovery after 50% compression, 380 kPa pressure for 50% compression, Sternson Rodofoam GR, CPD Closed Cell Foam Joint Filler or approved equal.

.2 Backer rod: closed cell vinyl foam.

.3 Joint Sealants: non-staining, non-sagging, grey polyurethane base such as Permapol RC-1 or Sikaflex 1-A (1 component) or approved equal.

.4 Hot Poured Rubber-Asphalt: rubber and asphalt conforming to ASTM D1190, W.R. Meadows Hi-Spec, Flintkote Flintseal 590-13 or approved equal.

.5 Cold Applied Rubber-Asphalt: rubber and asphalt conforming to ASTM D1850, W.R. Meadows Sealtight No. 158, Flintkote Flintseal 570-05 or approved equal.

.6 Inserts:

.1 Expansion Bolts/Expansion Anchors: Stainless steel Hilti, manufactured by Hilti Products Inc. Provide a minimum of 100 mm embedment unless noted otherwise.

.2 Structural Inserts: stainless steel inserts for bolts, sizes and locations as indicated on the Drawings. Provide a minimum of 100 mm embedment unless noted otherwise.

.7 Epoxy Bonding Agent:

.1 Polysulphide polymer epoxy resin (Sternson ST431).

.2 Polyamine epoxy - Sikador 32 Hi-Mod.

.8 Penetrating Sealers: Masterseal SL-40, Capseal X, Duralane, or Sikagard 71H.

.9 Pigmented Sealers: Capseal A50 or Allguard.

3. EXECUTION

3.1 Installation

.1 Coordinate work of this Section with other construction.

.2 Install all concrete accessories in accordance with Drawings and manufacturer's recommendations; straight, level and plumb.

.3 Ensure items are not disturbed during concrete placement.

.4 Sealants:

.1 Not less than 28 days after concrete placement, blow out joints with compressed air.

.2 Remove all loose particles, dust, laitance and curing compounds from joints.

.3 Install PVC, polyurethane or polyethylene foam rope joint filler same distance below concrete surface as joint width.

.4 Dry joint surfaces that are damp. Apply recommended primer.

.5 Install sealant in joints in accordance with manufacturer's directions except that primer is to be used in all cases.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 All plain and reinforced cast-in-place concrete shown on the Drawings unless specifically excluded, and includes but is not limited to the following:

.1 Foundations

.2 Columns

.3 Expansion Joints

.4 Repairing concrete

.5 Installation of drain pipes, deck drains, anchor bolts, conduits and other accessories as required to accommodate the work of other Sections.

1.2 Related Work

.1	Concrete Formwork and Falsework:	Section 03100
.2	Concrete Reinforcement:	Section 03201
.3	Concrete Accessories:	Section 03250
.4	Expansion Joint Assemblies:	Section 05820

1.3 Quality Assurance

.1 Cast-in-place concrete to conform to CSA-A23.1 and CSA-A23.2.

1.4 Inspection & Testing

.1 Notify the Engineer when completed formwork and concrete reinforcement is ready for inspection. Reinforcing in walls and piers shall be inspected prior to closing forms.

.2 Allow ample time for notification, inspection and corrective work, if required, before scheduling concrete placement.

.3 Concrete sampling, inspection and testing is to be performed by an inspection and testing firm appointed and paid by the Contractor.

.4 Provide free access to all portions of work and cooperate with testing firm.

.5 Submit proposed mix design of each class of concrete to the Engineer for review two (2) weeks prior to commencement of the work.

.6 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.

.7 Notify the Engineer twenty four hours in advance of any concrete placement.

.8 Three concrete test cylinders will be taken for every fifty or less cubic metres of each class of concrete placed.

.1 Notwithstanding 1.4.8 (above) the Engineer may request additional tests of concrete placed in critical sections of the work.

.9 At least three test cylinders will be taken daily for each class of concrete placed.

.10 One additional test cylinder will be taken during cold weather concreting and be cured on job site under same conditions as the concrete it represents.

.11 One slump test and one air content test will be taken for each set of test cylinders taken.

.12 Additional slump and air tests may be requested by the Engineer as necessary to verify quality of concrete.

.13 Testing of concrete will be performed in accordance with CSA A23.2. Test results will be issued to the Engineer and the Owner.

.14 Strength Requirements:

.1 To conform to the strength requirements of this Specification, the results of tests performed on laboratory cured cylinders for each class of concrete shall meet the following: (This Clause supersedes the corresponding clause in CSA-A23.1):

.1 The average of all tests shall exceed the specified strength.

.2 When five or more tests of the same class of concrete are available, the average of any five consecutive tests shall be equal to or greater than the specified strength.

.3 No three consecutive tests shall fall below the specified strength.

.4 No individual strength test shall be in excess of 3.5 MPa below the specified strength.

.2 If any of the foregoing criteria are not met the Engineer shall have the right to require one or more of the following; the costs of which shall be borne by the Contractor:

.1 Changes in the mix proportions for the remainder of the work.

.2 Additional curing on those portions of the structure represented by the test specimens which failed.

.3 After the completion of the testing procedure, if the Engineer is not satisfied with the indicated quality of the concrete in the structure, the Contractor may be required to strengthen or replace those portions which he deems to be unsatisfactory.

2. PRODUCTS

2.1 Concrete Materials

.1 Cement: normal, Symbol 10 Portland type conforming to CAN/CSA A5 (See **Table A**).

.2 Fine Aggregate: conforming to CAN/CSA-A23.1.

.3 Coarse Aggregate: conforming to CAN/CSA-A23.1, Group I, 28 mm, 20 mm to 5 mm or 40 mm to 5 mm.

.4 Coarse Aggregate for Toppings: conforming to CAN/CSA-A23.1, Group I, 10 to 2.5 mm.

.5 Water: clean and free from injurious amounts of oil, alkali, organic matter or other deleterious matter.

.6 Calcium chloride or admixtures containing calcium chloride shall not be used in concrete.

.7 Materials are to be obtained from the same source of supply or manufacturer for the duration of the project. All exposed concrete is to be consistent in colour.

2.2 Admixtures

.1 Air Entrainment: conforming to CAN/CSA-A266.1.

.2 Pozzolanic Material: conforming to CAN/CSA-A266.1.

.3 The use of Flyash to reduce cement contents is not permitted. Supplemental flyash to a maximum of 25% may be permitted at the discretion of the Engineer, except in Class C1 exposure conditions where a maximum of 10% supplemental flyash will be permitted.

.4 The use of superplasticizers to increase workability is not permitted.

.5 Silica Fume shall meet all the requirements for Type 'U' material as specified in CAN/CSA-A23.5.

2.3 Grout

.1 Epoxy Grout: Premixed in strict accordance with the manufacturer's instructions to obtain a minimum strength of 80 MPa in 7 days.

.2 Cement Grout: Mixed with sufficient water for placement and hydration capable of developing a minimum expressive strength of 20 MPa in 7 days and 45 MPa in 28 days. Grout to be air-entrained 5 to 8%.

.3 Non-Shrink Grout: Premixed in strict accordance with manufacturer's instructions to obtain a minimum compressive strength of 16 MPa in 24 hours and 50 MPa in 28 days. Air-entrain grout 5 to 8%.

2.4 Concrete Mixes

.1 Pay all costs for mix design. Submit design to the Engineer to review a minimum of two weeks prior to concrete pour.

.2 Provide concrete mixed in accordance with requirements of CAN/CSA A23.1.

