

1 General

1.1 SCOPE

- .1 Mobilization shall consist of preparatory work and operations including, but not limited to, those necessary to the movement of personnel, equipment, supplies and incidentals to Site and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on Site.
- .2 Demobilization shall consist of cleanup work and operations including, but not limited to, those necessary to the removal of personnel, equipment, and incidentals from Site.

1.2 PAYMENT

- .1 Payment for mobilization and demobilization will be made at the lump sum price shown in Bid Form.
- .2 The Contractor will be paid any portion of the mobilization Lump Sum Price exceeding five percent (5%) of the Tender Price within sixty (60) Days after the Actual Completion Date or on the final progress estimate (whichever occurs first).
- .3 Payment for the portion of the mobilization Lump Sum Price not exceeding five percent (5%) of the total Tender Price will be paid to the Contractor as follows. 60% of the remaining lump sum price will be paid on the first progress payment certificate due after Contractor has established the operations and facilities specified and the value of the Work completed on items other than mobilization exceeds two percent (2%) of the Tender Price. The remaining 40% will be paid upon completion of the contract and removal of equipment and cleanup of the work areas to the satisfaction of Consultant.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 SCOPE

- .1 Section 01 55 00 addresses general requirements for temporary vehicle movement, site access and parking not incorporated into the final or permanent work, as well as traffic control during construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Comply with General Conditions, Clause 3.3, Temporary Work.
- .3 During progress of the Works, make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the Works so as to minimize inconvenience to the general public.
- .4 Give minimum 48 h notice or as otherwise required by local bylaws to local police, fire departments, emergency services and municipal works authorities prior to beginning construction and comply in all respects with their requirements.
- .5 Inform all owners or occupants of properties where access is affected in advance of proposed road and/or sidewalk closures.

1.2 TEMPORARY ACCESS ROADS

- .1 Provide and maintain temporary access roads at locations approved by the Consultant.

1.3 TEMPORARY PARKING AREAS

- .1 Parking will be permitted on site provided it does not disrupt the performance of the work.

1.4 TRAFFIC CONTROL

- .1 During progress of the Work, make adequate provision to accommodate normal traffic along streets and highways immediately adjacent to or crossing the Works so as to cause minimum of inconvenience to general public.
- .2 Regulate traffic in general accordance with municipal requirements except where specified otherwise and in compliance with specific requirements stipulated herein.
- .3 Comply with requirements of the "Traffic Control Manual for Work on Roadways", published by the British Columbia Ministry of Transportation, for regulation of vehicle and pedestrian traffic or use of roadways upon or over which it is necessary to carry out work or haul materials or equipment.
- .4 When working on travelled way:
 - .1 Place equipment in such position as to present a minimum of interference and hazard to the travelling public.
 - .2 Keep equipment units as close together as working conditions will permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.

- .5 Do not close any lanes of road or highway without prior approval of the Consultant. Before re-routing traffic, erect suitable signs and devices as approved by the Consultant. Provide sufficient crushed gravel to ensure a smooth riding surface during work.
- .6 Keep travelled way well graded, free of pot holes and of sufficient width that required number of lanes of traffic may pass.
- .7 When directed by Consultant, provide well graded, graveled detours or temporary roads to facilitate passage of traffic around restricted construction area. Provide and maintain signs and lights, and maintain roadway.
- .8 Provide and maintain reasonable road access and egress to property fronting along or in vicinity of work under contract unless approved otherwise by Consultant.
- .9 Traffic Control Informational and Warning Devices
 - .1 Meet with Consultant prior to commence of work to prepare list of signs and other devices required for project.
 - .2 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from project work which may require road user response.
 - .3 Supply and erect signs, delineators, barricades and other miscellaneous warning devices in accordance with Municipal requirements.
 - .4 Place signs and other devices in additional locations as appropriate or as directed by the Consultant.
 - .5 Continually maintain traffic control devices in use by:
 - .1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - .2 Removing or covering signs which do not apply to conditions existing from day-to-day.
- .10 Control of Traffic Using Flaggers
 - .1 Provide flag persons, trained and properly equipped for the following situations:
 - .1 When public traffic is required to pass working vehicles or equipment which may block all or part of travelled roadway.
 - .2 When it is necessary to institute on-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - .5 For emergency protection when other traffic control devices are not readily available.

- .6 In situations where complete protection for workmen, working equipment and public traffic is not provided by other traffic control devices.
- .7 At each end of restricted sections where pilot cars are required.
- .11 Provide pilot cars where public traffic must use particularly hazardous routes or where traffic is required to remain in one lane or change periodically from one lane to another or negotiate sections of construction at restricted speed. Equip pilot cars with orange flashing lights and signs clearly designating vehicle as pilot cars.
- .12 Provide and maintain suitable detours or temporary access routes for pedestrian traffic, complete with suitable warning and advisory signs.
- .13 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken as specified herein and approved by Consultant to protect and control public traffic, existing conditions for traffic may be restricted.

1.5 PAYMENT

- .1 Payment for all work performed under this Section will be made at the lump sum price shown in Bid Form.
- .2 The Contractor will be paid in pro-rata increments based on the completed contract time in relation to the total contract duration as defined in the bid documents.
- .3 In the event that the construction duration is longer than the total contract duration as defined in the bid documents, no additional payment for work performed under this Section will be made

1.6 INSPECTION AND TESTING

- .1 Refer to General Conditions, Clause 2.3, Review and Inspection of the Work.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 SCOPE

- .1 Section 01 56 00 addresses general requirements for protecting Railway Property (of CN Rail and CP Rail) and coordination and safety requirements around active railway lines during construction. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
- .2 Besides the owners of the railway tracks – CN Rail (north track) and CP Rail (south track) – SRY Rail Link and BNSF also operate in this railway corridor.

1.2 PROTECTION OF RAILWAY PROPERTY

- .1 Prior to the Contractor moving onto Railway Property a work permit must be issued from CN Rail via:

Name: Rob Sewell
Title: Technical Services Engineer
Address: 11717 138th St, Surrey, BC V3R 6T5
Phone: 604-582-4424

- .2 Work shall be undertaken in accordance with “CN Guidelines Regarding Access to Workplace” a copy of which is provided in the Contract Specific Reference Documents.
- .3 Prior to the Contractor moving onto Railway Property a work permit must be issued from CP Rail via:

Name: Keith Nordin
Title: Assistant Superintendent, Pacific Gateway
Address: 1670 Lougheed Hwy, Port Coquitlam, BC V3B 5C8
Phone: 778-228-5195

- .4 Work shall be undertaken in accordance with any CP Rail guidelines regarding access to workplace.
- .5 The Contractor is responsible for all procedures and temporary works to protect the railway property, including any proposed temporary level crossings over the tracks.

1.3 ACCOMMODATION OF RAILWAY TRAFFIC

- .1 The Contractor will ensure the safety of, and minimize interference with traffic on the Canadian National Railway.
- .2 The Contractor shall perform all work to fully accommodate CN Rail train schedules.
- .3 The Contractor will submit for approval procedures and schedules for any portion of the Work on or over the railway right-of-way, with drawings as necessary, to both:

Canadian National Railway:

Att: Rob Sewell, Technical Services Engineer
11717 138th St, Surrey, BC V3R 6T5
Phone: 604-582-4424 Email: Robert.Sewell@cn.ca

Canadian Pacific Railway:

Att: Keith Nordin, Assistant Superintendent, Pacific Gateway
1670 Lougheed Hwy, Port Coquitlam, BC V3B 5C8
Phone: 778-228-5195 Email: Keith_Nordin@cpr.ca

- .4 Copies of this information shall be sent to the Consultant. No Work will be done on or over the CN Rail or CP Rail right-of-way without prior approval from CN Rail and CP Rail.
- .5 All equipment within 10 m of the nearest rail shall be stop operation, and moved clear of the operating width of the train, when instructed by the flagger on the approach of a train and remain clear until the flagger indicates that it is safe to return to work within the track limits.
- .6 CN Rail and CP Rail will decide which operations can be performed while the track remains open and which operations require traffic closure.
- .7 In general, a flagger will be required whenever work is done over the railway track, within 10 m of the railway track or when equipment crosses the railway track. The Contractor shall give the respective Railway Representatives notice of the start of such operations. The Contractor will not commence such operations until flaggers have been posted. A full-time flagger will be provided by CN Rail, if CN Rail is able to provide, and by a flagging contractor only if CN Rail does not have flaggers available. CP Rail will provide a part-time flagger as required to suite their train schedules. CN Rail, CP Rail and (if relevant) the flagging contractor will charge their costs to the Contractor.
- .8 MosClosure of railway traffic will be provided only for hoisting operation of the main overpass girders over the railway corridor. Closure of traffic will be limited to three (3) hours and will only be provided at a time acceptable to CN Rail. The Contractor will not start such operations until receipt of confirmation from the CN Rail contact or flagger that the closure is in effect.
- .9 The Contractor shall provide CN Rail with a three (3) month schedule of flagging requirements submitted a minimum of six (6) weeks in advance of commencing the work.
- .10 The Contractor shall be responsible for the cost of train delays if the operations requiring traffic closure are extended beyond the established time limits.

1.4 PAYMENT

- .1 Payment for all work performed under this Section will be made at the lump sum price shown in Bid Form.

- .2 The Contractor will be paid in pro-rata increments based on the completed contract time in relation to the total contract duration as defined in the bid documents.
- .3 In the event that the construction duration is longer than the total contract duration as defined in the bid documents, no additional payment for work performed under this Section will be made

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 MEASUREMENT PROCEDURES

- .1 Payment for de-construction and re-instatement of Deltalok wall at interface with foundations will include all costs for the controlled removal of the wall to facilitate the piled foundation construction according to the approved construction methodology of the Contractor. The lump sum price will include the cost for wall de-construction, and re-instatement and tie-in of the Deltalok wall around the new pilecap.
- .2 Payment for foundation excavation and backfill will include all costs for the controlled restricted excavation and backfilling required to facilitate the piled foundation construction according to the approved construction methodology of the Contractor. The lump sum price will include the cost for restricted excavation, excavation stability measures, and restricted backfill behind the Deltalok wall and around the new pilecap.
- .3 Payment for mobilization and demobilization of piling equipment will include all costs to mobilize and demobilize the equipment required for pile installation. The lump sum price will include the cost to mobilize to site, move equipment around the site as required for all pile installation activities and demobilize the equipment. No payment will be made to re-mobilize the equipment unless specifically authorized in writing prior to demobilizing the piling equipment.
- .4 Payment for supply and installation of 914 mm dia. steel pipe piles will include supply and installation of steel pipe, driving shoes, collars, shear rings, pile end plates for closed ended piles, cleanout (where required), granular fill, and all other work and materials necessary to complete the installation as specified. The lump sum price in the Form of Tender will include the cost to supply and install the length of piles indicated on the drawings. In addition, the high strain dynamic testing of the piles will also be included in this lump sum price.
- .5 Payment for supply and installation of pile reinforcement and cast in place concrete infill will be at the lump sum price in the form of tender. Payment will include, all costs associated with the supply and installation of the pile reinforcing and concrete in-fill within the pile and extending into the pile cap, as shown on the contract drawings.
- .6 Extra-Over payment for pipe pile length installation beyond the pile lengths indicated on the Drawings will be paid at the optional unit price rate provided in the Form of Tender. Payment will include supply and installation of extra length of 914 dia. steel pipe piles including splices, and all other works and materials necessary to complete the installation as specified. Payment under this provisional item will only be made if written authorization to install piles beyond the pile lengths indicated on the Drawings is given by the Geotechnical Engineer.

- .7 If conflict between location of piles and existing facilities exists, payment for work relating to exposing the existing obstruction, breaking out the destruction and backfilling the excavations will be undertaken in accordance with Section 10 of the General Conditions "Force Account", and will be paid at the optional Force Account Work rates provided in the Form of Tender.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Protect piles from damage due to excessive bending stresses, impact, abrasion, warping or other causes during delivery, storage and handling.
- .2 Replace damaged piles to satisfaction of the Consultant.

1.3 EXISTING CONDITIONS

- .1 Notify Consultant in writing if subsurface conditions at site differ from those indicated and await further instructions from Consultant.

2 Products

2.1 MATERIALS

- .1 Material requirements for steel pipe piles are specified in Section 02 45 08 - Steel Pipe Piles.
- .2 Do not splice piles without written permission of Consultant. When permitted, provide details for Consultant's review. Design details of splice to bear dated signature stamp of Professional Engineer registered or licensed in province of British Columbia, Canada.

3 Execution

3.1 EQUIPMENT

- .1 Provide pile installation equipment capable of installing the piles to the required capacities and anticipated tip elevations shown on the Contract Drawings and to complete high strain dynamic testing as specified. The equipment is to include a diesel hammer which has a rated energy of 205 kJ or greater (e.g. APE D62-42 diesel hammer) and other related equipment that may be required to avoid premature pile termination.
- .2 At least 2 weeks prior to commencement of pile installation, submit to Consultant for review, details of equipment for installation of piles including but not limited to the proposed hammer size, drop height, and cushion material to be used for installation of the pipe piles.

3.2 PREPARATION

- .1 Ensure that ground conditions at pile locations are adequate to support pile installation and load testing operations. Make provision for access and support of piling equipment during performance of work.
- .2 Do not drive piles within embankments until embankment fill has been placed and compacted to at least bottom elevation of pile cap.
- .3 Confirm that existing infrastructure does not conflict with proposed pile locations. Notify Consultant if conflict exists and await further instructions.
- .4 Provide Consultant 48 hours notice of commencement of pile installation to allow Geotechnical Engineer to be present on site for the pile installation.

3.3 FIELD MEASUREMENT

- .1 Maintain accurate records of driving for each pile, including:
 - .1 Type and make of hammer, stroke or equivalent energy (if applicable).
 - .2 Pile size and length, location of pile in pile group, location or designation of pile group.
 - .3 Sequence of installing piles in group.
 - .4 Number of blows per 300 mm for entire length of pile and number of blows per 25 mm for last 300 mm (if applicable).
 - .5 Pile termination criteria will be determined by the Geotechnical Engineering following submission of equipment to be used by Contractor. Final tip and cut-off elevations.
 - .6 Other pertinent information such as time of start and stopping of driving or installation including delays for splicing, interruption of continuous driving or installation, pile damage.
 - .7 Record elevation taken on adjacent piles before and after driving of each pile.
- .2 Provide Consultant with one copy of records.

3.4 HIGH STRAIN DYNAMIC LOAD TESTING

- .1 The Consultant may order pile complete high strain dynamic load testing to evaluate hammer efficiency and pile axial capacity for final acceptance. Testing will be performed by a testing agency selected by the Consultant and paid for by the Owner.
- .2 For the purpose of high strain dynamic testing, capacity of the pile to be not less than the ultimate capacity for the pile as shown on the Contract Drawings
- .3 Allowing the pile to set up for at least 3 days before testing. Testing to be completed on two piles within the pile group. Piles to be tested will be selected by the Consultant.

- .4 Crew and equipment costs associated with the remobilization of pile installation equipment for the purpose of pile testing or for repeated tests on the same pile will be considered incidental to the Work and no separate payment will be made.
- .5 Costs to the Owner for testing resulting from delays due to the Contractor's operation(s) or for repeated testing performed on the same pile will be back-charged to the Contractor. Such costs will be recovered by the Consultant via deductions to payments on the progress estimate.
- .6 If ordered by the Consultant, re-drive one or more piles in each group after a waiting period of not less than 24 hours, in order to assess any change in capacity.
- .7 High strain dynamic testing is to be performed in accordance with ASTM D 4945.