.3 All Concrete: minimum 28 day compressive strength, cement type, cement content, water cement ratio, nominal coarse aggregate size and maximum slump and minimum slump to be as shown in Table A.

.4 All Concrete: air content to be as shown in **Table B**.

TABLE A

Mix Type	Portion of Structure	Min. Cement Content (kg/m^3)	Max. Water/ Cement Ratio	Size of Coarse Agg. (mm)	Maximum Allowable Slump (mm)		Minimum Compressive Strength @ 28 Days (MPa)
					Max.	Min.	
1	Foundations	330	0.48	25-5	85	40	35
2	Columns	360	0.43	25-5	85	40	35
5	Expansion Joint Pocket	350	0.41	13-2.5	65	40	35

Maximum w/c ratio and minimum cement content are intended for durability only. More cement may be required in order to assure that minimum compressive strength is attained. Pay costs of additional cement required in order to assure the minimum compressive strength is attained.

TABLE B

Nominal Size of Coarse Aggregate in Concrete (mm)	Air Content
40	5.5 ± 1.0%
28 – 20	6.0 ± 1.0%
15 or less	7.0 ± 1.0%

2.5 Ready Mix Concrete

.1 Ready mix concrete shall not be used for the production of precast concrete.

.2 For other than ready mix concrete, either central mixed or transit mixed may be used provided the concrete produced conforms to these Specifications and to the particular requirements of CSA Standard CAN/CSA A23.1.

.3 In case of doubt as to the quality of the concrete provided or to be provided by the proposed supplier, the Engineer, at his discretion, may order the contractor not to use concrete on the

work from such supplier. The contractor shall arrange for an acceptable concrete supply without additional compensation or extension of time.

3. EXECUTION

3.1 Examination

.1 Before starting this work, examine work done by others which affects this work.

.2 Rectify all conditions which would prejudice proper completion of this work.

.3 Commencement of work implies acceptance of existing conditions.

3.2 Placing Concrete

.1 Place concrete in accordance with requirements of CAN/CSA-A23.1 and as indicated on the Drawings.

.2 Notify the Engineer and the inspection and testing firm twenty four hours prior to commencement of concrete operations.

.3 Ensure all anchors, seats, plates and other items to be cast into concrete are securely placed and will not interfere with concrete placement.

.4 Before placing concrete all equipment for mixing and transporting the concrete shall be cleaned of hardened concrete and foreign materials.

.5 Immediately before concrete is placed all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, and that all reinforcing steel is in the correct position and secured against movement during the placing operation. All forms shall be thoroughly cleaned and all debris, snow, ice or other foreign material removed. Chemicals shall not be used to remove ice or hardened concrete from the forms. All forms shall be thoroughly soaked with water except in freezing weather.

.6 Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent the separation or loss of the ingredients. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling or flowing. Vibrators shall not be used to move concrete. Under no circumstances shall the concrete which has partially hardened be deposited in the forms.

.7 When concreting is started, it shall be carried on as a continuous operation until the placing of the section is completed. When shown on the Drawings, concrete shall be placed in the sections indicated and according to the sequence given.

.8 When concrete is placed on an inclined surface, the placing operations shall begin at the lower end of the slope and progress upward; unless otherwise permitted by the Engineer.

.9 Concrete shall be thoroughly compacted by mechanical vibrators during placing operations. It shall be thoroughly worked around the reinforcement, embedded fixtures and into the corners of the forms.

.10 Internal vibrators shall operate at a speed of not less than 7,000 vibrations per minute and shall be applied at the point of deposit and in the area of freshly placed concrete.

.11 Internal vibrators shall be allowed to sink of their own weight in the concrete until they penetrate to the previous layer of concrete. They shall be withdrawn immediately at the same speed at which they sank, moved about 300 mm to a new location and the process repeated. Where required, internal vibration shall be supplemented by external form vibrators or chipping hammers which shall be applied to wall forms directly opposite where the internal vibrators are operating. Chipping hammers shall be fitted with a 50 mm by 50 mm steel plate to bear against the walls. External vibration shall be continued for approximately the same period of time as internal vibration.

.12 Where placing operations would involve dropping the concrete more than 1.5 metres, it shall be placed through "canvas elephant trunks" or galvanized iron chutes. Concrete shall not be raised at a rate greater than that for which proper vibration may be affected.

.13 The concrete surfaces shall be protected from rain until the final set occurs.

.14 A minimum of seventy two hours shall elapse between adjacent pours separated by construction joints or expansion joints.

.15 Provide 75 mm skin coat in all areas prior to pouring slabs, footings and foundations unless specifically noted otherwise.

.16 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature and test samples taken.

.17 Ensure reinforcement, inserts, embedded parts, formed expansion and control joints and water stops are not disturbed during concrete placement.

.18 Place concrete continuously between preset construction and control joints.

3.3 Construction Joints

.1 Joints not indicated on the Drawings shall be located so as to least impair the strength of the structure. The location of these joints shall be subject to the prior approval of the Consultant. Joints shall be in accordance with CAN/CSA-A23.1, or as indicated on drawings or directed by the Engineer.

.2 When the concrete has set and while it is still green, the surface film and all loose material shall be removed, without disturbing the aggregate, by means of a water jet assisted by light brushing to expose the aggregate and leave a sound irregular surface. Where this is not possible, the surface film shall be removed after the concrete has hardened, by mechanical means appropriate to the degree of hardness of the concrete so as to expose the aggregate and leave a sound, irregular surface. The roughened surface shall be washed with clean water to remove all laitance, dirt and loose particles. Wet surface with water and ensure forms are tight against face of hardened concrete. Epoxy bonding agent to be used where shown on drawings or as indicated by the Engineer.

3.4 Cold Weather Concreting

.1 Special measures over and above those generally described in this Specification shall be taken by the Contractor during concreting in cold weather. Cold weather, for the purpose of this Specification, is when the air temperature is at or below 5°C., or when, in the opinion of the Consultant, the air temperature is likely to fall below this limit within the next twenty four hours. In these circumstances, concrete must be heated for placing and then protected from the adverse affects of low temperature as determined by the Consultant.

(This Clause supplements CAN/CSA A23-1):

.2 Have equipment for heating materials, for enclosing the freshly deposited concrete and maintaining temperature and humidity during curing on site ready to be put into operation prior to commencing concreting.

.3 When the temperature is at or below 5°C the mix water shall be heated to the temperature not greater than 65°C which will produce concrete within the specified range at the time of placing.

.4 If the temperature is or was, at any time during the previous twenty four hours, at 0°C, or if the stockpiles of coarse and fine aggregate contain frozen material or are snow covered, then the aggregates as well shall be heated to a temperature of not less than 20°C nor more than 65°C. The aggregates shall be uniformly heated in the stockpiles and/or bins by steam, either injected, live or circulated in coils or by using dry heat before the aggregates are placed in the mixer. Whatever system is used, it shall be designed to give uniform heating which will avoid local overheating which may be injurious to the materials. That part of the stockpile in use shall be protected with tarpaulins, waterproof paper or plastic sheeting against the formation of ice and the accumulation of snow.

.5 The temperature of the reinforcement and forms shall be above 10°C prior to placing the concrete.

.6 The temperature of the concrete at the time of placing shall be between 10°C and 25°C unless the Engineer directs otherwise in relation to ambient conditions, the type of work and the protective system in use.

.7 The formwork, existing concrete and reinforcing steel against which concrete is to be placed shall be free from ice and snow and above freezing temperature before the Engineer will authorize placing to commence. The contractor shall preheat the area in which the concrete is to be placed when the air temperature is 0°C, or below, with live steam or moist hot air; this shall also remove the snow and ice and heat existing concrete to prevent the formation of a cold joint.