3.5 INSTALLATION

- .1 Piling not to commence until Geotechnical Engineer, or suitable representative approved by Consultant, is present on site.
- .2 Use driving caps and cushions to protect piles. Reinforce pile heads as required by Consultant. Piles with damaged heads as determined by Consultant, or Consultant's representative, will be rejected unless repaired to the satisfaction of the Consultant (if applicable).
- .3 Hold piles securely and accurately in position while installing.
- .4 Deliver hammer blows along axis of pile (if applicable).
- .5 Re-strike previously driven piles which may have heaved during driving of adjacent piles to re-seat and confirm adequate resistance (if applicable).
- .6 Remove loose and displaced material from around piles after completion of installation, and leave clean, solid surfaces to receive pile cap concrete.
- .7 Cut off piles neatly and squarely at elevations as indicated. Provide sufficient length above cut-off elevation so that portion damaged during driving is cut off. Do not cut tendons or other reinforcement that will be used to tie pile caps to pile.
- .8 Remove cut-off lengths from site on completion of work.
- .9 For high strain dynamic testing, ensure that the pile to be tested extends beyond 2.5 m above ground surface to allow the testing to be conducted.

3.6 INSTALLATION TOLERANCES

- .1 Pile heads to be within 75 mm of locations as indicated.
- .2 Piles not to be more than 2% of length out of vertical alignment.

3.7 OBSTRUCTIONS

- .1 Where an obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, proceed as directed by Consultant.

3.8 REPAIR/ RESTORATION

- .1 Pull out rejected piles and replace with new piles.
- .2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

3.9 PROTECTION

- .1 Protect adjacent structures, services and work of other sections from hazards due to pile installation operations.
- .2 Arrange sequencing of pile installation operations and methods such that no damage occurs to adjacent existing structures. If damaged, remedy damaged items to restore to original or better condition at own expense.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 REFERENCES

- .1 ASTM A252, Specification for Welded and Seamless Steel Pipe Piles.
- .2 CAN/CSA-G40.21-M, Structural Quality Steels (metric version).
- .3 CSA-W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .4 CSA-W47.1S1-M, Supplement No. 1-M to W47.1, Certification of Companies for Fusion Welding of Steel Structures.
- .5 CSA-W59-M, Welded Steel Construction (Metal Arc Welding) (metric version).

1.2 MEASUREMENT PROCEDURES

- .1 Payment for all Work performed under this section will be incidental to payment for Work described in other Sections unless shown otherwise in the Form of Tender.
- .2 Payment will be made in accordance with Section 02 45 01 – Pile Foundations, General.

1.3 TEST REPORTS

- .1 Prior to fabrication and, if requested, provide Consultant with two copies of steel producer's certificates in accordance with ASTM A252.
- .2 One Charpy V-notch test required per heat and results reported to Consultant by manufacturer.

2 Products

2.1 MATERIALS

- .1 Steel pipe of steel grade, sizes and wall thicknesses indicated.
- .2 Pile tip reinforcement: to CAN/CSA-G40.21.
- .3 Pile driving shoes: to CAN/CSA-G40.21.
- .4 Shear rings: to CAN/CSA-G40.21.
- .5 Splices: to CAN/CSA-G40.21.
- .6 Welding electrodes: to CSA-W48 series.

- .7 Reinforcing steel: to Section 03 20 01 - Concrete Reinforcement, grade 400W, sizes and details as indicated.

3 Execution

3.1 FABRICATION

- .1 Fabricate full length piles to eliminate splicing during installation wherever possible.
- .2 Full-length piles may be fabricated from piling material by splicing lengths together. Use complete joint penetration groove welds.
- .3 Submit details of planned use of pile material stock to Consultant for approval prior to start of fabrication. Re-use cut-off lengths as directed by Consultant.
- .4 Allowable tolerance on axial alignment to be 0.25% as measured by a 3 m straight edge.
- .5 Install pile tip reinforcement, splices, driving shoes, and shear rings as indicated.
- .6 Repair defective welds as approved by Consultant. Repairs to CSA-W59 and CSA-W59S1. Unauthorized weld repairs may be rejected.

3.2 INSTALLATION

- .1 Install piling in accordance with Section 02 45 01 - Pile Foundations, General.
- .2 If approved by Consultant, splice piles in place during installation by welding. To prevent distortion, tack opposite points first and then weld opposite sections for pipe walls thinner than 10 mm weld against a back up ring. Hold members in alignment during splicing operation. Make splice by complete joint penetration groove welds.
- .3 Perform internal visual inspection of steel pipe, joints and base prior to placing of concrete. Ensure pipe inside is free from foreign matter.
- .4 Install concrete in accordance with Section 03 30 54 – Cast-in-Place Concrete.
- .5 Fill steel pipe pile with concrete using methods to limit freefall and to prevent segregation. Ensure adequate vibration to completely fill cross section of pipe.
- .6 If applicable, driving shoes may be installed during shop fabrication.

3.3 WELDING

- .1 Weld in accordance with CSA-W59 and CSA-W59S1.
- .2 Welding certification of companies: in accordance with CSA-W47.1 and CSA-W47.1S1.

- .3 Welding certification of companies welding steel reinforcing bars placed in reinforced concrete: in accordance with CSA-W186.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-M, Concrete Materials and Methods of Concrete Construction.
 - .2 CSA S269.1, Falsework for Construction Purposes.
 - .3 CAN/CSA-S269.3-M, Concrete Formwork.

1.2 CERTIFICATION AND SUBMITTALS

- .1 Submit shop drawings for formwork and falsework.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings Comply with CAN/CSA-S269.3 for formwork drawings.
- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork/falsework as directed by Consultant.
- .5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of British Columbia, Canada.

1.3 MEASUREMENT AND PAYMENT

- .1 No measurement and payment will be made under this Section. Include costs in items of work for which concrete formwork is required.

2 Products

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use plywood and wood formwork materials to CSA-O121.
- .2 Form ties:
 - .1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface.
 - .2 Plywood form liner: medium density overlay Douglas Fir to CSA O121.

- .3 Form release agent: chemically active release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps.

3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Consultant's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.
- .8 Align form joints and make watertight. Keep form joints to minimum.
- .9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-A23.4, Precast Concrete Materials and Construction.
 - .3 CAN/CSA-G30.18-M, Billet-Steel Bars for Concrete Reinforcement.
 - .4 ASTM A276 - 10 Standard Specification for Stainless Steel Bars and Shapes

1.2 CERTIFICATION

- .1 Provide Consultant prior to fabrication with two copies of steel producer certificates, giving chemical and physical properties of the reinforcing steel.
- .2 The identification of reinforcing bars shall be maintained throughout the fabrication, coating (if required) and shipping processes to the installation in the Works.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings including placing of reinforcement in accordance with Article 3.10 of the General Conditions.
- .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacing, locations of reinforcement and mechanical splices if approved by Consultant, with identifying code marks to permit correct placement without reference to structural drawings. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
- .3 Detail lap lengths and bar development lengths to CAN3-A23.3.

1.4 MEASUREMENT AND PAYMENT

- .1 No measurement and payment will be made under this section. Include costs in items of concrete work for which reinforcement is required.

1.5 INSPECTION AND TESTING

- .1 Refer to General Conditions Clause 2.3 Review and Inspection of the Work and Clause 2.4 Defective Work.

2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Consultant.
- .2 Reinforcing steel: billet steel, grade 400W, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18.
- .4 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .5 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
- .6 Welded deformed steel wire fabric: to CSA G30.15. Provide in flat sheets only.
- .7 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.
- .8 Bar chairs for supporting stainless steel reinforcing bars shall be non-metallic; do not use concrete chairs to support stainless steel reinforcing bars.
- .9 Mechanical splices: subject to approval of Consultant.
- .10 Plain round bars: to CAN/CSA-G40.21.
- .11 Stainless steel reinforcement: pre-approved deformed bars, hot rolled, de scaled and pickled to ASTM A276 and ASTM A955M, Grade 420 minimum.
 - .1 Pre-approved stainless steel reinforcing bars, splice bars, and mechanical couplers for stainless steel reinforcing bars:

Pre-Approved Stainless Steel Reinforcing Bars	
Type/ASTM Designation	UNS Designation
316 LN	S31653
Duplex 2205	S31803
Duplex 2304	S32304
Nitronic 32/XM-28	S24100

- .2 Chemical composition of Duplex 2304 Stainless steel reinforcement: ASTM A276 Table 1
- .12 Tie wire for stainless steel reinforcing bars: type 316 stainless steel, 1.6 mm diameter.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Store reinforcing bars clear of ground on protective cribbing spaced to prevent sags in bundles. Adequately block bundles of straight bars to prevent contact between the layers of bundles.
- .3 Store stainless steel reinforcing bars separately from uncoated reinforcing steel bars with bar tags maintained and clearly visible until ready for placing.
- .4 Obtain Consultant's approval for locations of reinforcement splices other than those shown on placing drawings.
- .5 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .6 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
- .2 Upon request inform Consultant of proposed source of material to be supplied.

3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.
- .4 Obtain Consultant's approval for field bending of stainless steel reinforcing bars. Use only equipment assigned solely for this purpose.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.

- .2 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating
 - .2 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
 - .3 CAN/CSA-G30.18-M, Billet Steel Bars for Concrete Reinforcement.
 - .4 CAN/CSA-G40.21-M, Structural Quality Steels.
 - .5 CAN/CSA-G164-M, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .6 CSA-S6, Canadian Highway Bridge Design Code.
- .2 ASTM A143, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

1.2 MEASUREMENT AND PAYMENT

- .1 No measurement and payment will be made under this section. Include costs in items of concrete work for which galvanized reinforcement is required.

1.3 SHOP DRAWINGS

- .1 In accordance with General Conditions Clause 3.10

2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Consultant.
- .2 Reinforcing steel: billet steel, Grade 400W, deformed bars to CAN/CSA-G30.18, unless indicated otherwise. Provide one-piece bars with required lengths and bends.
- .3 Ties wire: smooth, equal or greater than 16 Ga (U.S. Steel Wire Gauge) to CSA-G30.3. Tie wires to be made of non-metallic material or material covered with acceptable coating.
- .4 Supports: to CSA-A23.1, rust-proof, galvanized steel or approved equal.
- .5 Galvanize all reinforcement to CSA-G164, minimum zinc coating 610 g/m². Galvanize reinforcement after bending and fabrication.
- .6 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.

- .7 Mechanical splices: subject to approval of Consultant.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada unless indicated otherwise.
- .2 Obtain Consultant's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
- .4 Welding of reinforcement is not permitted.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcing work.
- .2 Upon request, inform Consultant of proposed source of material to be supplied.
- .3 Provide Consultant with certified documentation for the galvanized coating containing the following information:
 - .1 Name of Galvanizer.
 - .2 Mass and thickness of galvanized coating.
 - .3 Results of fragility strength tests for base metal to be galvanized.
 - .4 Production lot number designating reinforcing steel lots. A production lot comprises reinforcing steel having undergone the same coating sequence, with the same product, at the same galvanizer.

3 Execution

3.1 GALVANIZING

- .1 No chromate treatment is required for the reinforcing. Allow galvanized bars to age at least 1 month prior to placing in new concrete.
- .2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143.

3.2 FIELD BENDING

- .1 Do not field bend reinforcement except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.
- .4 Touch up damaged galvanizing.

3.3 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.
- .2 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.
- .4 Protect galvanized bars with covering during transportation and handling.

3.4 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of galvanized reinforcing steel with two coats of an organic zinc-rich paint complying with CAN/CGSB-1.181 to provide continuous coating.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 REFERENCES

- .1 CAN/CSA-A23.1-M, Concrete Materials and Methods of Concrete Construction.
- .2 CAN/CSA-A23.2-M, Methods of Test for Concrete.
- .3 CAN/CSA-A3000-M, Cementitious Materials Compendium.
- .4 CAN/CSA-A23.5-M, Supplementary Cementing Materials.
- .5 CAN3-A266.1-M, Air-Entraining Admixtures for Concrete.
- .6 CAN3-A266.2-M, Chemical Admixtures for Concrete.
- .7 CAN3-A266.4-M, Guidelines for the use of Admixtures in Concrete.
- .8 ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .9 ASTM D1751, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

1.2 SUBMITTAL

- .1 Submit proposed mix design for concrete to Consultant for review at least 2 weeks prior to commencement of work.
- .2 If proprietary concrete repair products are to be used, submit proposed products to Consultant at least 2 weeks prior to commencement of work.
- .3 Submit temporary works drawings and procedures required to facilitate the concrete repair and retrofit. Temporary works drawings shall be prepared and sealed by a professional engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia.

1.3 MEASUREMENT AND PAYMENT

- .1 With the following exceptions no measurement and payment will be made under this Section. Include costs in applicable Lump Sum Price of associated work.
- .2 Payment for construction of new concrete pile caps (including associated screen wall) shall be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required to construct the pile caps including concrete, reinforcing, formworks, excavation, backfilling, submittals, quality control, curing, and finishing.

- .3 Payment for reinforced concrete infill of columns will not be paid under this section, and shall be considered incidental to the associated work. Include costs in applicable lump sum price of associated work.
- .4 Payment for heating and hoarding will be made at the optional Unit Price Rate provided in the Form of Tender. Unit Price Rate will include supply and installation weather protection enclosures and, if necessary, heating measures to ensure proper initial set and curing of cast-in-place concrete during periods of prolonged temperatures below 5 degrees Celsius and rain that are affecting the project schedule. Payment under this provisional item will only be made if written authorization is given by the Consultant.
- .5 Payment for staircase concrete footing will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required to construct the concrete footing including concrete, reinforcement, formwork, submittals, quality control, curing, and finishing.
- .6 Payment for staircase concrete landings will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required to construct the concrete footing including concrete, reinforcement, formwork, submittals, quality control, curing, and finishing.
- .7 Payment for Existing Parkade Cantilever Partial Demolition, as indicated in the Contract Drawings and Clause 03 30 54 – 3.8, will be made at the Lump Sum Price bid. Lump Sum Price will include all labour, materials and equipment required to demolish the concrete portion of the existing parkade cantilever without damage to the existing reinforcement. Payment shall also be for the removal and disposal of debris from site, and for the containment and treatment of the contaminated water (if the Contractor elects to use a hydro-demolition alternative).

2 Products

2.1 MATERIALS

- .1 Portland cement: to CAN/CSA-A5, Type GU.
- .2 Water: to CAN/CSA-A23.1.
- .3 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
- .4 Air entraining admixture: to CAN3-A266.1.
- .5 Chemical admixtures: to CAN3-A266.2. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing. Do not use admixtures containing calcium chloride.

- .6 Supplementary cementing materials: to CAN/CSA-A23.5, Type F.
- .7 Super-plasticizing admixtures: to CAN3-A266.6.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 35 MPa at 28 days.
- .9 Premoulded joint fillers:
 - .1 Bituminous impregnated fibreboard: to ASTM D1751.

2.2 CONCRETE MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give the following properties.
- .2 All cast-in-place concrete:
 - .1 Cement: Type GU Portland Cement.
 - .2 Minimum compressive strength at 28 days: as shown on Drawings.
 - .3 Class of Exposure: C1.
 - .4 Normal size of coarse aggregate: 19 mm.
 - .5 Slump at time and point of discharge: 60 to 80 mm (without super plasticizer).
 - .6 Air content: 5% to 7%.
 - .7 Do not change concrete mix without prior approval of Consultant.
 - .8 Slump may be enhanced by the site addition of super plasticizer, subject to *Consultant's* approval of product, dosage and mixing procedure.
- .3 Additional Specifications for cast-in-place concrete for overpass and platform decks:
 - .1 Silica Fume application rates: 5% to 8% by mass of cementing materials.
 - .2 Water / cement ratio by mass: 0.38 maximum.

2.3 SAMPLES

- .1 At least 4 weeks prior to commencing work, inform Consultant of proposed source of aggregates and provide access for sampling.

3 Execution

3.1 GENERAL

- .1 Complete cast-in-place concrete work in accordance with CAN/CSA-A23.1.

3.2 WORKMANSHIP

- .1 Obtain Consultant's approval before placing concrete. Provide 24 h notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 Do not place load upon new concrete until authorized by Consultant.
- .7 Concrete tolerance in accordance with CAN/CSA-A23.1 straight edge method.

3.3 FINISHING OF FORMED SURFACES

- .1 General:
 - .1 Patch and finish formed surfaces to CAN/CSA A23.1 except as noted.
 - .2 Repair honeycombed and defective concrete with method approved by Consultant.
- .3 Finish Types
 - .1 For bridge deck, see Section 03 30 55S.
 - .2 Class 2 - Common Finish. Finish all formed concrete exposed to view. Common finish to consist of smooth form finish to CAN/CSA A23.1.
 - .3 Class 3 - Rough Form Finish. Finish all formed concrete in contact with backfill with a rough form finish to CAN/CSA A23.1.
 - .4 Chamfer exposed corners 20 mm by 20 mm.
 - .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
 - .6 Tool stair nosings to produce radius as indicated on drawings.

3.4 CONSTRUCTION JOINTS

- .1 Prepare construction joints to CAN/CSA-A23.1 and roughen joint to a nominal amplitude of 6 mm.
- .2 The location of construction joints not shown on the drawings to be approved by the Consultant.

3.5 INSERTS

- .1 Set sleeves, ties, and other inserts and openings as indicated or specified elsewhere. Sleeves and openings not indicated on structural or civil drawings must be approved by Consultant.
- .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Consultant before placing of concrete.

3.6 CURING

- .1 Cure concrete to CAN/CSA-A23.1 except where specified otherwise. Curing compounds shall not be used without the written authorization of the Consultant.

3.7 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a CSA certified Testing Laboratory in accordance with CAN/CSA-A23.1 except as follows:
 - .1 A strength test will consist of three standard cylinders, one tested at 7 days and two at 28 days.
 - .2 Frequency of testing may be increased at *Consultant's* discretion.
- .2 Contractor will pay for costs of tests as specified.
- .3 Consultant will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .4 Non-destructive methods for testing concrete shall be in accordance with CAN/CSA-A23.2.
- .5 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.
- .6 Concrete failing to meet the requirements to be retested, strengthened or rejected in accordance with CAN/CSA A23.2. All additional testing, strengthening, and/or replacement to be at the Contractor's expense.

3.8 EXISTING PARKADE CANTILEVER DEMOLITION

- .1 Partial demolition of concrete portion of existing cantilever, as indicated in the Contract Drawings, shall be completed without damage to the existing reinforcement, and with measures in place to ensure that debris do not damage adjacent parts of the structure. Demolition can be completed by grinders and by jackhammers that are limited to a maximum 18 kg, or alternatively by hydro-demolition subject to the Consultant approving the proposed hydro-demolition methodology. Preparation of

edges of the indicated demolition area shall minimize damage to the sound substrate concrete.

END OF SECTION

1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.

1.2 SUBMITTALS

- .1 Provide certification and submittals as specified within Section 03 30 54 – Structural Cast-in-Place Concrete
- .2 Submit a detailed plan of equipment and manpower to be used for the concrete removal, deck preparation, placement, finishing and curing of the concrete deck, curbs, and expansion joints a minimum of 2 weeks prior to the scheduled placement dates for review by the Consultant. The plan shall also contain details such as debris and water containment methods, water source, the distribution system, person(s) responsible for quality control, and staff to maintain the system. Adjust proposed methods if and as requested by Consultant. Do not proceed with concrete placement until all methods and procedures have been approved by Consultant.
- .3 Submit proposed mix design for concrete deck to Consultant for review at least 2 weeks prior to scheduled placement of concrete.
- .4 If proprietary concrete products are to be used, submit proposed product to Consultant at least 2 weeks prior to commencement of work.

1.3 MEASUREMENT AND PAYMENT

- .1 Payment for overpass concrete deck will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required to construct the overpass concrete deck including concrete, reinforcement, embedded plates and anchorages, formwork, submittals, quality control, curing, and finishing.
- .2 Payment for viewing platform will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required to construct the tower concrete deck including concrete, reinforcement, embedded plates and anchorages, formwork, submittals, quality control, curing, and finishing.
- .3 Payment for Existing Parkade Concrete Cantilever Retrofit will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required to construct the concrete cantilever retrofit, including concrete, reinforcement, embedded plates and anchorages, formwork, submittals, quality control, curing, and finishing.

2 Products

2.1 MATERIALS

- .1 Portland cement: to CAN/CSA-A3000 – Type GU
- .2 Supplemental cementing materials: to CAN/CSA-A23.5
- .3 Silica Fume: CSA Standard A3000 Cementitious Materials Compendium for Type SF silica fume.
- .4 Water: to CAN/CSA-A23.1
- .5 Aggregates: to CAN/CSA-A23.1
- .6 Air entrainment admixture: to CAN3-A266.1-M
- .7 Chemical admixtures: to CAN3-A266.2M. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .8 All other concrete materials: to CAN/CSA-A23.1
- .9 Reinforcing steel: to Section 03 20 01 – Concrete Reinforcement

2.2 CONCRETE MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give following properties: for concrete in deck.
 - .1 Cement:
 - .1 Type GU Portland cement.
 - .2 Minimum cement content (excluding silica fume): 350 kg/m³.
 - .2 Minimum compressive strength at 28 days: 35 MPa.
 - .3 Class of exposure: C1.
 - .4 Nominal size of coarse aggregate: 19 mm.
 - .5 Slump at time and point of discharge: 60 to 80 mm without superplasticizer, adjusted to allow for the selected concrete placing method if necessary.
 - .6 Air content: 5.5 to 8.0%.
 - .7 Ratio of water to total cementitious materials: 0.38 maximum.
 - .8 Silica Fume: 5% to 8% by mass of cementing materials.
 - .9 Do not change concrete mix without prior approval of *Consultant*.
 - .10 Superplasticizer product, dosage and mixing procedure to be approved by Consultant.

- .2 Bonding Slurry: use slurry consisting of one part Type GU Portland cement and one part masonry sand by mass, mixed with water and superplasticizers to produce a thick creamy consistency suitable for brushing. Water:cement ratio not to exceed 0.38 by mass.

2.3 EQUIPMENT

- .1 Provide screeding equipment of adequate size and design to permit the complete finishing deck width at one time. The screeding sequence shall provide the prescribed surface finish, without forming any cold joints. Details of vibratory screed finishing equipment shall be submitted to the Consultant for review and approval.

3 Execution

3.1 GENERAL

- .1 Do concrete work in accordance with Section 03 30 53 - Cast-in-Place Concrete.
- .2 Place concrete at temperatures limits to CSA-A23.1/A23.2
- .3 At the completion of each day's Work, the Contractor shall leave all material and equipment at the Site in a secure, stable and safe condition.
- .4 When air temperature is at or forecast to be at or below 5°C within a period of 24 hours of placing concrete, requirements for protection by means of heated enclosures, coverings or insulation shall be provided in accordance with the requirements of CSA A23.1-09 for cold weather concreting. Concrete temperature at placing to be a minimum of 10°C
- .5 When ambient air temperature exceeds 20 °C during the placing period, follow the requirements of CSA A23.1-09 for hot weather concreting. Concrete temperature at placing to be a maximum of 25°C.
- .6 Do not place concrete during rain or excessive wind or dust.

3.2 PLACEMENT

- .1 Ensure that rate of placing is sufficient to complete proposed placing, finishing and initiation of curing operations within one single, continuous placing operation; that experienced concrete finishers are provided to finish deck; that curing equipment and finishing tools and equipment are on site and in satisfactory condition for use.
- .2 Do not place concrete if rain, strong winds or otherwise unsuitable weather is forecast. Alternatively, provide tenting or hoarding to protect the freshly poured concrete from the unsuitable weather. Protect the freshly placed concrete from drying as detailed in CSA A23.1-04.

- .3 Immediately prior to placing, check falsework and wedges and make necessary adjustments.
- .4 Deliver concrete to the final point of placement in a manner that prevents segregation of the concrete and does not contaminate the prepared surface.
- .5 If concrete placement is stopped for longer than 30 minutes, install a bulkhead to prepare a construction joint if so instructed by the Consultant.
- .6 Immediately after concrete has been placed and consolidated, strike off surface. Correct immediately any improper adjustment and operation which results in unsatisfactory consolidation and smoothness. Unsatisfactory performance may be cause for rejection of equipment and removal of concrete in place.
- .7 Following completion of strike off by hand methods, float deck slab surface longitudinally to a smooth uniform surface with hand-operated wood float boards 3.5 to 5 m long, minimum 25 mm thick, minimum 200 mm wide, ribbed and trussed as necessary to provide a rigid float, and equipped with adjustable handles at each end. Provide adjusting screws spaced at maximum 600 mm centres between float board and rib. Maintain float board true to line and free of twist.
- .8 Use floats to remove roughness and minor irregularities and to seal concrete surface to approval of Consultant. Excessive working of surface is not permitted.

3.3 FINISHING

- .1 Formed surfaces: Section 03 30 54.
- .2 Finishing deck slabs: when concrete has hardened sufficiently to prevent dislodgement of coarse aggregate particles, give surface a uniform tined or broomed finish free from porous spots, irregularities, depressions, small pockets or rough spots.
- .3 Finish surface to within 3 mm in 3 m from line, level or grade as measured with a straight edge placed on surface.
- .4 If flatness is unacceptable and in a 4-10 mm tolerance range, grind the surface of hardened concrete and restore tining with grooving equipment to provide a skid resistant surface. For deviation from flatness greater than 10 mm, remove and replace concrete using procedures as specified for unsound concrete in this specification, or as acceptable to the Consultant, at the expense of the Contractor.
- .5 Finishing sidewalk: uniform stiff broom anti-slip surface.

3.4 PROTECTION AND CURING

- .1 For concrete placed when ambient air temperature is below 5°C comply with the cold weather requirements of CAN/CSA-A23.1. Concrete shall not be placed when the

ambient temperature exceeds 25°C. Concrete more than 45 minutes old shall be rejected.

- .2 Unformed surfaces: cure with burlap and water. Carefully place two layers of damp burlap on the surface of the concrete as soon as practicable following placement. Overlap each strip by at least 75 mm and secure against displacement by wind. Maintain burlap in place and keep thoroughly and continuously wet for seven days after day of placing. Provide misting as described in A23.1 when water evaporation from the concrete surface is predicted to exceed 1.5 kg/m²/hr and according to A23.1 Appendix D.
- .3 Do not use a curing agent.
- .4 During curing period uncover only such areas as are immediately needed for finish treatment. Recover and continue curing.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 775/A 775M, Specification for Epoxy-Coated Reinforcing Steel Bars.
 - .2 ASTM D 412, Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension.
 - .3 ASTM D 2240, Test Method for Rubber Property - Durometer Hardness.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN3-A23.4, Precast Concrete - Materials and Construction.
 - .3 CSA-A251-M, Qualification Code for Manufacturers of Architectural and Structural Precast Concrete.
 - .4 CSA-G30.15-M, Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
 - .5 CAN/CSA-G30.18-M, Billet-Steel Bars for Concrete Reinforcement.
 - .6 CAN/CSA-G40.21-M, Structural Quality Steels.
 - .7 CAN/CSA-G164-M, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .8 CSA-G279-M, Steel for Prestressed Concrete Tendons.
 - .9 CSA-W47.1, Certification of Companies for Fusion Welding for Steel Structures.
 - .10 CSA-W48.1-M, Carbon Steel Covered Electrodes for Shielded Metal Arc Welding.
 - .11 CSA-W59-M, Welded Steel Construction (Metal Arc Welding).
 - .12 CSA-W186-M, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.2 DESIGN REQUIREMENTS

- .1 Design precast elements to CAN3-A23.3 and CAN3-A23.4 to carry handling stresses.
- .2 Design precast elements to carry loads specified by Contract Administrator.

1.3 PERFORMANCE REQUIREMENTS

- .1 Tolerance of precast elements to CAN3-A23.4, Section 10.

1.4 SHOP DRAWINGS

- .1 Prepare and submit shop drawings in accordance with GC 5, and in accordance with CAN3-A23.3 and CAN3-A23.4.
- .2 Include the following items:
 - .1 Design calculations for items designed by manufacturer.
 - .2 Details of prestressed and non-prestressed members, reinforcement and their connections.
 - .3 Camber.
 - .4 Finishing schedules.
 - .5 Methods of handling and erection.
 - .6 Openings, sleeves, inserts and related reinforcement.
- .3 Each drawing submitted shall bear stamp and signature of qualified professional Contract Administrator registered or licensed in province of British Columbia, Canada.

1.5 QUALIFICATIONS

- .1 Precast concrete elements to be fabricated and erected by manufacturing plant certified by Canadian Standards Association in appropriate categories according to CSA-A251.
- .2 Precast concrete manufacturer to be certified in accordance with CSA's certification procedures for precast concrete plants prior to submitting tender and to specifically verify as part of tender that plant is currently certified in appropriate categories, i.e. Structural and Prestressed.
- .3 Only precast elements fabricated in such certified plants to be acceptable to owner, and plant certification to be maintained for duration of fabrication, erection until warranty expires.
- .4 Welding companies certified to CSA-W47.1.

1.6 MEASUREMENT PROCEDURES

- .1 Payment for Supply and Install Precast Deck Stay-in-Place Forms shall be made at the Lump Sum Price bid. The Lump Sum Price shall include the cost of all submittals, materials and work required under this section.

2 Products

2.1 MATERIALS

- .1 Cement, aggregates, water, admixtures: to CAN/CSA-A23.1 and CAN3-A23.4.

- .2 Reinforcing steel: to CAN/CSA-G30.18.
- .3 Pre-stressing steel tendons and bars: to CAN/CSA-S6 and CSA-G279.
- .4 Welded wire fabric: to CSA-G30.15.
- .5 Hardware and miscellaneous materials: to CAN/CSA-A23.1.
- .6 Forms: to CAN3-A23.4.
- .7 Welding materials: to CSA-W48.1.
- .8 Welding electrodes: to CSA-W48.1 and certified by Canadian Welding Bureau.
- .9 Galvanizing: hot dipped galvanizing with minimum zinc coating of 610 g/m² to CAN/CSA-G164.
- .10 Epoxy coating: to ASTM A 775/A 775M.
- .11 Steel primer: to CAN/CGSB-1.40.
- .12 Zinc-rich primer: to CAN/CGSB-1.181.
- .13 Bearing pads: natural rubber, 60 durometer hardness to ASTM D 2240, and 15.5 MPa minimum tensile strength to ASTM D 412, moulded to size or cut from moulded sheet.