.8 Concrete shall not be placed on a frozen subgrade or against frozen ground. The Contractor shall protect excavations prepared for footings, etc. with straw or covers prior to opening for placing concrete.

.9 The layout of batching and mixing plant and type of handling equipment shall be such that distance and time of transport of mixed concrete before placing is kept to the minimum to avoid heat loss.

.10 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flowlines and cold joints.

.11 Mix cement and aggregate before adding water. No material including the mix water shall be at a temperature above 65°C at the time of mixing. The heating water over 40°C should not be brought into direct contact with the cement but shall be added into the mixer before, with or after the aggregate is placed and the mix turned over a few times to distribute the heat before the cement is added; the prescribed mixing time shall then start.

At no time shall the temperature of the mixed concrete exceed 40°C.

The use of salt, calcium chloride or other chemicals in the mix to lower the freezing point or accelerate the sets is prohibited.

3.5 Hot Weather Concreting

.1 For the purpose of this Specification, hot weather is considered when the temperature is at or above 25°C.

.2 The concrete temperature at the time of placing in hot weather shall not exceed 27°. In the event of the concrete temperature limit being exceeded, the concreting operations shall be suspended until the constituent materials of the concrete are cooled. Aggregate stockpiles may be sprayed with water to give evaporative cooling. The mixing water may be cooled by ice; the ice may be incorporated directly into the concrete as part of the mix water provided it is completely melted by the time the mixing is completed.

.3 Mixing time shall be kept to the minimum time necessary for effective mixing of the concrete.

.4 At no time during the curing period shall the temperature of the concrete exceed 60°C; wherever possible it shall be maintained at the optimum curing temperature of 20°C.

.5 The use of a retarding admixture in hot weather concreting to facilitate placing, finishing and to control temperature rise in the concrete must be approved by the Engineer prior to use in the work. The amount of retarding admixture added to the concrete shall be the minimum. The actual amount required shall be determined on the basis of the contractor's sequence, speed of placing and finishing operations and other job conditions such as temperature.

.6 Temperature records of concrete placed in hot weather shall be kept together with those of the corresponding air temperature readings. Where required by the Engineer, the contractor shall provide suitable tube inserts in the concrete for thermometers.

3.6 Concrete Protection for Reinforcement

.1 Ensure reinforcement is placed to provide minimum concrete cover in accordance with Section 03201 of these Specifications or as indicated on drawings.

3.7 Screeding

.1 Screed slabs in accordance with CAN/CSA-A23.1. Screed level, maintain surface flatness of maximum 3 mm in 3000 mm. Pitch to drains 2% of nominal or as shown on the Drawings.

3.8 Construction Tolerance

.1 The work shall be carefully and accurately set out; true to the positioning, levels, slopes and dimensions shown on the Drawings but the following may be allowed in the finished structural concrete:

.1 Sizes of Member or Thickness of Slabs: +6 mm-0 mm.

.2 Cover of Concrete over Reinforcement or Tendons Where Normal Cover is More than 25 mm: ± 3 mm.

.3 Cover of Concrete over Reinforcement Where Normal Cover is 25 mm or Less: +6/-3 mm.

.4 Variations from Plumb Columns, Piers, Walls: 6 mm in 3000 mm.

.5 Variations from Flat: 6 mm in 3 m.

.6 Exposed Girders and Other Conspicuous Lines: 6 mm in 6000 mm.

.7 Sleeves and Openings in Size and Location: ± 6 mm.

.2 If these tolerances are exceeded the Contractor may, at the discretion of the Engineer, be required to remove and replace or to modify the placed concrete before acceptance.

.3 Allowance must be made for settlement, closure of form joints and elastic shortening of forms and shoring. The Engineer may direct cambering of forms during construction.

3.9 Curing

.1 All concrete shall receive moist curing for a period of at least seventy two hours. One of the following methods shall be used as soon as the concrete has hardened sufficiently to prevent marring:

.1 Surface covered with canvas or other satisfactory material and kept thoroughly wet.

.2 Surface sealed with polyethylene sheeting at least 6 mils thick and the concrete kept thoroughly wet.

.3 Subject to the approval of the Engineer, a liquid, membrane forming, curing compound supplied at the rate recommended by the manufacturer may be used. Curing compounds shall not be used on a surface where bond is required for additional concrete.

.4 Surfaces of concrete which are protected by formwork which is left in place for seven days shall not require any additional curing (except as specified for hot weather). If the formwork is removed in less than seven days, the concrete shall receive a moist curing as above or until seven days have elapsed since the concrete was placed; whichever occurs first.

.5 No concreting will be allowed until all materials required for the curing phase are on site and ready for use.

.6 The Contractor shall protect and heat, where necessary, all concrete which has been placed when the air temperature is 5°C or below. In the opinion of the Engineer, when the air temperature is likely to fall below 5°C at any time during the twenty four hours after the concrete is placed, the concrete shall then also be protected and heated, when necessary, from the time the concrete is placed. When the air temperature falls below 5°C during the seven days after the concrete is placed, the Engineer may instruct the Contractor to institute protection and heating where necessary to prevent damage to the concrete by freezing or to allow the concrete to develop sufficient strength to carry the dead and live loads which will be imposed on it by further construction work or general traffic in the near future.

.7 The system of protection, surface or enclosed with heating, where necessary, (or fully insulated forms) is subject to approval of the Engineer. It must be adequate and designed in relation to ambient conditions and the type of construction to satisfactorily achieve these curing conditions in the concrete.

.8 For proper curing of concrete the temperature of all surfaces of the concrete shall be maintained at not less than 20°C for five days or at not less than 10°C for seven days after placing. Further, the concrete shall be kept above freezing temperature for a period of at least nine days and shall be kept from alternate freezing and thawing for at least fourteen days after placement.

.9 No salt or other chemicals shall be used to lower the freezing point of the concrete as a substitute for the specified curing and protection.

.10 At the end of the specified protection period, the temperature of the concrete shall be reduced gradually at a rate not exceeding 10°C per day until the outside air temperature has been reached.

.11 The Contractor shall keep a full record of the temperature of concrete upon placing and a daily record of the curing temperature of the concrete for the full protection period.

.12 Concrete which is allowed to freeze or which obtains insufficient curing conditions shall be subject to all necessary investigations and testing as deemed necessary by the

Engineer . If found unsatisfactory, all such concrete shall be removed and the portion reconstructed as directed by the Engineer.

.13 The cost incurred by the Engineer for such investigation, testing or inspection of reconstruction and the cost of reconstruction shall be borne by the Contractor.

.14 Prior to placing the bearings, coat the top surface of abutment and pier seats with two coats of Cappar-Nicklepoxy Curing and Sealing Compound, Product No. 2 or approved alternate; in strict accordance with the manufacturer's recommendations and at a rate of approximately 1 litre/m^2 each coat.

3.10 Formed Concrete

.1 Allow the Engineer to inspect concrete surfaces immediately upon removal of the forms.

.2 Any imperfect joints, voids, stone pockets or other defective areas and tie holes, as specified, shall at once be patched before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than 25 mm with the edges perpendicular to the surface. The area to be patched and a space at least 150 mm wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar.

.3 The patch shall be made of the same material and of the same proportions as used for the concrete except that the coarse aggregate shall be omitted and white cement added to match the colour of the surrounding concrete. The amount of mixing water shall be as little as is consistent with the requirements.