2.2 MIXES

- .1 Concrete.
 - .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1, to give following properties: for all concrete.
 - .1 Cement: use Type GU Portland cement.
 - .2 Minimum compressive strength at 28 days: as shown on the drawings.
 - .3 Class of exposure: C1.
 - .4 Nominal size of coarse aggregate: to CAN/CSA-A23.1.
 - .5 Water cement ratio: to CAN/CSA-A23.1.
 - .6 Air content: to CAN/CSA-A23.1
 - .7 Chemical admixtures: to CAN/CSA-A23.1
- .2 Grout.
 - .1 Minimum compressive strength: 40 MPa.
 - .2 Grout for levelling pads: "Target Flowcrete" with fine aggregate or as approved.

2.3 MANUFACTURED UNITS

- .1 Manufacture units in accordance with CAN3- A23.4, and CSA-A251.
- .2 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast on part of unit which will not be exposed.
- .3 Provide hardware suitable for handling elements.
- .4 Design tendons and anchorages and install post-tensioning ducts in accordance with CAN/CSA-S6.
- .5 Welded stud connectors: Section 05122.

2.4 FINISHES

- .1 Finish surfaces with wood float unless noted otherwise on the drawings.

2.5 SOURCE QUALITY CONTROL

- .1 Provide Contract Administrator with certified copies of quality control tests related to this project as specified in CAN3-A23.4 and CSA-G279.
- .2 Inspect prestressed concrete tendons in accordance with CSA-G279.
- .3 Provide records from in-house quality control programme based upon plant certification requirements to Contract Administrator for inspection and review.
- .4 Upon request, provide Contract Administrator with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.
- .5 Precast plants should keep complete records of supply source of concrete material, steel reinforcement, pre-stressing steel and provide to Contract Administrator for review upon request.

3 Execution

3.1 ERECTION

- .1 Do precast concrete work in accordance with CAN3-A23.4 and CAN3-A23.3.
- .2 Do welding in accordance with CSA-W59, for welding to steel structures. Do not weld reinforcement.
- .3 Erect precast elements within allowable tolerances as indicated.
- .4 Non-cumulative erection tolerances in accordance with CAN3-A23-4.

- .5 Set elevations and alignment between units to within allowable tolerances before connecting units.
- .6 Fasten precast units in place as indicated on reviewed shop drawings.
- .7 Secure with bolts using tack-weld nut to bolt.
- .8 Uniformly tighten bolted connections with torque indicated.
- .9 Do not weld or secure bearing plates at sliding joints.
- .10 Clean field welds with wire brush and touch-up galvanized finish with zinc-rich primer.
- .11 Ballast walls shall be attached to the girders by field welding as shown on the drawings.

3.2 CLEANING

- .1 Obtain approval of cleaning methods from Contract Administrator before cleaning soiled precast concrete surfaces.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

PART 1 - GENERAL

1.1 SUMMARY

- 1.1.1 Precast concrete platform, ramp and step units for access to or within buildings and structures for permanent use. Precast units shall be complete with embeds as specified by the Consultant. Individual stair tread units must be able to be removed from the complete stair installation without the need to remove adjacent treads. Design concrete mix and forms, supply necessary materials and install precast concrete stair treads as indicated and specified.
- 1.1.2 Quality Control: Refer to General Requirements.
- 1.1.3 Refer to Section 03 30 54 Structural Cast-in Place Concrete for finishing of Precast Concrete Stair Treads.

1.2 REFERENCES

- 1.2.1 Referenced standards shall be the current edition of the standard at the time of Tender except where the authority having jurisdiction recognizes an earlier edition only.
- 1.2.2 Work of this Section shall conform to the following standards unless indicated otherwise:
- 1.2.3 ACI 301, Specification for Structural Concrete.
- 1.2.4 ACI 303.1, Specification for Cast-in-Place Architectural Concrete.
- 1.2.5 CAN/CSA-A23.1-A23.2-00, Concrete Materials and Methods of Concrete Construction / Methods of Test for Concrete.
- 1.2.6 CAN/CSA-A23.3-94 (R2000), Design of Concrete Structures.
- 1.2.7 CAN/CSA A5-93, Portland Cement.
- 1.2.8 CAN/CSA A3000-98, Cementitious Materials Compendium (includes CAN/CSA-A5-98, CAN/CSA-A23.5-98, A362-98, A 363-98.
- 1.2.9 CSA 269.3-M92 Concrete Formwork.

1.3 SUBMITTALS

- 1.3.1 Refer to the General Requirements.

1.3.2 Product Data: For all concrete materials, accessories and admixtures proposed for use including the following:

1.3.2.1 Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.3.3 Shop Drawings: The manufacturer shall submit complete engineered shop drawings for each item supplied under this section. Shop Drawings shall show at a minimum, plan views, elevations, details and specifications. Submittals shall be signed and sealed by a British Columbia licensed professional engineer.

1.3.4 Samples: For each of the following items:

1.3.4.1 Full Size section of Precast Concrete Stair tread. Sample length 200mm minimum.

1.4 **QUALITY ASSURANCE**

1.4.1 Pre-fabricated units provided under this section shall comply with the current editions of the following codes:

1.4.1.1 British Columbia Building Code 2012

1.4.1.2 Life Safety Codes NFPA 101 HB

1.4.2 Installer and manufacturer: shall submit written information regarding the following:

1.4.2.1 Manufacturer: shall have minimum of 5 years' experience in the manufacture of precast concrete landings and steps.

1.4.2.2 Installer:

1.4.2.2.1 Use a minimum of 2 workers who are thoroughly trained by the manufacturer in the necessary crafts and who are familiar with specified requirements and methods needed for proper performance of this section.

1.4.2.2.2 Workers shall be experienced in the fields of carpentry, determination of proper level and drainage slope, installation of metal railings, setting of foundations, anchoring, welding and fabricating in the field, and painting experience for final finish and/or touch-up of metal railings.

- 1.4.2.2.3 Experience: Worker shall have a minimum of 5 years' experience in the installation of precast concrete landings, platforms, ramps, steps, and railings.
- 1.4.2.3 The Manufacturer shall demonstrate to the Owner that each of the requirements of this specification and the codes listed have been met or exceeded by the units delivered. This shall be accomplished by load tests and/or engineering data assembled and presented in a logical and understandable method.
- 1.4.2.4 Faulty units shall be immediately replaced at the site without additional cost to the Owner.
- 1.4.3 Tolerances: Refer to Structural drawings for cast-in-place Concrete specifications. Tread units must be installed so that there is less than 5mm tread height deviation between adjacent treads for the entire run.
- 1.4.4 Mock-ups: Before casting architectural concrete, build mock-ups to demonstrate aesthetic effects and qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for the completed Work:
 - 1.4.4.1 Build mock-ups in location and of size indicated or, if not indicated, as directed by the Architect
 - 1.4.4.2 Notify the Architect seven days in advance of dates and times when mock-ups will be constructed.
 - 1.4.4.3 Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
 - 1.4.4.4 Obtain the Architect's approval of mock-ups before casting architectural concrete.
 - 1.4.4.5 Maintain mock-ups during construction in an undisturbed condition as a standard for judging completed Work.
 - 1.4.4.6 Approved mock-ups may become part of completed Work if undisturbed at time of Substantial Performance.

1.5 **WARRANTY**

- 1.5.1 Provide 5 year manufacturer's warranty covering materials and labour for all items provided.

1.6 MEASUREMENT AND PAYMENT

- 1.6.1 All materials and work required under this section to be included in Lump Sum Price bid for Supply and Install Precast Concrete Staircase Treads.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- 2.1.1 Architectural Precast Structures Ltd, 9844 199A Street, Langley, BC V1M 2X7.
(604) 888-1968

- 2.1.1.1 Alternate manufacturers will be subject to approvals.

2.2 MATERIALS

- 2.2.1 General: Products used to obtain specified finish or to repair surface defects shall conform to Section 03 30 545 Structural Cast-in Place Concrete, and Structural drawings for cast-in-place concrete specifications, unless indicated otherwise in this Section.

- 2.2.2 Cement: Grey Portland, conforming to ASTM C150 Standard Specification for Portland Cement Type I or III.

- 2.2.3 Concrete:

- 2.2.3.1 ACI-301.

- 2.2.3.2 ACI-318.

- 2.2.3.3 ASTM C94 Standard Specification for Ready-Mix Concrete.

- 2.2.3.4 4500 psi minimum 28 day compressive strength.

- 2.2.4 Supplemental Cement Materials

- 2.2.4.1 Granulated Ground Blast-Furnace Slag: ASTM C989. Not to exceed 30% by weight of cementitious material.

- 2.2.5 Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements.

- 2.2.6 Steel Reinforcement.

- 2.2.6.1 Provide reinforcement as a welded cage whose position is assured and maintained by positive holding methods.
- 2.2.6.2 ASTM A615 Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement, 60 ksi standard smooth and deformed steel bars.
- 2.2.6.3 Provide reinforcement in areas required by engineering calculation using loads required as listed above.
- 2.2.7 Form Materials: Machined Steel or equal to assure smooth un-textured surface.
- 2.2.8 Concrete Bonding Adhesive: Epoxy adhesive subject to a compliance certificate. Handling, mixing, and application of adhesive shall be in accordance with manufacturer's specifications.
- 2.2.9 Bonding Grout: Prepare using a mix of approximately one part cement to one part fine sand passing a No. 30 mesh sieve, mixed to consistency of thick cream then brushed into surfaces.
- 2.2.10 Grout: Non-shrink, non-metallic, and shall develop a minimum compressive strength of 40 MPa in 28 Days. Testing:
 - 2.2.10.1 Compressive Strength of Grout: In accordance with ASTM C109, Compressive Strength of Hydraulic Cement Mortars.
 - 2.2.10.2 Non-shrink Properties of Grout: In accordance with ASTM C827, Early Volume Change of Cementitious Mixtures.
- 2.2.11 Water: Quantity of mixing water shall be no more than necessary to facilitate handling and placing.

2.3 **STEP UNITS**

- 2.3.1 Units shall be reinforced pre-cast concrete with finished surfaces. Dimensions as indicated on contract drawings.
- 2.3.2 Units shall have clear level landing and a specified number of risers and treads as required by the height of each landing.
- 2.3.3 All units shall be adaptable to right turn, left turn and straight out installation.
- 2.3.4 Units shall have sand-blasted anti-slip textured concrete surface on tread and landing surface.

2.3.5 Individual stair tread units must be able to be removed from the complete stair installation without the need to remove adjacent treads. This is to minimize future disruption in the event a stair tread becomes damaged and/or defective and needs to be replaced.

2.3.6 Units nosing shall have saw cut strips as per architectural drawings

2.3.7 Units shall be fastened to steel stringer as per structural details

2.4 ACCESSORIES

2.4.1 Other materials proposed for use shall be submitted to the Architect for approval and considered based on successful performance in prototype or similar construction.

2.4.2 Contractor to provide fasteners for treads as per structural specification

2.4.3 Concrete Curing and Sealing Compound: To ASTM C309.

2.4.3.1 Acceptable Product: Florseal, by Sika Canada Inc., or approved alternative.

2.5 FINISHES

2.5.1 Colour finishes produced from locally obtained aggregates to be approved by the Architect

2.5.2 Hardener Sealer:

2.5.2.1 Non-metallic material composed of a premixed blend of Portland cement and synthetic oxide with a Moh's hardness of not less than 8 and a minimum compressive strength of 55 MPa at 28 days.

2.5.3 Sealer for Exposed Concrete:

2.5.3.1 Acrylic based, clear compound Florseal WB, by Sika, or approved alternative.

2.5.4 Water Repellent Coatings: Refer to Section 07 19 00 - Water Repellents.

2.5.5 Finishing Unformed Surfaces: Provide Trowelled Finish in conformance with ACI 301

2.5.6 Finishing for Stair Tread top faces: Sand-blasted Finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- 3.1.1 Clean supporting structure of extraneous loose material by compressed air. Provide sufficient equipment to permit procedures to be enforced.
- 3.1.2 Place precast landing in position on the footers and shim level and square.
 - 3.1.2.1 Shim shall be Presco Shims or ramp/stair manufacturer approved equal.
- 3.1.3 Place precast concrete stair tread pieces in position, leveling and squaring each piece to the previous piece until all pieces are in place.
- 3.1.4 Tolerances allowed in joints at horizontal surfaces per ADAAG and British Columbia Building Code.
- 3.1.5 Grout for rigidity the full load bearing area of footers using non-shrink with non-metallic aggregate construction grout or equivalent. Use bond-inhibiting coating on the pre-cast step unit in the area of grouting to permit relocation.

3.2 Protection, Cleaning And Sealing

- 3.2.1 Protection:
 - 3.2.1.1 Protect Precast Concrete Stair Treads from damage by the elements and defacement during construction operation.
 - 3.2.1.2 Protect corners and surfaces subject to damage with boards.
 - 3.2.1.3 Keep exposed concrete free from laitance caused by spillage, leaking forms or other contaminants. Do not permit laitance to penetrate, stain or harden on surfaces during the remainder of the construction period.
- 3.2.2 Cleaning:
 - 3.2.2.1 Immediately prior to application of sealer, thoroughly clean surfaces and maintain free of foreign materials such as sand, chips and dust from sandblasting and bush hammering operations. Rinse surfaces which are cleaned with a sealant manufacturer recommended cleaning solution and allow drying before sealer application.
 - 3.2.2.2 Exposed surfaces shall be clean, free of rough areas, and with acceptable surfaces without the need for Owner applied cosmetic finishes.
- 3.2.3 Sealing:

- 3.2.3.1 Apply two coats of sealer to exterior concrete surfaces, first coat pigmented where indicated, second coat clear in accordance to manufacturer's instructions. Use the same method of application throughout the entire job.
- 3.2.3.2 Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION

1 General

1.1 REFERENCES

- .1 American Association for State Highway and Transportation Officials (AASHTO)
 - .1 AASHTO Standard Specifications for Highway Bridges.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 325M, Specification for Structural Bolts, Steel, Heat Treated 120/105ksi Minimum Tensile Strength.
 - .2 ASTM A 490M, Specification for High-Strength Steel Bolts, Classes 10.9 and for Structural Steel Joints.
 - .3 ASTM A106/ASME SA106 B&C, Specification for High Strength Seamless Structural Pipe, with 360 MPa (52 ksi) Minimum Yield Strength and Low Temperature Charpy Toughness.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-G40.20, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 CAN/CSA-G40.21, Structural Quality Steels.
 - .3 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 CAN/CSA-S6, Design of Highway Bridges.
 - .5 CAN/CSA-S16.1, Limit States Design of Steel Structures.
 - .6 CSA S269.1, Falsework for Construction Purposes.
 - .7 CSA W48 Series, Electrodes.
 - .8 CSAW59, Welded Steel Construction, (Metal Arc Welding).

1.2 SUBMISSIONS

- .1 Submit erection diagrams, shop details, welding procedures, and erection procedure drawings to the Consultant. In accordance with General Conditions Clause 3.10 – Shop Drawings.
- .2 Erection procedure drawings to bear signature and stamp of qualified professional engineer registered or licensed in province of British Columbia, Canada.
- .3 Drawings showing details of connections designed by the Contractor shall bear the signature and stamp of qualified professional engineer registered or licensed in province of British Columbia, Canada.