.4 Modify or replace concrete not conforming to qualities, lines, details and evaluations specified herein or indicated on the Drawings; to the approval of the Engineer.

3.11 Surfacing and Finishing

.1 Surface finishes shall be classified as follows:

.1 Class 1 - Ordinary Surface Finish
.2 Class 2 - Rubbed Finish
.3 Class 3 – Floated Finish
.4 Class 4 - Sidewalk Finish

.2 All concrete shall be given a Class 1 finish. After the job is completed, all exposed surfaces of the columns shall receive a Class 2 finish.

.3 Class 1 - Ordinary Surface Finish:

.1 Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except those which are not to be exposed or not to be waterproofed. On all surfaces the cavities produced by form ties, if specified to be filled, and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned and after having been kept saturated with water for a period of not less than three hours, shall be carefully pointed and trued with a mortar of cement

and fine aggregate, mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall not be more than one hour old. The mortar patches shall be cured as specified under "Curing". All construction and expansion joints in the completed work shall be left carefully tooled and free from all mortar and concrete. The joint filler shall be left exposed for its full length and with clean and true edges. Pointing and patching of concrete surfaces which are to receive a Class 3 finish must be of uniform texture and match the texture of the surrounding formed finishes. An approved acrylic polymer bonding agent shall be used in all repair mortar.

.2 The resulting surfaces shall be true and uniform; all surfaces which cannot be repaired to the satisfaction of the Consultant shall be "rubbed" as specified for Class 2 - Rubbed Finish.

.4 Class 2 - Rubbed Finish:

.1 After removal of forms, the rubbing of concrete shall be started as soon as conditions will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of three hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse Carborundum stone or alternatively scrubbed as a sack finish using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the proportion used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface in both color and texture has been obtained. The paste produced by this rubbing shall be left in place at this time.

.2 After the final rubbing is complete and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste powder and objectionable marks.

.3 It is essential that the prepared concrete surface, including all patching and filling, be uniform in colour and texture. All portions of bridge elements, including those cast in more than one pour, shall be of the same colour and texture. Any staining caused by cement, water, weather, or other conditions shall be prevented, removed, or covered by methods and materials approved by the Engineer.

.4 If uniformity of colour or texture is not achieved, the Contractor shall use the following procedure, or other approved procedure, before the concrete finish will be accepted:

"After the surface preparation has been completed to the satisfaction of the Engineer, the surface of the concrete shall be saturated with water for at least 30 minutes. A thin grout composed of one part standard cement, two parts fine sand, and one part white cement shall be spread on the surface and rubbed immediately with a Carborundum stone until the surface is covered with a lather. This lather shall be allowed to set for at least 5 days. The surface shall then be smoothed by being rubbed lightly with a fine Carborundum stone. The surface shall be smooth and true in texture and uniform in appearance including color."

.5 Class 3 - Floated Surface Finish:

.1 After the concrete has been compacted, the surface shall be carefully rodded and struck off with a stroke board to conform to the cross-section and grade shown on the Drawings. Proper allowance shall be made for camber, if required. The strike board may be operated longitudinally or transversely and shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither end is raised from the site forms. A slight excess of concrete shall be kept in front of the cutting edge at all times.

.2 After striking off and consolidating, the surface shall be made uniform by longitudinal or transverse floating; or both.

.3 After floating has been completed and the excess water removed, but while the concrete is still plastic, the surface shall be tested for trueness with a straight edge. Any depression found shall immediately be filled with fresh mixed concrete. High areas shall be cut down and refinished. The final surface shall conform to the required grade and contour such that the deviation is not greater than 6 mm under a 3 mm straight edge.

.6 Class 4 - Sidewalk Finish:

.1 After the concrete has been deposited in place, it shall be compacted and the surface struck off by means of a strike board. The surface shall be made uniform, dense and free from voids by wood trowel floating. When the concrete has hardened sufficiently the surface shall not vary by more than 3 mm in 3 m under a straight edge.

.2 When the concrete has hardened sufficiently, the surface shall be given a broom finish. The strokes of the broom shall be square across the slab with adjacent strokes slightly overlapped so as to produce regular corrugations not over 3 mm in depth.

.3 Sidewalk surfaces shall be laid out in blocks with an approved grooving tool as shown on the Drawings or as directed by the Engineer. An edging tool shall be used on the end of all sidewalks.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Bearing plates.

.2 Miscellaneous inserts, sleeves, plates, anchors and railing anchor assemblies.

.3 Curb and miscellaneous cover plates.

.4 Miscellaneous structural steel.

1.2 Related Work

.1 Moulded Reinforced Elastomeric Bearings: Section 05812

1.3 Reference Standards

.1 Perform welding in accordance with the requirements of CSA W59.1.

.2 Welding work on all load carrying structures and assemblies is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.1 in Division 1 or Division 2.

.3 All welders employed in the field to weld load carrying structures in the field are to possess valid "S" Classification, Class "O" certificates issued by the Canadian Welding Bureau. If the structures have hollow structural sections, welders are to possess valid "T" Classification Class "O" certificates.

1.4 Shop Drawings

.1 Submit shop drawings for review.

.2 Clearly indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners and accessories.

.3 Include erection drawings, elevations and details where applicable.

.4 Indicated welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

2. PRODUCTS

2.1 Materials

.1 General: Metals are to be free from defects impairing strength, durability and appearance of the best commercial quality for the purpose specified. All materials are to be new. All exposed fastenings are to be of the same material, colour and finish as the metal to which applied; unless otherwise noted.

.2 Steel: Conforming to CSA G40.21M, Type W, with a yield strength of 300 MPa, except hollow structural sections - 350 MPa.

.3 Welding Materials: conforming to CSA W59.

.4 High Tensile Bolts, Nuts and Washers: conform to ASTM A325.

.5 Standard Machine Bolts, Nuts: conform to ASTM A307.

.6 Anchor Bolts: conform to AISI C1017 or C1020 and ASTM 108.

2.2 Finishes

.1 Shop Primer and Field Touch up: inorganic zinc, conforming to CGSB 1-GP-171b; coating: Type I, Class B, self curing two component cold application inorganic zinc complete with "cellusoid".

.2 Galvanizing: hot dipped galvanizing conforming to CSA G164; minimum 600 gm/m^2 coating.

.3 Field Touch up Galvanizing: conform to CGSB 1-GP-178a.

2.3 Fabrication

.1 Verify all dimensions on site prior to shop fabrication.

.2 Fabricate items of sizes and profiles detailed on drawings with joints neatly fitted and properly secured.

.3 Fit and shop assemble in largest practical sections for delivery to site.

.4 Supply all components required for proper anchorage of miscellaneous metals. Fabricate anchorage and related components of same material and finish as metal fabrications unless otherwise specified or shown.

.5 Weld connections where possible otherwise bolt connections. Counter-sink all exposed fastenings. Cut off bolts flush with nuts.

.6 Accurately form all connections and joints with exposed faces flush, mitres and joints tight.

.7 Grind or file exposed welds and metal sections smooth and flush.

.8 Provide for flush welded or hairline butt field joints.

.9 Shop fabricate openings in members for other components. Reinforce openings to restore member to original design strengths.

.10 Provide lugs, clips, brackets, hangers and struts as required for attaching miscellaneous metal items securely to the structure.

.11 Thoroughly clean all surfaces of rust, scale, grease and foreign matter prior to galvanizing. Galvanize all items indicated on the Drawings.