- .4 Erection diagrams are general-arrangement drawings showing or indicating the principal dimensions of the bridge, piece marks, the sizes of all members, field-welding requirements, the sizes and types of bolts, and bolt installation requirements.
- .5 Shop drawings to show total camber diagram to be used as web cutting profile including allowance for welding distortion if required.
- .6 Shop Details will provide:
 - .1 Full detail dimensions and sizes of all component parts of the structure. These dimensions will make allowance for changes in shape due to weld shrinkage, camber, and any other effects that cause finished dimensions to differ from initial dimensions.
 - .2 All necessary specifications for the materials to be used.
 - .3 Identification of areas requiring special surface treatment.
 - .4 Identification of fracture: critical and primary tension members and component parts.
 - .5 Bolt installation requirements.
 - .6 Details of all welds.
- .7 Welding procedures are to comply with CSA W47.1, Canadian Standards Association.
- .8 The erection procedure drawings are to indicate the proposed method of erection, including the sequence of erection, the weights and lifting points of the members, and the location and lifting capacities of the cranes used to lift them. Show details of temporary bracing and bents to be used during construction.
- .9 The symbols for welding and non-destructive testing on shop drawings are to be in accordance with CSAW59.
- .10 Welding procedure specifications, data sheets and repair procedures shall be available for review by the Consultant.
- .11 Provide Consultant prior to fabrication with two copies of steel producer certificates.
- .12 Provide Consultant with two copies of certified test reports for Charpy V-notch tests. Results on a per production heat basis.

1.3 MEASUREMENT AND PAYMENT

- .1 All materials and work required under this section shall be included in Lump Sum Prices bid for structural steel of each of the following separated Works:
 - .1 Tower Concrete-Filled Columns, Bracing and Deck Framing Girders

- .2 Pylons, including Cables and Cable Anchorages. Supply, install and stress Dywidag Tempcore Threadbar 40T Stay System, including staged tensioning
 - .3 Overpass Deck Framing Girders, Outriggers and Hinged Ramp
 - .4 Staircase Column and Framing Girders
 - .5 Existing Parkade Fencing Support Girder Framing, including anchorages
 - .6 Elevator Structural Framing
- .2 Lump Sum Prices bid also to include following:
- .1 Weld inspection (Radiographic or Ultrasonic) of optional shop splices and additional field splices.
 - .3 Contractor to confirm the estimated measurement of structural steel in tonnes of steel incorporated into work computed on basis of CISC Code of Standard Practice including nuts, bolts and washers to confirm all structural steel is accounted for in Lump Sum Prices bid.
 - .4 Payment for Supply and Install Tower Platform 1.22 m High Railing will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required under this Section to construct the custom railing detailed in the Contract Drawings, including structural steel stanchions, attachments, plate rails, cable rails, ancillary parts, submittals, quality control, and specified coatings / finishing.
 - .5 Payment for Supply and Install Staircase 1.07 m High Railing will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required under this Section to construct the custom railing detailed in the Contract Drawings, including structural steel stanchions, attachments, plate rails, cable rails, ancillary parts, submittals, quality control, and specified coatings / finishing.
 - .6 Payment for Supply and Install Overpass 3.19m High Fencing will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required under this Section and Related Section 32 31 20 (Stainless Steel Fencing Panels) to construct the custom fencing detailed in the Contract Drawings, including structural steel stanchions, attachments, mesh panels, railings, ancillary parts, submittals, quality control, and specified coatings / finishing.
 - .7 Payment for Remove and Dispose Existing Parkade Fencing and associated supports over replacement zone will be made at the Lump Sum Price bid. Lump Sum Price shall include all labour and materials required to safely remove and dispose off-site the existing parkade fencing being replaced. The Lump Sum price shall also include temporary safety fencing to protect workers and the public from the free edge of the parkade while the new fencing is being installed. The Contract shall plan the removal and replacement work to minimize the period that the temporary fencing will be required.

- .8 Payment for Supply and Install Existing Parkade 1.83 m High Fencing will be made at the Lump Sum Price bid. Lump Sum shall include all labour and materials required under this Section and Related Section 32 31 20 (Stainless Steel Fencing Panels) to construct the custom fencing detailed in the Contract Drawings, including structural steel stanchions, attachments, mesh panels, railings, ancillary parts, submittals, quality control, and specified coatings / finishing.

2 Products

2.1 MATERIALS

- .1 Steel: To CAN/CSA G40.21, grade and types as indicated. Substitution of steel members or components for size and grade will not be permitted unless approved by Consultant. All steel is to be new. Acceptance of any material by an inspector will not preclude subsequent rejection of the material if it is found defective.
- .2 High-Strength Bolts, Nuts, and Washers: Ship nuts and bolts together as an assembly. ASTM A 325/A 325M or ASTM A 490/A 490M high-strength bolts for use with corrosion-resistant steel are to be Type 3. ASTM A 490 bolts are not to be galvanized or plated. Overtap the nuts of galvanized fasteners by the minimum amount required for assembly and lubricate with a lubricant containing a visible dye. The use of a mechanically deposited zinc coating will require prior approval from Consultant.
- .3 Electrodes: The selection, supply, and storage of electrodes and fluxes are to be in accordance with Clause 5 of CSA W59. Only controlled hydrogen (CH) designation electrodes shall be used for the flux-cored welding process. The weld metal in fracture critical and primary tension members is to meet the Charpy V-notch energy requirements specified in CAN/CSA-S6. As required by CSA W59, weld metal used with corrosion resistant steels is to have corrosion resistance and be of a colour similar to that of the base metal.
- .4 Shear Connectors: To be of a headed stud type in accordance with ASTM Standard A108 and Appendix H of CSA W59.
- .5 Hot dip galvanizing: To CAN/CSA-G164, minimum zinc coating of 600 g/m².
- .6 Anchor bolts, washers and nuts: To CAN/CSA-G40.21.
- .7 Bearings: To CAN/CSA-S6 as indicated.
- .8 Shrinkage compensating grout: Pre-mixed compound consisting of non-metallic aggregate, Portland cement, water reducing agents and plasticizing agents.

3 Execution

3.1 FABRICATION

.1 Quality of Work

- .1 The standards for quality of work and finish are to comply with the best modern practices for steel bridge fabrication (with particular attention to the appearance of parts exposed to view).
- .2 Store plain or fabricated structural steel above the ground on skids or other supports and keep free from dirt and other foreign matter. Adequately support long members to prevent excessive deflection.
- .3 All visible girder faces of uncoated weathering steel to be brush off blast cleaned (SSPC SP6) to remove mill scale and create uniform appearance.

.2 Plates

- .1 Unless otherwise shown on the Drawings, steel plates for main members (and their splice plates) are to be cut so that the primary direction of rolling is parallel to the direction of tensile or compressive stress.
- .2 Plane, mill sheared edges of plates more than 16 mm thick and carrying calculated tension, or ground to a minimum depth of 3 mm. Oxygen cutting of structural steel is to be done by machine, except that hand-guided cutting is allowed for copes, blocks, and similar cuts where machine cutting is impracticable. Re-entrant corners are to be free from notches and have a fillet of the largest practical radius, but not less than 25 mm. The quality and repair of the cut edges are to comply with Clause 5 of CSA W59. All cut edges that are not to be welded are to have a surface roughness not greater than 1000, as specified by CSA B95.
- .3 Cut webs to the prescribed camber, with allowance for shrinkage due to cutting and subsequent welding.

.3 Bent Plates

- .1 Load-carrying, rolled steel plates to be bent are to be cut from the stock plates so that the bend line is at right angles to the direction of rolling, except as otherwise approved by Consultant for orthotropic decks; and have their corners lightly chamfered by grinding in the region of the bend before bending.
- .2 Carry out cold bending so that no cracking or tearing of the plate occurs. Minimum bend radii, measured to the concave face of the metal, are to be as shown in CAN/CSA-S6, Table 10.17.
- .3 Hot bending at a plate temperature not greater than 600°C is to be used to form radii less than those specified for cold bending. Use accelerated cooling using compressed air or water for a hot bent component only when its temperature is below 300°C.

.4 Straightening Material

- .1 All steel is to be flat and straight before being worked. Steel with sharp kinks or bends may be rejected. Attempts to straighten sharp kinks or bends will require approval.
- .2 Rolled plates, sections, and built-up members may be straightened using mechanical means or by the application of a controlled heating procedure in accordance with Clause 5.10.5 of CSA W59. After straightening of a bend or buckle, examine the surface of the steel for evidence of fracture or other damage and take corrective action if necessary.

.5 Bolt Holes

- .1 Drill or ream all holes to the finished diameter, except that punched holes will be allowed in material up to 16 mm thick. When shown on the Drawings, oversize or slotted holes meeting the following requirements are permitted.
 - .1 Oversize holes shall not be more than 4mm larger than bolts 22mm or less in diameter, not more than 6mm larger than bolts 24mm in diameter, and not more than 8mm larger than bolts 27mm or more in diameter. Oversize holes used in any piles of connections shall be provided with hardened washers under heads or nuts adjacent to plies containing oversize holes.
 - .2 Short slotted holes shall not be more than 2mm wider than the bolt diameter and shall not have a length that exceeds the oversize diameter requirements of item (a) by more than 2mm. When used in any piles of connections, hardened washers shall be provided under heads or nuts adjacent to plies containing slotted holes.
 - .3 Long slotted holes shall not be more than 2mm wider than the bolt diameter and shall not be greater than 2.5 times the bolt diameter.
 - .4 Hardened Structural plate washers or a continuous bar not less than 8mm thick shall cover long slots that are in the outer plies of joints after installation.
 - .5 When ASTM A 490 or ASTM A 490M bolts larger than 26mm in diameter are used in oversize or slotted holes in outer plies, the hardened washers shall be at least 8mm thick and comply with ASTM F 436.
 - .6 The requirements for the nominal diameter of a hole shall not preclude the use of the following bolt diameters and hole combinations:
 - .1 A $\frac{3}{4}$ in bolt or an M20 bolt in a 22mm diameter hole;
 - .2 A $\frac{7}{8}$ bolt or an M22 bolt in a 24mm diameter hole; and
 - .3 A 1 in bolt or an M24 bolt in a 27mm diameter hole.

- .2 The diameter of a punched hole is not to be more than 2 mm larger than the nominal diameter of the bolt unless oversize holes are specified. The diameter of the die is not to exceed the diameter of the punch by more than 2 mm. Holes are to be clean cut and without ragged or torn edges, but the lightly conical hole that results from clean cutting is acceptable. Holes may be reamed to admit fasteners.
- .3 Holes that are to be reamed to final diameter are to be first sub-drilled or sub-punched to 4 mm smaller than the nominal bolt diameter of the bolt. With the connecting parts assembled and securely held, ream the holes to 2 mm larger than the nominal diameter of the bolts. Match-mark the parts before disassembly.
- .4 Holes that are drilled full-size shall be 2 mm larger than the nominal diameter of the bolt unless oversize holes have been specified. They are to be accurately located by using suitable numerically controlled drilling equipment, or by using a steel template carefully positioned and clamped to the steel. The accuracy of the holes prepared in this manner, and their locations, are to be such that like parts are identical and require no match marking. The holes for any connection may be drilled full-size when the connecting parts are assembled and clamped in position, in which case match-mark the parts before disassembly.
- .6 Pins and rollers are to be accurately turned to the dimensions and finish shown on the Drawings and be straight and free from flaws. Forge and anneal pins and rollers more than 175 mm in diameter. Pins and rollers 175 mm or less in diameter may be either forged and annealed or of cold-finished carbon-steel shafting. Bore holes for pins to the specified diameter and finish at right angles to the axis of the member. The diameter of the pinhole is not to exceed that of the pin by more than 0.5 mm for pins 125 mm or less in diameter or more than 0.75 mm for larger pins. Bore pinholes on completion of the assembly of built-up members.
- .7 Curved Girders
 - .1 Flanges of curved, welded I-girders may be cut to the radius. However, they may be curved by applying heat if the radius, R , is greater than 45 000 mm and also the requirements of Cl. 10.24.4.7.1 of CAN/CSA-S6.
 - .2 Heat Curving of Rolled Beams and Welded Girders
 - .1 Steel beams and girders with a specified minimum yield point greater than 350 MPa are not to be heat curved. In heat curving using the continuous or V-type heating pattern, the temperature of the steel shall not exceed 600°C, as measured by temperature-indicating crayons. Submit a detailed procedure for the heat-curving operation for review. The procedure is to describe the type of heating to be employed, the extent of the heating patterns, the sequence of operations, and the method of support of the girder, including an assessment of any dead-load stresses present during the operation. Transverse web stiffeners may be welded in place either before or after the heat-curving operation. However, unless allowance is made for the

longitudinal shrinkage, locate and weld bracing connection plates and bearing stiffeners after curving. Camber girders before heat curving. Rolled sections may be heat cambered using an approved procedure. Plate girders are to have the required camber cut into the web, with suitable allowance for camber loss due to cutting, welding, and heat curving.

- .3 Each member is to carry an erection mark for identification.

3.2 WELDED CONSTRUCTION

- .1 All welding procedures, including those related to quality of work, techniques, repairs, and qualifications, are to comply with CSA W59, except where modified by this specification.
- .2 Process with limited application: The electroslag and electrogas welding processes specified in Clause 5 of CSA W59 is not to be used for welding quenched and tempered steels or for welding components of members subject to tension stress or stress reversal.
- .3 Members and components of members designated primary-tension or fracture-critical are to meet the requirements of this specification in addition to the requirements of CSA W59. The use of heat to alter the sweep or camber of fracture-critical girders will require approval from the Consultant.
- .4 Any company undertaking welded fabrication in accordance with this Section is to be certified to Division 1 or 2 of CSA W47.1.
- .5 Complete joint penetration groove welds are to meet the requirements of Clauses 10 and 12.4 of CSA W59. Unless produced with the aid of a steel backing, they are to have the root of the initial weld gouged, chipped, or otherwise removed to sound metal before welding of the other side is started. Provide runoff tabs or extension bars so that groove welds terminate on the tab. Place the welds that attach the tabs to the piece being welded inside the joint so that they are incorporated into the final weld.
- .6 Where practicable, make web to flange fillet welds continuous by machine or automatic welding. Welds may be repaired using either a semi-automatic or manual process, but the repaired weld is to blend smoothly with the adjacent welds.

3.3 WELDING OF FRACTURE-CRITICAL AND PRIMARY TENSION MEMBERS

- .1 Except as permitted by this specification, use only welding consumables with Charpy V-notch toughness requirements in compliance with CAN/SCA-S6 Table 10.14 and certified by the Canadian Welding Bureau to CAN/CSA-W48. In the absence of an applicable CAN/CSA-W48 requirement, use the applicable Standard(s) in the American Welding Society A5 series of Standards. In groove welds connecting two different grades of steel, the classification of consumables used, including Charpy V-notch impact requirements, are to be that applicable to the grade with the lower ultimate tensile strength.
- .2 For groove welds in fracture-critical and primary tension members using certified consumables where the Charpy V-notch test temperature required by CAN/SCA-S6 Table 10.14 is lower than the test temperature required by CAN/CSA-W48 or the applicable Standard(s) in the American Welding Society AS series of Standards, or where these Standards are not applicable, welding consumables are to be approved by the Canadian Welding Bureau and qualified using a verification test assembly to establish the impact properties of the weld metal. The test procedures are to be those specified in CAN/CSA-W48 or the applicable American Welding Society Standard, except that only Charpy V-notch tests are required and welding is to be carried out using the preheat and the maximum heat input to be used in practice. The Charpy V-notch results are to meet the requirements of CAN/SCA-S6 Table 10.14. Qualification is required for each electrode diameter used and for the consumables supplied by each manufacturer. The qualification is to be valid for consumables for all groove weld procedures that use a heat input the same as or lower than that used in the qualification test.
- .3 For groove weld procedures involving fracture-critical and primary tension members made of 700Q and 700QT steels, consumables are to be qualified by welding procedure tests and approved by the Canadian Welding Bureau. Conduct the tests in accordance with CSA W47.1 using 700Q or 700QT steels for the base plate and include weld metal and heat-affected zone (HAZ) Charpy V-notch impact tests in accordance with Appendix E of CSA W47.1. Weld metal impact tests are to meet the requirements of CAN/SCA-S6 Table 10.14 and HAZ impact tests are to meet the requirements of CAN/SCA-S6 Table 10.12 or 10.13 for the base plate, as applicable. Only manufacturers of qualified consumables are to supply consumables for fabrication. The qualification is to be valid for all groove weld procedures that use a heat input the same as or lower than that used in the qualification test.
- .4 When the welding consumables have not previously been certified by the Canadian Welding Bureau, they are to be qualified by welding procedure tests in accordance with Clause 11.8.2.1 (b) of CSA W47.1 and are to include Charpy V-notch impact tests of the weld metal. For steels other than 700Q and 700QT Charpy V-notch tests in the HAZ are not required. Weld metal Charpy V-notch properties are to be established

by qualification tests in accordance with CSA W47.1 (including Appendix E) and are to meet the requirements of CAN/CSA-S6 Table 10.14. Only manufacturers of qualified consumables are to supply consumables for fabrication. Perform qualification testing for each lot or batch of consumables. The qualification is to be valid for all weld procedures that use a heat input the same as or lower than that used in the qualification test. Consumables for 700Q and 700QT steels are to be qualified in accordance with this specification.

- .5 Do not use tack welds on fracture-critical or primary tension members unless they are incorporated into the final weld. Do not use temporary welds on fracture-critical or primary tension members, or on flange material in compression, unless approved.

3.4 WELDING CORRECTIONS AND REPAIRS TO FRACTURE-CRITICAL MEMBERS

- .1 Except as required by this specification, document repairs to base metal and to welded joints. Include in the documentation all of the details required by this specification. Welding repair procedures are to be approved by the Consultant in accordance with this specification.
- .2 Repair of base metal by welding at the producing mill is not permitted.
- .3 Repair welding may be performed using any appropriate welding procedure approved by the CWB for the fabrication of fracture-critical members and primary tension members. All repair welding is subject to non-destructive tests as specified in this specification.
- .4 Approval for Non-Critical Repairs
 - .1 Prepare written repair procedures for non-critical repairs as specified and submit them to the Consultant for prior approval. These procedures are to apply to shop repair of discontinuities identified during fabrication. Such approved repair procedures are to be employed after the Consultant has verified that the discontinuity to be repaired is as described in the approved procedures. Repairs that may receive prior approval include the following:
 - .1 Repairs of welds because of rollover, undercut, or insufficient throat that does not require excavation.
 - .2 Repairs of welds requiring excavation of defects (including porosity, slag, and lack of fusion), repair of arc strikes, and removal of tack welds not incorporated into a final weld.
 - .3 Visually detected planar and laminar discontinuities as specified in Table 5.2 of CSA W59, but not deeper than 25 mm or one-half the thickness of the edge of the cut plate, whichever is less. Such discontinuities are not to be within 300 mm of a tension groove weld. There is also to be no visible planar

- or laminar discontinuity on any prepared face of a tension groove joint prior to welding.
- .4 Occasional gouges exceeding 5 mm, but not more than 10 mm deep on edges not to be welded, which may be repaired by welding. The procedures specified in Clause 5.3.4 of CSA W59 are to be followed.
 - .5 Gouges not more than 5 mm deep on otherwise satisfactory cut or roiled surfaces that can be repaired by machining or grinding without welding do not require prior approval. Follow the procedures specified in Clause 5.3.4 of CSA W59.
- .5 Repair procedures beyond those described in this specification will be considered critical and be approved individually before repair welding can begin.
 - .6 Repair procedures are to include sketches or full-size drawings, as necessary, to adequately describe the deficiencies and the proposed method of repair. Critical repair procedures are to include the location of the discontinuity.
 - .7 Minimum Steps for Repair
 - .1 Repair procedures, except in cases meeting the requirements of these specifications, is to include at least the following steps, which are to be performed in the following order:
 - .1 Clean and/or grind surfaces, as necessary, to aid visual and non-destructive tests to enable the constructor and Consultant to identify and quantify the discontinuities.
 - .2 Draw the discontinuities as they appear from visual inspection and non-destructive testing.
 - .3 Arc-air gouging, when necessary, is to be part of the approved welding procedure.
 - .4 Use magnetic particle inspection, or another inspection method approved by the Consultant, to determine whether the discontinuities were removed as planned.
 - .5 Grind all air-carbon-arc gouged and oxygen-cut surfaces that form a boundary for a repair weld to form a smooth, bright surface. Do not use oxygen gouging.
 - .6 Show in detail, all required runoff tabs and backup bars.
 - .7 Preheat and interpass temperatures are to be in accordance with CAN/CSA-S6 Table 10.15. Maintain preheat and interpass temperatures without interruption until the repair is completed.
 - .8 The repair procedures are to refer to the applicable welding procedure specification and the related data sheet. If both of these were approved by the

- Canadian Welding Bureau before fabrication, they need not be qualified by test for the specific method of repair unless a change in essential variables has been made or unless otherwise required by the Consultant.
- .9 If the geometry of the repair joint or of the excavation is similar to the geometry of a pre-qualified joint preparation as specified in CSA W59 and permits good access to all portions of such joints or excavations during the proposed sequence of welding, it does not require qualification by test unless required by the Consultant.
 - .10 Describe peening in detail, when required and obtain approval from the Consultant. Peening equipment is not to contaminate the joint.
 - .11 Employ post-heat and continue without interruption from the completion of repair welding to the end of the minimum specified post-heat period. Post-heat of the repair area is to be between 200 and 260°C and is to continue for at least 1 h for each 25 mm of weld thickness, or for 2 h, whichever is less.
 - .12 Grind flush faces of repairs with the plate or blended to the same contour and throat dimension as the remaining sound weld.
 - .13 If stress-relief heat treatment is required, describe in detail. Perform final acceptance non-destructive testing after stress relief is complete.
 - .14 Examine repairs of groove welds in fracture-critical members by radiographic testing. Examine fillet weld repairs by magnetic particle testing. Radiographic testing is to comply with Clause 7.4.2 of CSA W59 and may be performed as soon as the weldment has cooled to ambient temperature. Ultrasonic testing and magnetic particle testing are to comply with Clause 7.4.3 and 7.4.4, respectively, of CSA W59. Final acceptance testing by magnetic particle and ultrasonic methods are not to be performed until the steel weldments have been at ambient temperature for at least the elapsed time specified in CSA/CAN-S6 Table 10.16.
- .8 Perform all repair welding and non-destructive testing as described in the approved repair procedure.
 - .9 Retain approved critical repair procedures as part of the project records.
 - .10 The use of Cobalt 60 as a radiographic source in quality control will be permitted only when the steel being tested is more than 75 mm thick. Maintain documentation of all visual and non-destructive testing for review and confirmation by the Consultant. Submit the documentation to the Consultant on completion of the project.

3.5 BOLTED CONSTRUCTION

- .1 These clauses specify requirements for bolted steel construction using ASTM A 325/A 325M or ASTM A490/A 490M high-strength bolts.

.2 Assembly

- .1 When assembled, all joint surfaces, including those adjacent to bolt heads, nuts, and washers, are to be free from loose scale, burrs, dirt, and foreign material that would prevent the solid seating of the parts. Prepare the faying surfaces of connections as follows:
 - .1 For clean mill scale, the surfaces are to be free from oil, paint, lacquer, or any other coating in all areas within the bolt pattern and for a distance beyond the edge of the bolthole that is the greater of 25 mm or the bolt diameter.
 - .2 For Class A and B surfaces, surfaces shall be cleaned to remove mill scale per SSPC-SP6. Coated joints are not to be assembled before the coating has cured for the minimum time used in the tests to determine the mean slip coefficient.
 - .3 For Class C hot-dip galvanizes the surfaces in accordance with CAN/CSA-G164 and subsequently roughened by hand wire brushing. Power wire brushing shall not be used.

.3 Hardened Washers

- .1 Apply the following requirements to hardened washers:
 - .1 Provide hardened washers as follows under the element turned (head or nut) during installation:
 - .1 As required by this specification.
 - .2 For ASTM A490/A 490M bolts.
 - .2 Hardened washers will also be required:
 - .1 For oversize or slotted holes that meet the requirements of Clause 3.1.5.
 - .2 Under the head and nut of ASTM A490/A490M bolts when used with steel with a specified minimum yield strength of less than 280 MPa.
 - .3 When ASTM A490/A 490M bolts of greater than 26 mm diameter are used in oversize or slotted holes. The washers in this case are to have a minimum thickness of 8 mm.
- .4 Use beveled washers to compensate for lack of parallelism where, in the case of ASTM A 325/A 325M bolts, an outer face of bolted parts has more than a 5% slope with respect to a plane normal to the bolt axis. In the case of ASTM A 490/A 490M bolts, use beveled washers to compensate for any lack of parallelism due to the slope of outer faces.
- .5 Turn-of-Nut Tightening
 - .1 Tighten pre-tensioned bolts using the turn-of-nut method to at least 70% of the minimum tensile strength specified in the applicable ASTM Standard.

- .2 After the holes in a joint are aligned, place a sufficient number of bolts and bring to a snug-tight condition to ensure that the parts of the joint are brought into full contact with each other. Following the initial snugging operation, place bolts in any remaining open holes and bring to snug-tightness. Re-snugging may be necessary in large joints. When all bolts are snug tight, further tighten each bolt in the joint by the applicable amount of relative rotation specified in CAN/CSA-S6 Table 10.18, with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation, there is to be no rotation of the part not turned by the wrench unless the bolt and nut are match-marked to enable the amount of relative rotation to be determined.

.6 Inspection

- .1 The owners designated representative will determine whether the requirements of this specification have been met. Installation of bolts will be observed to ascertain that a proper tightening procedure is employed including visually examining the turned element of all bolts for evidence that they have been tightened. When properly installed, the tip of the bolt is to be flush with or outside the face of the nut. Tensions in bolts installed by the turn-of-nut method exceeding the applicable ASTM standard will not be cause for rejection. When there is disagreement concerning the results of an inspection of bolt tension, the following arbitration procedure will be adopted:
 - .1 The owner's designated representative will use an inspection wrench that is a manual or power torque wrench capable of indicating a selected torque value.
 - .2 Place three bolts of the same grade and diameter as those under inspection and representative of the lengths and conditions of those in the bridge individually in a calibration device capable of measuring bolt tension. A washer will be under the part turned if washers are so used in the bridge or, if no washer is used, the material abutting the part turned is to be of the same specification as that in the bridge.
 - .3 When the inspection wrench is a manual wrench, tighten each bolt specified in the previous paragraph in the calibration device by any convenient means to an initial tension of approximately 15% of the required fastener tension, and then to the minimum tension specified for its size. Tightening beyond the initial condition should not produce greater nut rotation beyond that permitted by CAN/CSA-S6 Table 10.18. Apply the inspection wrench to the tightened bolt and the average torque necessary to turn the nut or head 5.0° in the tightening direction is to be determined. The average torque measured in these tests of three bolts will be taken as the job inspection torque to be used in the manner specified in Item 5. The job inspection torque is to be established at least once each working day.
 - .4 When the inspection wrench is a power wrench, first apply it to produce an initial tension of approximately 15% of the required fastener tension and then

adjust it so that it will tighten each bolt specified in Item 2 to a tension of at least 5%, but not more than 10% greater than the minimum bolt tension specified for its size in the applicable ASTM standard. This setting of the wrench will be taken as the job inspection torque to be used in the manner specified in Item 5. Tightening beyond the initial condition is not to produce greater nut rotation than that permitted by CAN/CSA-S6 Table 10.18. Establish the job inspection torque at least once each working day.

- .5 The owner's designated representative will inspect bolts represented by the sample specified in Item 2 that have been tightened in the bridge shall be inspected by applying, in the tightening direction, the inspection wrench and its job inspection torque to 10% of the bolts (but not fewer than two bolts) selected at random in each connection. If no nut or bolt head is turned by this application of the job inspection torque, the connection shall be accepted as being properly tightened. If any nut or bolt head is turned by the application of the job inspection torque, this torque shall be applied to all of the bolts in the connection, and all of the bolts whose nut or head is turned by the job inspection torque shall be retightened and re-inspected. Alternatively, the fabricator or erector, at his or her option, may retighten all of the bolts in the connection and then resubmit the connection for inspection.
- .7 Do not reuse ASTM A490/A 490M and galvanized ASTM A325/A 325M bolts once they have been fully tightened. Other ASTM A 325/A 325M bolts may be reused up to two times, provided that proper control on the number of reuses can be established. Touch-up of pre-tensioned bolts in a multi-bolt joint will not constitute a reuse unless a bolt becomes substantially unloaded as other parts of the joint are bolted.
- .8 Pre-assemble girders and other main components in the shop in order to prepare or verify the field-splices. Support components in a manner consistent with the finished geometry of the bridge, as specified on the Drawings, with allowance for any camber required to offset the effects of dead load deflection. Holes in the webs and flanges of main components are to be reamed or drilled to final size while in assembly. The components are to be pinned and firmly drawn together by bolts before reaming or drilling. Drifting done during assembly shall be sufficient only to align the holes and not to distort the steel. If necessary, use reaming to enlarge holes. When a number of sequential assemblies are necessary because of the length of the bridge, the second and subsequent assemblies are to include at least one section from the preceding assembly to provide continuity of alignment. Trial assemblies will be required whether the field-splices are bolted or welded. Check each assembly for camber, alignment, accuracy of holes, and fit-up of welded joints and milled surfaces. Corrective work, if necessary, will be carried out at no cost to the Owner.
- .9 As an alternative to the trial assembly when the bolt holes have been prepared by numerically controlled drilling or using a suitable template, the accuracy of the drilling may be demonstrated by a check assembly consisting of the first components of each

type to be made. If the check assembly is satisfactory, further assemblies of like components will not be required. If the check assembly is unsatisfactory for any reason, the work is to be redone or repaired in a manner acceptable to the Owner. Further check assemblies will be required, as specified by the Owner, to demonstrate that the required accuracy of fit-up has been achieved.

- .10 Match-mark connecting parts that are assembled in the shop for reaming or drilling holes. Prepare a drawing to show how the marked pieces should be assembled in the field to replicate the shop assembly.