3. EXECUTION

3.1 Erection

.1 Obtain Engineer's permission prior to site cutting or making adjustments which are not part of the scheduled work.

.2 Install items plumb, square and level, to fit accurately and maintain free from distortion or defects detrimental to appearance and performance.

.3 Make provision for erection stresses and temporary bracing. Keep work in alignment at all times.

.4 Replace damaged items in course of installation.

.5 Perform required field welding. Grind all visible field welds smooth. Conform to the requirements of CSA W47.1.

.6 Perform necessary cutting and altering for the installation of work of other Sections and as indicated on the Drawings. No additional cutting is to be done without the approval of the Engineer.

.7 Perform all field assembly bolting and welding to match standard of shop bolting and welding. Bolts and screws are to be concealed whenever possible.

.8 After installation, touch up field bolts, nuts, welds and scratched and damaged prime painted and galvanized surfaces. Field touch up primer to be the same as shop primer. Preparation and procedures are to be the same as shop applied primer. Touch up galvanized surfaces with zinc rich primer.

.9 Supply to appropriate Sections, items required to be cast into concrete complete with necessary setting templates.

END OF SECTION

1. GENERAL

1.1 Documents

.1 This section of the specification forms part of the Contract Documents and is to be read, interpreted and coordinated with other parts.

1.2 Description

.1 This section specifies the requirements for supply and installation of the new steel beam guiderail, timber blocks and timber posts.

2. PRODUCTS

2.1 New Materials

.1 Steel Beam Guiderail:

.1 Steel rail: to AASHTO M180 Class A Type 1 zinc coated.

.2 Effective length of beam section is to be 3.81 m.

.3 Bolts: to ASTM A307, Grade A, galvanized to ASTM A153.

.4 Nuts: to ASTM A563, galvanized to ASTM A153.

.5 Washers: to be made of steel, galvanized to ASTM A153.

.2 Breakaway Cable Terminal

.1 Definition: A portion of guiderail located at the terminus of a given guiderail installation as shown on the standard drawings, including, but not limited to, the following:

.1 Three (3) sections of Steel Beam Guiderail

.2 A terminal end section

.3 Wire rope and associated hardware

.4 Two concrete anchors for end posts

.2 Steel rail: to AASHTO M180 Class A Type I zinc coated.

.3 Terminal end section, including terminal connector and all other requirements to AASHTO M180 Class A Type I zinc coated, except terminal connector shall be to AASHTO M180 Class B Type I zinc coated.

.4 Rectangular plate washer: to AASHTO M180

.5 Bolts: to ASTM A307, Grade A, galvanized to ASTM A153.

.6 Nuts: to ASTM A563, galvanized to ASTM A153.

.7 Wire rope and fittings: Rope to conform to AASHTO M-30, 19 mm preformed, 6 X 19, wire strand core or independent wire rope core (IWRC), galvanized, right regular lay, manufactured of improved plow steel with a minimum breaking strength of 190 kN. Swaged fittings to be machined from hot-rolled carbon steel to ASTM A576, Grade 1035, and annealed suitable for cold swaging, drilled to accommodate 5 mm plated spring steel pin to retain stud. Stud to conform to ASTM A449, galvanized to ASTM A153, threaded to Class 2A fit before galvanizing, milled with 10 mm slot for 5 mm plated spring steel pin. All components must develop the strength of the wire rope.

.8 Sleeve: to ASTM A53.

.9 Nuts (25 mm, for cable assembly): to ASTM A325.

.10 Bearing plate, end plate, and anchor plate: to ASTM A36M, galvanized to ASTM A123.

.3 Timber Post and Offset Block:

.1 Posts and blocks shall be grade No. 1 timber, with a strength of not less than 8.3 Mpa in bending at the extreme fibre, as provided in CSA O86.1 for “Posts and Timbers”. Grading shall be in accordance with NLGA Standard Grading Rules for Canadian Lumber.

.2 Posts and blocks shall be pressure preservative treated conforming to CSA 080M, with pentachlorophenol in heavy hydrocarbon solvent (oil-borne) or pentachlorophenol in chlorinated hydrocarbon solvent (pentamethylene chloride) or chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA). The retention of preservatives for posts shall conform to CSA 080M, 080.14, Table 1, Minimum Retention of Preservatives in Pressure Treated Wood for Highway Construction, under the heading "Post-Guiderail, Guide, Sign and Sight".

3. EXECUTION

3.1 Post Hole Excavation

.1 Holes for guiderail posts in earth, silts, clays, sands, medium tills and fine to medium gravels shall be formed by one of the following methods:

.1 by auger excavation

.2 by driving a mandrel

.2 Holes for guiderail posts in coarse gravels, boulder fills, talus, rock debris, shot rock fill and large boulders or solid rock shall be formed by one of, or a combination of, the following methods:

.1 with the Engineer's approval, by excavation with a backhoe

.2 by drilling with a large diameter rock drill sized to permit posts to freely slip into the finished holes without trimming or driving of posts

.3 by drilling with a small diameter rock drill followed by blasting.

.3 Excavation of guiderail post holes in advance of post and guiderail beam installation shall be confined to the section or sections in which guiderail is currently being installed. Such advance excavation is to be kept to a minimum as directed by the Engineer.

.4 All open holes and excavated material piles produced by such advance excavation which are left unattended shall be signed, barricaded, covered and/or illuminated to the satisfaction of the Engineer.

3.2 Erection

.1 Install posts plumb at locations and to depths indicated or directed.

.2 Compact bottom of excavation to provide firm foundation. Set posts plumb and square in hole, backfill in 150 mm layers and compact each layer to a minimum of 95% of maximum standard proctor dry density before placing succeeding layer.

.3 Cut off tops of posts to elevations indicated only after inspection approval by Engineer.

.4 Treat cut tops with two (2) coats of same type of wood preservative used to pressure treat posts.

.5 Erect steel beam components to details indicated on plans. Lap joints in direction of traffic. Tighten nuts to 100 N.m torque.

3.3 Painting

.1 Touch up damage to galvanized finish with two (2) coats of zinc-rich paint.

3.4 Road Maintenance and Damage

.1 The Contractor shall take every precaution necessary to ensure that no damage occurs to the re-paved surface, as a result of his execution of the work under this contract.

.2 All damage caused by the Contractor to such repaved surface shall be immediately repaired, as directed by the Engineer, and at the Contractor's expense.

.3 The Contractor shall be responsible for the repair of damage caused by his operations to highway side slopes, fill slopes, ditch bottoms and back slopes. Such repair shall include filling of holes, removal of debris, regrading and contouring, clean-out of ditches and reseeding, and any other work as directed by the Engineer required to leave the work site in an acceptable condition.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Furnish all labour, materials and equipment required for the supply and installation of bearings shown on the Drawings and/or in the Specifications and include the following:

.1 Moulded reinforced elastomeric bearings including anchor bolts, shims, anchorages, sole plates, top plates, masonry plates, base plates, grout and coring.

1.2 Related Work

.1 Examine work done by other trades:

.1 Before commencing fabrication of the work of this Section, require the supplier to inspect and take field measurements of work done by other trades which may affect the work. Before commencement of the work of this Section, require the supplier to notify the Engineer, in writing, of his acceptance of work done under other Divisions or by other trades. If any conditions exist which will prejudice a proper installation of the work, notify the Engineer, in writing, and do not proceed with installation of the work until deficiencies are corrected and the Consultant has received the letter of acceptance.

.2 Cooperation:

.1 Where items of other trades are to be built into the work of this Section or items under this Section are to be built into the work of other trades, procure or provide such items in ample time to avoid delay.

.2 Attend upon and cooperate with other trades in respect of the work of this Section and do everything necessary to enable the work of other trades to be fitted in a first-class manner; without delay.

.3 Shop Drawings:

.1 Submit shop drawings for review by the Engineer.

.2 Clearly indicate plate sizes, connection attachments, anchorage sizes and types of fasteners and accessories.

.3 Include erection drawings, elevations and details where applicable.

.4 Indicate welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

.5 The drawings and design calculations: stamped by a Professional Engineer.

2. PRODUCTS

2.1 Moulded Reinforced Elastomeric Bearings

.1 Bearings: consisting of elastomer and steel:

.1 Elastomeric material: virgin natural polyisoprene (natural rubber) or neoprene (polycloroprene). Physical properties to meet the requirements outlined below.

Property	Test	Req. for Natural Rubber	Req. for Neoprene
Hardness, °Shore A	ASTM D2240	60 ± 5	60 ± 5
Tensile Strength, MPa	ASTM D412	Min. 17.2	Min. 17.2
Ultimate Elongation, Percent	ASTM D412	Min. 400	Min 350
Heat Resistance	ASTM D573	70 hrs @ 70°C	70 hrs @ 100°C
Change in Hardness, °Shore A		Max. +10	Max. +15
Change in Tensile Strength %		Max. -25	Max. -15
Change in Ultimate Elong. %		Max. -25	Max. -20
Compression Set, %	ASTM D395 Method B	22 hrs @ 70°C Max. 25	22 hrs @ 100°C Max. 35
Ozone Resistance	ASTM D518 Mounting Procedure A, 20% 40°C ± 2°C	25 pphm @ 48 hr. No cracks	50 pphm @ 100 hr. No cracks
Bond During Vulcanization, kN/m^2	ASTM D429 Method B	Min. 350	Min. 350
Brittleness @ -40°C.	ASTM D746 Procedure B	No failure	No failure
Low Temp. Crystallization	ASTM D2240	168 hr. @ -25°C	168 hr. @ -10°C
Increase in Hardness, ° Shore A	ASTM D2240	Max. +15	Max. +15

.2 Supply internal steel plates to sizes as indicated on drawings. All steel components of the bearings to CSA G40.21M Grade 260W steel. Internal steel shims to have minimum yield strength of 260 MPa.

.2 Manufacture:

.1 Process:

.1 Mould steel laminated bearings as a single unit under pressure and heat.

.2 Completely bond steel reinforcing plates on all surfaces to the elastomeric material during moulding, except that no elastomeric cover is required over internal details, i.e., vertical holes or slots covered by bearing seats or flanges which will not be exposed to moisture after erection of the bridge. Use steel plates as indicated on drawings.

.3 Provide a smooth surface finish on all moulds.

.4 Fabricate internal steel plates free from sharp edges.

.5 Fabricate all internal elastomeric laminates of uniform thickness.

.3 Dimensional Tolerances:

.1 Overall dimension of assembled bearings shall be ± 3mm in plan and height.

.2 Elastomer - thickness: -0 / +3mm
- horizontal dimensions: -0 / +6mm.

.3 Thickness of individual layers of elastomer: ± 20%

.4 Edge cover of embedded steel:

3mm minimum
6mm maximum

.5 Internal details (holes or slots): ± 3mm

.6 Relative position of holes, slots or inserts to each other: 2 mm

.7 When designed to be parallel, the tolerance of parallelism of any upper surface of a bearing with respect to any lower surface of the bearing, as datum, shall be 0.2% of the diameter for surfaces circular in plan and 0.2% of the longer side for surfaces rectangular in plan..

.8 Steel plate finishes: The surface finish between masonry plates and between top plates and bearing shall conform to ANSI 500.

2.2 Bearings Components

.1 Require the bearing supplier to supply the bearings complete but not limited to the following items:

.1 Masonry plates, shoe plates with anchorage, top plates, base plates and anchor bolts.

.2 Supply the bearings with the properties as shown on the Drawings.

.3 Bearings: conform to CAN/CSA-S6 plus interims unless otherwise noted herein.

.4 Finish all steel components of bearings including top plates, sole plates, base plates and masonry plates in accordance with one of the following:

.1 Blast cleaned in accordance with SSPC-SP6 Commercial Blast Cleaning and all surfaces to be zinc metallized in accordance with CSA G184 (7 mils zinc). Apply an acrylic sealer coat over metallized surfaces.

.2 Blast cleaned in accordance with SSPC-SP6 Commercial Blast Cleaning, and all surfaces prime coated prior to assembling the bearing. In addition apply one top coat to all exposed surfaces, paint system consisting of the following or equivalent:

.1 Amerlok 400 AL Prime coat and Amerthane 487 top coat as manufactured by Ameron Canada Inc.

3. EXECUTION

.1 Protect bearings from damage or distortion during handling, transport, storage and installation and keep clean and free of all deleterious matter and contaminants including moisture and dust.

.2 Provide suitable handling devices as required. Use temporary clamping devices to maintain correct orientation of the parts during handling, transport, storage and installation but do not use for slinging or suspending bearings unless specifically designed for this purpose.

.3 Verify the condition of the bearings supplied to the site.

.4 Install bearings in the structure as specified and directed by the bearing supplier. Installation procedure subject to review of the Engineer. Do not dismantle bearings which have been pre-assembled except with the prior written approval of the supplier and the Engineer. Agree to the position of any temporary packing between the outer bearing plates and the structure with the Engineer.

.5 After installation leave bearings and their surrounding area clean. Remove temporary transit clamps at a time to be agreed upon by the supplier and the Engineer.

.1 Locate bearings so that their centre lines are within $\pm$ 3 mm of their correct positions. Level of a single bearing or the mean levels of more than one bearing at any support: within a tolerance of $\pm$ 0.0001 times the sum of the adjacent spans of a continuous girder but not exceeding $\pm$ 5 mm. Set bearings to their correct inclination to the horizontal within a tolerance of $\pm$ 0.1° in any direction.

Departures from common planetary of twin or multiple bearings: within tolerances specified by the Engineer.

.2 Tighten threaded fixings uniformly to avoid overstressing any part of the bearing. Supply vibration-resistant type fasteners where significant vibration may occur.

.3 Bed bearings over their entire area. Voids or hard spots after installation are not acceptable. Bedding material: capable of transmitting the applied load to the structure without damage. Bedding mortar thickness: not greater than 20 mm. Where bedding mortar is used extend beyond the bearing perimeter at least 50 mm or twice the thickness of the bedding mortar; whichever is the greater. Fall away the top surface of this extension from the bearing to prevent the collection of water around the bearing.

.6 Upon completion of the installation, certify, in writing to the Engineer, that the bearings have been correctly installed.

3.2 Guarantee

.1 Require the supplier to provide a written guarantee stating that the bearings have been fabricated such that they will perform satisfactorily within the design range of movement and under the design loads for a five year period from the date of substantial completion provided the bearings have been properly installed. The supplier is to indicate that they have reviewed the installation procedures and find it in accordance with their recommendations. Provide in the guarantee for the replacement (including supply and installation) of the bearings at no cost to the Owner in the event that the bearings do not perform satisfactorily within the design range of movement and under the design loads.

.2 The General Contractor is to guarantee, in writing, the performance of the bearings for a five (5) year period from the date of substantial completion. Provide in the guarantee for the replacement (including supply and installation) of the bearings at no cost to the Owner in the event that the bearings do not perform satisfactorily in the range of design movement and under the design loads. Ensure that the bearings are installed in such a manner that will not void the fabrication guarantee.