3.6 TOLERANCES

- .1 Structural members consisting of a single rolled shape are to meet the straightness tolerances of CSA G40.20, except that columns are not to deviate from straight by more than 1/1 000 of the length between points of lateral support. A variation of 1 mm from the detailed length will be permissible in the length of members that have both ends finished for contact bearing. Other members without finished ends may have a variation from the detailed length of not more than 2 mm for members 10 m or less in length, and not more than 4 mm for members over 10 m in length.
- .2 When compression members are butted together to transmit loads in bearing, mill or saw cut the contact faces. The completed joint is to have at least 75% of the entire contact area in full bearing, defined as not more than 0.5 mm separation, and the separation of the remainder will not exceed 1 mm. At joints where loads are not transferred in bearing, the nominal dimension of the gap between main members will not exceed 10 mm.
- .3 The surface finish of bearing surfaces that are in contact with each other or with concrete are to meet the roughness requirements specified in CSA B95 and CAN/CSA-S6 Table 10.19. Surfaces of flanges that are in contact with bearing sale plates are to be flat within 0.5 mm over an area equal to the projected area of the bearing stiffeners and web. Outside this area, a 2 mm deviation from flat is acceptable. The bearing surface is to be perpendicular to the web and bearing stiffeners.
- .4 Bearing Plates shall meet the following requirements:
 - .1 Rolled steel bearing plates 50 mm or less in thickness may be used without planing if a satisfactory contact bearing is obtained.
 - .2 Rolled steel bearing plates more than 50 mm thick but not more than 100 mm thick may be straightened by pressing or by planing on all bearing surfaces to obtain a satisfactory contact bearing.
 - .3 Plane rolled steel-bearing plates more than 100 mm thick on all bearing surfaces, except for those surfaces that are in contact with concrete foundations and are grouted to ensure full bearing.

- .5 The tolerances for welded components are to comply with Clause 5.4 of CSA W59. The dimensional tolerances of welded structural members are to be those specified in Clauses 5.8 and 12.5.3 of CSA W59. Built-up, bolted structural members are to comply with the straightness tolerances specified in CSA G40.20 for rolled wide-flanged shapes. Bearing stiffeners fitted to bear are to have a minimum bearing contact area of 75% and a maximum separation of 1 mm over the remaining area. Fitted intermediate stiffeners are to have a minimum bearing contact area of 25% and a maximum separation of 2 mm.
- .6 Miscellaneous steel incorporated into the structure shall be fabricated to within 2 mm of the dimensions shown on the drawings unless approved by the Consultant.

3.7 QUALITY CONTROL

- .1 The Contractor shall retain and pay for an independent qualified inspection company to complete in-plant fabrication inspection. The Contractor shall propose a suitable inspection company to the Consultant prior to fabrication. The inspection company will:
 - .1 Verify that the correct materials are incorporated into the structure.
 - .2 Complete all non-destructive weld testing.
 - .3 Complete fabrication inspections to verify the geometry conforms to the drawings and specifications.
- .2 Upon completion of the fabrication, the inspection company shall provide a report summarizing the work completed included summaries of all inspection work completed.
- .3 The Owner, at their discretion, may complete independent quality assurance inspections. The Contractor shall facilitate suitable access to allow these inspections to be completed included moving and supporting components as required. The Owner will attempt to schedule non-destructive testing so as not to interfere with the progress of the work. The Contractor shall bear the cost of re-inspection after defects are repaired.
- .4 Welding inspectors are to be qualified by the CWB to the requirements of CSA W178.2.
- .5 Perform, as a minimum, the following non-destructive testing of welds:
 - .1 Visual inspection of all welds.
 - .2 Radiographic inspection of fracture critical built-up girders as follows:
 - .1 Flange splices in tension or stress reversal zones: 100%.
 - .2 Flange splices in compression zones: 25%.

- .3 Web splices: 100% for one-half of the depth from the tension flange and 25% for the remainder of the web.
- .3 Radiographic or ultrasonic inspection of groove welds in flanges and webs of other built-up girders, as follows:
 - .1 Flange splices in tension or stress reversal zones: 100%.
 - .2 Flange splices in compression zones: 25%.
 - .3 Web splices: 100% for one-half of the depth from the tension flange and 25% for the remainder of the web.
- .4 Magnetic particle inspection of web-to-flange fillet welds, as follows:
 - .1 Submerged-arc welds: 25%.
 - .2 Semi-automatic welds: 50%.
 - .3 Manual welds: 100%.
- .5 Magnetic particle inspection of fillet welds, as follows, for connection plates and stiffeners to which cross bracing or diaphragms are attached:
 - .1 For one-half of the depth from the tension flange: 100%.
 - .2 Transverse welds on tension flanges: 100%.
- .6 Perform radiographic and ultrasonic testing before assembly of the flanges to the webs.
- .6 The acceptance standards for dynamically loaded structures specified in CSA W59 of Clause 12.5.4 are to apply to weld defects. Remove welds that do not meet the acceptance standards of this specification and re-weld and retest. Perform repairs and non-destructive testing of fracture-critical and primary-tension members in accordance with this specification.
- .7 Welded shear studs shall be tested in accordance with Appendix H of CSA W59.
- .8 In the fabricator's plant, the specification and grade of steel used for main components are to be identified by use of suitable markings or recognized colour coding. Cut pieces that are identified by piece mark and contract number need not continue to carry specification identification markings when it has been established that such pieces conform to the required material specifications. Keep records to identify the heat number of the material and the corresponding mill test report for each component of a fracture-critical or primary tension member.

3.8 TRANSPORT AND DELIVERY

- .1 Load structural steel for shipping, transport, unloading, and storing clear of the ground at its destination without being excessively stressed, deformed; or otherwise damaged.

3.9 ERECTION

- .1 Lift and place components using appropriate lifting equipment, temporary bracing, guys or stiffening devices so that they are not overloaded or unstable. Additional permanent material may be provided, if approved, to ensure that the member capacities are not exceeded during erection.
- .2 Design, furnish, maintain and remove all falsework, including necessary foundations, required for the safe erection. Do not use any of the material intended for use in the finished structure for temporary purposes during erection, unless such use is approved.
- .3 Remove temporary bracing or guys when no longer required for the stability of the bridge, unless otherwise approved.
- .4 Erect the bridge to the proper alignment on plan and in elevation, taking into account the specified dead load camber.
- .5 Assemble parts following the piece marks shown on the erection drawings and match-marks. Main girder splices and field connections are to have half their holes filled with fitting-up bolts and drift-pins (half bolts and half pins) before the installing and tightening of the balance of the connection bolts. The fitting-up bolts may be the same high-strength bolts used in the installation. The pins are to be 1 mm larger in diameter than the bolts. Excessive drifting that distorts the metal and enlarges the holes is not allowed, although reaming up to 2 mm over the nominal hole diameter is permitted, except for oversize or slotted holes.
- .6 When cantilever erection is used, fully bolt slices that support the cantilevering member before the cantilever is further extended or loaded.
- .7 With the exception of splices of main material, the correction of minor misfits involving minor amounts of reaming, cutting and shimming is permitted. The correction of other shop fabrication, or any deformation resulting from handling or transportation that prevents the proper assembly and fitting of the parts, will require approval from the Consultant.
- .8 Any company undertaking field welding in accordance with this section has to be certified to Division 1 or 2 of CSA W47.1.
- .9 Do not use tack welds intended to be used for attachments or for any other purpose unless they subsequently become a part of the welds shown on the Drawings. Tack welds that are not part of the welds shown on the Drawings are not to be used on any portion of the girders.

- .10 Protection of the substructure against staining: Protect the substructure against rust staining by water runoff from the bridge.

END OF SECTION

1 General

1.1 REFERENCES

- .1 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- .2 CAN/CSA-G40.21-M, Structural Quality Steels.
- .3 CAN/CSA-S16.1-M, Limit States Design of Steel Structures.
- .4 CSA-W59, Welded Steel Construction (Metal Arc Welding).
- .5 CAN/CSA G164-M92 - Hot Dip Galvanizing of Irregularly Shaped Articles.
- .6 ASTM A143 Standard Practices for Safeguarding of Embrittlement of Hot Dip Galvanized Steel Products.
- .7 Section 316 of BC Ministry of Transportations, 2012 Standard Specification for Highway Construction.

1.2 SUBMITTALS

- .1 Provide Consultant prior to fabrication with two copies of steel producer certificates, in accordance with CAN3-G40.20.
- .2 Welding procedure specifications, data sheets and repair procedures shall be available for review by the Consultant.

1.3 MEASUREMENT PROCEDURES

- .1 Except for specific payment items, no measurement will be made under this Section. Include metal fabrication costs in applicable lump sum prices of members in which they are embedded or that they are attached to.
- .2 Payment for Supply and Install Overpass Deck Drainage and Pilecap Pit Drainage Systems shall be made at the Lump Sum Price bid. The Lump Sum Price shall include all embedded drain assemblies and associated covers, attachments and piping as detailed in the Contract Drawings, including all connections to existing storm outlets. The Lump Sum shall also include the costs of all submittals, materials and work required under this section and related sections.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with General Condition Clause 3.10.
- .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.5 INSPECTION AND TESTING

- .1 Provide the Consultant a fabrication schedule at least 2 weeks in advance of the fabrication of steelwork elements and shall allow the Consultant access to the fabrication shop for inspect of the works.

2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CAN/CSA-G40.21, Grade 300W.
 - .1 Steel to be galvanized shall have a chemical composition as follows:
 - .1 Carbon less than 0.25%
 - .2 Phosphorus less than 0.04%
 - .3 Manganese less than 1.3%
 - .4 Silicon less than 0.04% or between 0.15% and 0.22%.
 - .2 Welding materials: to CSA-W59.
 - .3 Welding electrodes: to CSA-W48 Series.
 - .4 Bolts and anchor bolts: to ASTM A325 M.
 - .5 Galvanized Fasteners: to ASTM A153 Class C, and ASTM A563.
 - .6 Bearings: To CAN/CSA-S6 as indicated.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Plates to be bent shall be taken from the stock plates so that the bend line will be at right angles to the direction of rolling. The inside radius of the bend shall not be less than the thickness of the plates. Before bending, the corners of the plate shall be ground to a radius of 2 mm throughout the part to be bent.
- .3 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .4 Where possible, fit and shop assemble work, ready for erection.
- .5 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

- .6 Following the requirements of ASTM A143 when fabricating components to be galvanized.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

3 Execution

3.1 ERECTION

- .1 Complete welding work in accordance with CSA-W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to *Consultant* such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Make field connections with bolts to CAN/CSA-S16.1-M.
- .6 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .7 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 REFERENCES

- .1 CSA G279, Steel for Prestressed Concrete Tendons.
- .2 CSA S6, Canadian Highway Bridge Design Code.

1.2 SUBMITTALS

- .1 Provide Consultant with copy of following field records:
 - .1 Date of tensioning.
 - .2 Identification and number of elements.
 - .3 Identification of jacking equipment.
 - .4 Required total load per strand.
 - .5 Initial tension.
 - .6 Anticipated and actual gauge pressure for each stay.
 - .7 Anticipated and actual elongation.
 - .8 Any problems encountered.

1.3 QUALITY ASSURANCE

- .1 Provide Consultant with following items, minimum of five weeks prior to commencing post tensioning work for review:
 - .1 Load - strain curves certifying physical properties for each mill heat of bar steel and/or wire steel. Physical properties and chemical composition to conform to minimum specification requirements indicated for bar steel and/or wire steel.
 - .2 Mill certificates for cable stays, couplers and anchorages. Carry out hardness test for heat-treated anchorages.
 - .3 Standard test data certifying that all components of system conform to minimum specification requirements indicated for these components. Manufacturer to provide quality control procedures for review by Consultant.
 - .4 Quality control procedures.

1.4 MEASUREMENT AND PAYMENT PROCEDURES

- .1 All materials and work required under this section to be included in Lump Sum Price bid for Dywidag Tempcore Threadbar 40T Stay System. The Lump Sum Price shall include the submittals, supply, installation, stressing, quality control and testing of the specified Dywidag Tempcore Threadbar 40T Stay System, including the stays and all ancillary parts, and including staged tensioning.

2 Products

2.1 MATERIALS

- .1 Bar stay cables: to CAN/CSA S6, and CSA G279.
- .2 Cable stays to be galvanized Dywidag Threadbar produced by the Tempcore (quenched and tempered) process. Threads to be hot-rolled onto the bar without reductions of the nominal bar diameter. Threadbars with notches such as machined threads will not be permitted. Stays to have the following properties:
 - .1 Steel Grade: 500/550 MPa (yield/ultimate)
 - .2 Cross Sectional Area: as shown on the drawings
 - .3 Elongation at rupture: min. 10% at 10D
 - .4 Charpy V-notch Toughness: min. 100 Joule at -20°C
 - .5 Carbon Content: max. 0.22%
 - .6 Weldable: yes
 - .7 Fatigue: fatigue stress range = 150 MPa for bar diameter greater than 32 mm.
 - .8 Couplers and Anchorages: to develop 100% of the guaranteed ultimate strength of the threadbar

3 Execution

3.1 CONSTRUCTION

- .1 Galvanize stays, couplers and anchorages to ASTM A123-02 and ASTM A143-03.
- .2 Install and tension stays as indicated on the drawings.
- .3 Start tensioning only with written approval of Consultant.
- .4 Do not weld stays, couplers or anchorages.
- .5 Couplers shall not be used for stay lengths less than the maximum available Dywidag Tempcore Threadbar supply length of 50 m.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- 1.1.1 The Work includes furnishing of labour, material and equipment for providing bituminous damp-proofing to exterior surfaces of cast-in-place concrete perimeter foundation walls and to the earth-side surfaces of retaining walls, abutments and elevator and escalator pits below grade.

1.2 QUALITY CONTROL

- 1.2.1 Manufacturer's requirements for temperature and humidity during application shall be adhered to.

1.3 REFERENCES

- 1.3.1 CAN/CGSB-3712-M: "Emulsified Asphalt, Mineral Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings".
- 1.3.2 CAN/CGSB-37.3M: "Application of Emulsified Asphalts for Damp-proofing or Waterproofing".

1.4 SUBMITTALS

- 1.4.1 Submission shall be made in accordance with the General Requirements
- 1.4.2 The Contractor shall submit duplicate samples of the bituminous damp-proofing intended for use.

1.5 DELIVERY, STORAGE, AND HANDLING

- 1.5.1 Materials shall be delivered and stored in their original containers, in undamaged condition, sealed with labels intact and protected from freezing.
- 1.5.2 Labels shall indicate manufacturer's name, brand, weight and other references proving the conformance to acceptable standards and approved samples.

1.6 MEASUREMENT PROCEDURES

- 1.6.1 No measurement will be made under this Section. Include bituminous damp-proofing costs in applicable lump sum prices of members to which they are applied.

PART 2 - PRODUCTS

2.1 MATERIALS

- 2.1.1 Damp-proofing material shall be static type mineral colloid asphalt emulsion, conforming to CAN/CGSB-37.2M.
- 2.1.2 Protection board shall be #15 asphalt felt.

PART 3 - EXECUTION

3.1 EXAMINATION

- 3.1.1 All surfaces to be damp-proofed shall be examined, and all conditions shall be adequate to provide a satisfactory damp-proofing application.
- 3.1.2 Starting of application shall imply acceptance of areas and conditions.