END OF SECTION

GUARANTEE FORM

TO:

PROJECT: _____

TENDER NO.: _____

REFERENCE: _____

BRIDGE FILE NO.: _____

We, the undersigned, hereby jointly and severally guarantee The Owner against defects in the said bearings and/or workmanship related to their installation for a period of five years after completion and acceptance of the work on the above mentioned project. We guarantee for the five year period that the said bearings will perform satisfactorily within the project specifications, design range of movement and under the design loads.

In the event the bearings do not perform satisfactorily, the replacement and/or repairs will be done at no cost to The Owner.

Type of Model & Bearing _____

Installation/Acceptance Date _____

Guarantee/Commencement Date _____

Guarantee Termination Date _____

Date _____

General Contractor _____

Name of Corporation

_____ _____

Corporate Seal of Signing Officer
Supplier

Signing Officer

_____ _____

Corporate Seal of Signing Officer
Installer

Signing Officer

_____ _____

Corporate Seal of Signing Officer

Signing Officer

1. GENERAL

1.1 Work Included

.1 Furnish all labour, materials and equipment required for the supply and installation of expansion joints as shown on the Drawings and/or specifications and include the following:

.1 Expansion joint assemblies, cover plates, curb plates, and anchorages.

1.2 Related Work

.1 Examination of work by other trades:

.1 Before commencing installation of the work of this Section, require the supplier to inspect and take field measurements of work done by other trades which may affect this work. Before commencement of the work of this Section, require the supplier to notify the Engineer, in writing, of his acceptance of work done under other Divisions or by other trades. If any conditions exist which will prejudice a proper installation of the work, notify the Engineer, in writing, and do not proceed with installation of the work until deficiencies are corrected.

1.3 Cooperation

.1 Where items of other trades are to be built into the work of this Section or items under this Division are to be built into the work of other trades, procure or provide such items in ample time to avoid delay.

.2 Attend upon and cooperate with other trades in respect of the work of this Section and do everything necessary to enable the work of other trades to be fitted in a first class manner; without delay.

.3 Shop drawings:

.1 Submit shop drawings for review by the Engineer.

.2 Clearly indicate plate sizes, connection attachments, anchorage sizes and types of fasteners and accessories.

.3 Include installation drawings, elevations and details where applicable.

.4 Indicate welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

.5 The drawings and design calculations: stamped by a Professional Engineer registered in one of the provinces of Canada.

2. MATERIALS

2.1 Materials

.1 Expansion joint assemblies:

.1 Expansion joints: Continuous seal and steel assembly as manufactured by: GSH Model GSH-141-W-D, Watson Bowman-ACME PS57 Type C system or Maurer D-75 System (Goodco Ltd.), modified to meet the requirements of drawings and specifications on this contract.

.2 Supply expansion joints complete with e seal, jaw extensions, angles, anchor plates and bolts, anchor studs, curb plates and installation plates as may be applicable. Install expansion assembly in strict compliance with the manufacturer's recommendations and directions. Install the assembly as a waterproof expansion joint. Upon completion of the installation certify, in writing to the Engineer, that the assembly has been correctly installed.

.3 Seal: vulcanized, elastomeric compound using silicone as the sole polymer, resilient and resisting heat, oil and ozone; extruded form with smooth surfaces and of uniform dimensions; no splices unless approved by the Engineer; held between metal jaws and do not rely on the compression of the seal as the sole means of retaining the seal between the jaws.

.4 Manufacture seal material to meet the following requirements:

Property Determined on Molded Specimens	ASTM Test Procedure	Physical Requirements
Min. Silicone	Content	80%
Max. Specific	Gravity	1.3
Tensile Strength kPa min.	D412-62T	9000
Elongation at break % Min.	D412-62T	350
Hardness Durometer A	D676-59T	55(+7/-5)
Compression set % max. 22 hrs./70°C 70 hrs./100°C	D395-61 & Method B Para. 5(a) or (b)	 15 40
Oven aging, 70 hrs./100°C Tensile Strength Change, max. % Elongation Change Max. % Hardness Points Change, max.	D573-53	 20 40 10
Oil Swell, ASTM Oil No. 3 70 hrs./140°C. Weight Change, Max. %	D471-63T	 45
Ozone Resistance 20% Strain Wipe with Solvent to Remove Surface Contamination	D1149-62T	 No cracks
Material Workable Temperature Range		-57°C to 204°C
Brittle Temperature		-68°C

The preformed seal shall meet the following requirements:

Property Determined on Actual Seals Under 50% Deflection	Physical Requirements
High temp. recovery, 22 hrs./100°C	Min. 85% recovery
Low temp. recovery, 72 hrs./-10°C	Min. 75% recovery
Low temp. recovery, 22 hrs./-30°C	Min. 65% recovery

.5 Supply such information as is required to fully indicate the qualifications of the particular seal is in accordance with the physical requirements set out above.

.6 Supply seal 125 mm longer than the length as shown on the Drawings. Remove the overlength amount from the seals in the attendance of the Engineer or his representative. The Engineer will use the samples to conduct any tests which he may desire to have carried out in order to verify the quality of the seal. The Engineer will arrange such tests and they will be paid for by the Owner.

.7 The Engineer will inspect the seals when delivered to determine visual compliance which do not require physical tests including surface quality and dimensional compliance.

.8 Replace seals which are not manufactured to meet the physical inspection at no extra cost to the Engineer.

.9 Replace individual lengths of seal if tests on samples show that the seal or materials do not meet the requirements set out in this specification; at no extra cost to the Owner.

.10 Supply an adequate amount of approved liquid lubricant-sealer complete with full instructions for proper and approved application procedures.

.11 Hot dipped galvanized all steel cover plates and related hardware in accordance with CSA G164, minimum 600 g/mm^2.

.12 Fabricate from steel conforming to CSA G40.21M Grade 260W or equal; all steel components of the expansion assemblies.

3. EXECUTION

3.1 Delivery and Joint Assembly

.1 Package the seal and lubricant-sealer in suitable fashion so as to prevent damage and contamination. Materials will not be accepted until they have been inspected and approved by the Engineer.

.2 Provide adjustment devices for the expansion assembly to allow for setting the joint width to suit the temperature when the joints are cast into the blockouts. Place seal between the angles in strict accordance with the manufacturer's instructions just prior to setting the unit into position in the deck.

.3 Adjust the gap on the job site to suit the ambient temperature at the time of final fixing of the joint to each side of the blockout. Take care to remove all buried adjustment clamps and bolts prior to concreting.

3.2 Installation

.1 Require the expansion joints to be installed by the supplier or his authorized agent as approved by the Engineer and in strict compliance with the manufacturer's recommendations and directions. Upon completion of the installation, require the supplier to certify in writing to the Engineer, that the expansion joints have been correctly installed.

.2 Upon installation, all joints and seals are to be water tested for leakage and suitable repair performed to correct areas of failure. Retest after repairs. Tests are to be performed in the presence of the Engineer.

3.3 Guarantee

.1 Require the expansion joint supplier to provide a written guarantee stating that the expansion joints have been fabricated such that they will perform satisfactorily within the design range of movement for a period of five years from the date of substantial completion provided the expansion joints have been properly installed. The supplier is to indicate in writing that they have reviewed the installation procedures and find them to be in accordance with their recommendations. Provide in the guarantee for the replacement of the expansion joints at no cost to the Owner in the event that the expansion joint does not perform satisfactorily within the design range of movement and under the design load.

.2 The General Contractor is to guarantee, in writing, the performance of the expansion joints for a five year period from the date of substantial competition. Provide in the guarantee for the replacement of the expansion joints at no cost to the Owner in the event that the expansion joint does not perform satisfactorily in the range of design movement and under the design load. Ensure the expansion joints are installed in a manner which will not void the guarantee.

END OF SECTION

GUARANTEE FORM

TO:

PROJECT: _____

TENDER NO.: _____

REFERENCE: _____

BRIDGE FILE NO.: _____

We, the undersigned, hereby jointly and severally guarantee The Owner against defects in the said expansion joint assemblies and/or workmanship related to their installation for a period of five years after completion and acceptance of the work on the above mentioned project. We guarantee for the five year period that the said expansion joint assemblies will perform satisfactorily within the project specifications, design range of movement and under the design loads.

In the event the bearings do not perform satisfactorily, the replacement and/or repairs will be done at no cost to The Owner.

Type of Expansion Joints _____

Installation/Acceptance Date _____

Guarantee/Commencement Date _____

Guarantee Termination Date _____

Date _____

General Contractor _____

Name of Corporation

_____ _____

Corporate Seal of Signing Officer
Supplier

Signing Officer

_____ _____

Corporate Seal of Signing Officer
Installer

Signing Officer

_____ _____

Corporate Seal of Signing Officer

Signing Officer

1. GENERAL

1.1 Description

.1 This section outlines requirements for cleaning and re-painting portions of the existing bridge steel.

1.2 Definitions

.1 Solvent Cleaning to SSPC-SP 1.

.2 Hand Tool Cleaning to SSPC-SP 2 or Power Tool Cleaning to SSPC-SP 3.

1.3 Paint Product Qualifications

.1 Paints must be accepted by Engineer before use on project. Provide paint manufacturer's name and address, name of paint and manufacturer's paint code number.

.2 Within fourteen (14) calendar days of award, submit to Engineer the following information on paint to be used in the work for approval:

.1 Toxicity (LC50 index).

.2 Chemical composition.

.3 Submit product qualifications and certify they meet specification at least two (2) weeks before commencement of painting.

1.4 Paint Samples

.1 Permit Engineer to take two (2) samples of each paint to be used, one from manufacturer's containers and one from painter's pot.

2. PRODUCTS

2.1 Materials

.1 Coating Systems. The paint system shall be the following, or approved equal:

Carbomastic 615HS One-coat system.

.1 Colour: Tinting material to be compatible with paint used and not detrimental to its service life. Colour tint to match black colour of existing bridge coating.

.2 Be responsible for ensuring paint material is compatible with surface to which it is being applied, by field tests or other means.

.3 All paints shall have a LC50 index value of greater than 100 parts per million.

.4 Detergents, or other agents for cleaning structural steel: shall be non-toxic, biodegradable and approved by Engineer.

3. EXECUTION

3.1 Description

.1 Steel surfaces of existing structural steel members to be re-painted as per the drawings.

3.2 Preparation of Steel Surfaces

.1 Surface preparation: Prior to hand tool or power tool cleaning, solvent clean areas to be painted to SSPC SP 1 to remove all visible deposits of oil, grease or other foreign matter. Use clean rags soaked in Carboline Thinner #2 or Toluol.

.2 A best effort with the specified methods of cleaning shall be performed in limited access areas. The acceptability of the best effort cleaning in these areas is at the sole discretion of the Engineer.

3.3 Degree of Cleanliness of Metal

.1 Do not apply paint until prepared surfaces are approved.

3.4 Protection of Surfaces

.1 Protect surfaces not to be painted and if damaged, clean and restore surfaces to approved condition. These surfaces include underside of concrete deck, abutment and pier concrete, bearings.

.2 Apply paint as soon as possible but not more than twelve (12) hours of the surface having been cleaned. This will be strictly enforced and leaving “open steel” overnight will require re-cleaning.

.3 Remove contaminants such as salts, acids, alkali, other corrosive chemicals, grease, oil, solvents, cement or concrete splatter, from cleaned or painted surfaces before each coat is applied.

.4 Protect cleaned and freshly painted surfaces from dust.

3.5 Mixing Paint

.1 Mix paint as directed by manufacturer. Provide a copy of paint manufacturer’s instructions for use to Engineer.

.2 Use only new material from unopened containers.

.3 Do not thin paint except for spray application. Use thinner for spray application according to manufacturer's instructions.

.4 Mix ingredients before use to ensure break-up of lumps, complete dispersion of settled pigment, and uniform composition.

.5 Mix paint during application to keep pigment in suspension and composition uniform.

.6 Mix paint by mechanical methods. Hand mixing will not be permitted.

.7 Do not mix or keep paint in suspension by means of air stream bubbling.

3.6 Number and Thickness of Paint Coats

.1 Carbomastic 615 HS.

.1 One-coat, 200 microns DFT

.2 80% solids by volume

.3 Coverage Rate: 3.95 m^2/litre

3.7 Applying Paint

.1 Do not use dipping or roller coating method of application.

.2 Apply paint by brushing, spraying or a combination of both. Use sheepskins or daubers only when no other method is practical in places of difficult access.

.3 Use brush to work paint into cracks, crevices and places not adequately painted by spray.

.4 Do not apply paint when:

.1 Air temperature is below 5°C or air temperature is expected to drop below 0°C before paint has dried.

.2 Surface temperature is over 50°C unless paint is specifically formulated for application of high temperature.

.3 There is fog, mist, danger of rain or snow, or relative humidity is above 85 percent.

.4 Surface temperature is less than 3°C above the dew point.

.5 Surface to be painted is wet, damp or frosted.

.6 Previous coat is not thoroughly dry.

.5 When paint must be applied in damp or cold weather, paint under shelter and heat surrounding air and steel to comply with temperature and humidity requirements. Protect paint until it is dry or until weather conditions permit its exposure.

.6 Paint to be protected from rain prior to sufficient drying.

.7 Apply each coat of paint as a continuous film of uniform thickness, free of pores. Repaint and permit to dry any thin spots or areas missed in application before next coat of paint is applied.

.8 Apply paint on surfaces approved by Engineer. Time interval between each coat to meet manufacturer's recommendations and Engineer's approval.

.9 Brush application:

.1 Work paint into cracks, crevices and corners and paint surfaces not accessible to brushes by spray, daubers or sheepskins.

.2 Brush out runs and sags immediately or grind out and repaint later.

.3 Leave a minimum of brush marks in finished paint surfaces.

.4 Follow paint manufacturer's instructions for brush application.

.10 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.

.3 Keep paint ingredients properly mixed in spray pots or containers during operations.

.4 Apply paint in a uniform layer, with overlapping at edges of spray pattern.

.5 Brush out immediately all runs and sags, or remove runs and sags from finished work and repaint.

.6 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray. In areas not accessible to spray gun, use brushes, daubers and sheepskins.

3.8 Repair of Defective Work

.1 Engineer shall identify damage to the coating. The contractor shall feather edge the coating around the damaged area a minimum of 50mm from the edge of the damaged area in all directions. Contractor shall use 80 grid abrasive-coated paper to expose each coat of the coating system, including the primer. The contractor shall apply by brush, the same number of coats as is found in the repair area using the same material. Total thickness of the repair shall be no less than 90% of the total thickness of the adjacent coating.

.2 Contractor shall remove excess paint thickness that is more than 25% the maximum of any coat. The method of removal shall be approved by the Engineer.

END OF SECTION