3.2 PREPARATION

- 3.2.1 Damp-proofing shall be applied to sound, dry surfaces.
- 3.2.2 Form tie holes shall be patched, flush with surrounding surfaces and shall have cured prior to application of damp-proofing.
- 3.2.3 All loose materials shall be removed from concrete foundation walls by brushing wall surfaces with a wire brush. Other directions of surface preparation required in the manufacturer's literature shall also be followed.

3.3 APPLICATION

- 3.3.1 The application shall not take place at temperatures lower than 5 degrees Celsius.
- 3.3.2 Damp-proofing shall be applied in two coats.
- 3.3.3 Application shall extend from finish grade to bottom of foundation walls and over footings as follows:
 - 3.3.3.1 Prime Coat: Shall be emulsion diluted with 20 percent cold water, applied by brush or spray at rate of 0.5 litres per square metres and be allowed to set and cure; and

- 3.3.3.2 Second Coat: Shall be undiluted emulsion, applied by brush at the rate of 1.0 litres per square metres and be allowed to set and cure.
- 3.3.4 Backfilling operations shall not begin before the inspection of damp-proofing application by the Owner.
- 3.4 PROTECTION
- 3.4.1 All damp-proofing shall be protected from rain and freezing until properly set and cured. Completed application shall not be allowed to become wet during the curing period.
- 3.4.2 All adjacent finishes shall be protected from drips or smears of asphalt.
- 3.4.3 Protection board shall be installed before backfilling operations commence.
- 3.5 CLEAN-UP
- 3.5.1 All spillage of materials, staining, discolouration, overspray of adjacent surfaces due to application of bituminous damp-proofing shall be immediately removed during the progress of the Work.
- 3.5.2 All surplus material, equipment, and debris resulting from the Work performed, shall be promptly removed.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

PART 1 - GENERAL

1.1 WORK INCLUDED

- 1.1.1 The Work includes furnishing of all labour, material and equipment for the supply and installation of water repellent coatings to pre-cast concrete end closure panels, exposed surfaces of cast-in-place concrete not subject to foot traffic, and exterior surfaces of concrete unit masonry walls as indicated on Drawings.

1.2 QUALITY CONTROL

- 1.2.1 Materials and workmanship shall be in accordance with standards of Master Painters Institute (MPI), "Architectural Painting Specification Manual."
- 1.2.2 The contractor for water repellent coatings shall employ for this work only, qualified journeymen mechanics, holding provincial tradesman qualification certificate of proficiency.

1.2.3 Mock-up:

- 1.2.3.1 water repellent coating shall be applied to approximately 10 square metre area of surface to be treated;
- 1.2.3.2 verification shall be made that surface is coated with sufficient water repellent coating to effectively repel moisture; and
- 1.2.3.3 verification shall be made that application of water repellent coating will produce no surface stains.

1.3 SUBMITTALS

- 1.3.1 Submittals shall be made in accordance with the General Requirements
- 1.3.2 Prior to commencement of application, the Contractor shall submit the coating manufacturer's literature, specifications, and application instructions for the Owner approval.
- 1.3.3 The Contractor shall submit, for inclusion in the maintenance manual, copies of manufacturer's literature, specifications and application instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- 1.4.1 Products shall be delivered and stored in original sealed containers with manufacturer's labels intact.
- 1.4.2 Labels shall indicate manufacturer's name, brand and other references proving the conformance to accepted standard.
- 1.4.3 Products shall be stored only in area heated, well ventilated, in minimum ambient temperature of 7 degrees Celsius.

1.5 ENVIRONMENTAL CONDITIONS

- 1.5.1 Water repellent coating shall be applied when ambient temperature is above 10 degrees Celsius.
- 1.5.2 Water repellent coating shall be applied only during dry weather or at least three days after surfaces have dried as a result of rainfall.

1.6 PROJECT SITE CONDITIONS

- 1.6.1 Plants and vegetation, which might be affected by water repellent coating fumes or alkalinity of material, shall be protected by suitable methods.
- 1.6.2 Water repellent coating shall not be applied where dust is being generated.

1.7 WARRANTY

- 1.7.1 Provide a five-year non pro-rated warranty covering materials and installation against moisture intrusion through the treated vertical surfaces.
- 1.7.2 Notify the manufacturer's representative a minimum of 48 hours in advance of application of material.

1.8 MEASUREMENT PROCEDURES

- 1.8.1 No measurement will be made under this Section. Include water repellents costs in applicable lump sum prices of members to which they are applied.

PART 2 - PRODUCTS

2.1 MATERIALS

- 2.1.1 Water repellent coating shall be a solvent based coating of acrylic resins and volatile hydrocarbon solvents, waterclear.
- 2.1.2 Water repellent coating shall impart little or no perceptible sheen.
- 2.1.3 Coatings containing tars of polysulfide polymers shall not be used for this application.
- 2.1.4 Water Repellent Coating: Proprietary blend of modified silane/siloxane monomers and polymers with react with alkalinity of the surface to be treated, triggering a chemical reaction that locks the sealer into the fabric of the substrate. Materials selection shall be based upon optimum penetration and resultant repellency.

2.1.4.1 Accepted Products:

- 2.1.4.1.1 “Krytol Hydrostop” as manufactured by Kryton International Inc.
- 2.1.4.1.2 “Fabrishield 700 Series” as manufactured by Fabriken Chemicals International Inc.
- 2.1.4.1.3 Or approved alternative.

PART 3 - EXECUTION

3.1 PREPARATION

- 3.1.1 Substrate surfaces shall be prepared and cleaned in accordance with coating manufacturer’s instructions.
- 3.1.2 Concrete surfaces to receive the coating shall have cured for 28 days minimum.

3.2 APPLICATION

- 3.2.1 Vertical Services: Apply water repellent in accordance with manufacturer’s directions and as follows: protect surrounding materials from water repellent overspray and raindown. Commence the application of water repellent only after a minimum of seven (7) days of dry weather has elapsed prior to application. Ensure air temperature is above 5o C at time of installation. Test a small area of the surface with an application of sealer before commencing general application of the repellent and obtain approved of the

Owner before commencing Work. Apply water repellent by low pressure spray initially with a light list followed by a uniform flood coat to provide enough material to carry a 100 mm raindown from the contact point. Allow to dry and repeat a second time.

- 3.2.2 Horizontal Surfaces: Apply water repellent with manufacturer's directions and as follows: Protect surrounding materials from water repellent overspray. Commence the application of water repellent only after a minimum of seven (7) days of dry weather has elapsed prior to application. Ensure air temperature is above 5o C at time of installation. Test a small area of the surface with an application of sealer before commencing general application of the repellent using a low pressure spray equipment at a rate of not more than 300 ft²/gal and back roll with a roller from uniform coverage. Allow to dry and repeat a second time.

3.3 FIELD QUALITY CONTROL

- 3.3.1 After water repellent coating has dried, coated surfaces shall be sprayed with water.

- 3.3.2 Surfaces that show water absorption shall be recoated.

3.4 PROTECTION

- 3.4.1 Adjacent surfaces not scheduled to receive the water repellent coating application shall be protected from accidental over-sprayed.

- 3.4.2 Joints which shall subsequently receive caulking and sealants shall be protected.

- 3.4.3 Glass and pre-finished metal shall be protected from over-sprayed.

3.5 CLEANING

- 3.5.1 Adjacent over-sprayed surfaces, in particular: glass and pre-finished metal, shall be cleaned immediately by methods recommended by the manufacturer.

- 3.5.2 Protective covers, masking, surplus material, equipment and debris shall be removed from the Work Site upon completion of the Work of this Section.

END OF SECTION

PART 1 - GENERAL**1.1 WORK INCLUDED**

- 1.1.1 The Work includes furnishing of all labour, materials and equipment for the installation of single ply, fully adhered EPDM (Ethylene Propylene Diene Monomer) roofing membrane including all related sealants and metal flashings indicated on Drawings.
- 1.1.2 The Work shall also include the supply and installation of EPDM liners to metal gutters as shown on Drawings.
- 1.1.3 Construct to RCABC Standards.

1.2 QUALITY CONTROL

- 1.2.1 The insulation and roofing membrane shall be installed by a roofing applicator approved by the membrane manufacturer and the Owner. The roofing applicator shall be a member of the Roofing Contractors Association of British Columbia, (RCABC).
- 1.2.2 Construct to RCABC Standards.
- 1.2.3 Inspection shall be carried out continuously for equipment preparation, preparatory work, storage, application of materials and general trade installation procedures.
- 1.2.4 Materials used in the installation shall be of one manufacturer or subject to approval by the roofing membrane manufacturer.
- 1.2.5 Construct to RCABC Standards.

1.3 REFERENCES

- 1.3.1 Roofing Contractors Association of British Columbia (RCABC): "Roofing Practices Manual".
- 1.3.2 CSA-A123.4: "Bitumen for Use in Construction of Built-up Roof Coverings and Dampproofing and Waterproofing Systems".

1.4 SUBMITTALS

- 1.4.1 Submittals shall be made in accordance with the General Requirements
- 1.4.2 Two copies of manufacturer's specifications, installation and maintenance instructions shall be submitted for review and for inclusion in maintenance manuals.

1.4.3 Sample of membrane adhered to substrate be submitted. Minimum sample size shall be 600 mm square. Tags shall identify the components, date and conditions of membrane application, and curing conditions.

1.4.5 Construct to RCABC Standards.

1.5 DELIVERY AND STORAGE

1.5.1 Materials shall be delivered in original wrappings and containers with manufacturer's labels intact.

1.5.2 Wrappings and containers shall not be removed from the Work Site prior to inspection by the Owner.

1.5.3 Roofing material shall be stored under cover, protected from water and dampness.

1.6 ENVIRONMENTAL REQUIREMENTS

1.6.1 Construct to RCABC Standards.

1.6.2 When installation is to be carried out in temperatures below 4 degrees Celsius, the Contractor shall obtain additional printed installation recommendations from the approved membrane manufacturer on how products shall be installed.

1.7 MEASUREMENT PROCEDURES

1.7.1 No measurement will be made under this Section. Include EPDM – Conventional Roofing and Waterproofing costs in applicable lump sum prices of members to which they are applied.

PART 2 - PRODUCTS

2.1 ACCEPTED MANUFACTURERS

2.1.1 Carlisle Syntec Systems Canada;

2.1.2 Equivalent systems listed by RCABC.

2.2 MATERIALS

2.2.1 All materials employed in the system shall be compatible with the roofing membrane and substrates.

2.2.2 Membrane: Cold applied 1.52 mm thick Ethylene Propylene Diene Monomer (EPDM) membrane to the following properties:

Property Tested	Test Method	Typical Test Results
Colour	Visual	See Exhibit IV
Specific Gravity	ASTM-D-297-79	1.27
Tensile Before Heat Aging	ASTM-D-412-75	9.7 MPa
Tensile After 7 Days @ 116°C	ASTM-D-573-78	11.0 MPa
Elongation Before Heat Aging	ASTM-D-412-75	320%
Elongation After 7 Days @ 116°C	ASTM-D-473-78	135%
Tear Resistance	ASTM-D-624-73	29.7 kN/m
Ozone Resistance	ASTM-D-1149-78	No Degradation
Low Temperature Brittleness	ASTM-D-746-79	Exceeds -45%
Operating Temperature Range		-45 °C to + 115 °C
Water Vapour Transmission	ASTM-E-69-72 Method BW	3.7 x 10 ³ Metric Perm-cm
Shore Hardness	ASTM-D-2240-75	60 + 4 Pts.

- 2.2.3 Membrane Flashings: 1.52 mm thick EPDM compatible with roofing membrane.
- 2.2.4 Bonding Adhesive: compatible with substrate to which the membrane is bonded.
- 2.2.5 Splicing Cement: shall be to manufacturer's recommendations.
- 2.2.6 Lap Sealant: shall be compatible with membrane, shall be trowel or gun consistency.
- 2.2.7 Water Cut-off Mastic: shall be compatible with substrate and membrane.
- 2.2.8 Moulded Pipe Flashing: shall be compatible with materials with which it is used.
- 2.2.9 Lap Primer: shall be to manufacturer's recommendation.
- 2.2.10 Pourable Sealer: shall be compatible with substrates.
- 2.2.11 Flashings: shall be in accordance with Section 07 62 00 Sheet Metal Flashing and Trim
- 2.2.12 Sealants: shall be in accordance with Section 07 92 10, "Joint Sealing".

PART 3 - EXECUTION**3.1 INSPECTION**

- 3.1.1 Surfaces to receive membrane roofing shall be examined to assure they are smooth, dry and free from conditions that will adversely affect execution, permanence or quality of Work.
- 3.1.2 Membrane roofing shall be applied after other Work which penetrates the roof assembly has been completed.
- 3.1.3 Work of other trades shall be verified to ensure that movement of workers and materials across the substrate has been completed prior to membrane installation.

3.2 PREPARATION

- 3.2.1 Roofing membrane shall be applied over clean and dry surfaces to RCABC requirements and membrane manufacturer's recommendations.
- 3.2.2 Surrounding surfaces shall be protected against damage from membrane installation Work.

3.3 MEMBRANE INSTALLATION

- 3.3.1 The membrane manufacturer's instructions shall be followed for all Work.
- 3.3.2 The application of membrane roofing shall produce a single ply fully adhered membrane installation.
- 3.3.3 Membrane shall be installed with the minimum number of joints. The largest size factory formed sheet as is practicable shall be used.
- 3.3.4 Membrane installation shall be started at low point of the roof and worked towards the high point. Higher sheets shall be lapped over the lower sheets, so the flow of water is not against the edges of the sheet.
- 3.3.5 Membrane shall be placed on roof and in gutters so it is free of buckles or wrinkles. Membranes shall not be stretched. Sheets shall be laid with a minimum 75 mm lap. Membranes shall be allowed to relax for a minimum of 30 minutes before securing or splicing.
- 3.3.6 Membrane sheet shall be turned back one third of its width. A uniform coating of adhesive shall be applied according to manufacturer's instructions, to both the membrane underside and substrate surface.

- 3.3.7 Membrane shall be bonded to horizontal and vertical surfaces by applying bond adhesive to membrane and to substrate. A lambswool roller shall be used at manufacturers prescribed coverage rates and allowance shall be made to dry until adhesive will not stick when touched.
- 3.3.8 Coated membrane shall be rolled into adhesive avoiding wrinkles. Sheet shall be pressed down evenly to achieve maximum adhesion, and push broom shall be used to achieve maximum contact.
- 3.3.9 Unbonded portion of the sheet shall be folded back and the bonding procedure repeated until full and complete bonding has been achieved.
- 3.3.10 At joints, both lap surfaces shall be cleaned and primer applied in accordance with manufacturer's recommendations to both lap surfaces. A uniform coating of splicing cement shall then be applied to both lap surfaces of the membranes. Top sheets shall be rolled over underlying sheets.
- 3.3.11 Spliced joints shall be rolled with a clean steel roller and lap sealant applied.
- 3.3.12 Seaming tape shall be installed to folded edges of membrane and rolled heavily with hand roller; polyethylene-backing tape shall be removed and joints shall be closed allowing membrane to fall into position without stretching.
- 3.3.13 Membrane flashings shall be installed around pipe columns, at vertical skylight curbs, into gutters and at other locations in accordance with Drawings and to manufacturer's instructions.
- 3.3.14 Corners, pipe seals, flashing protrusion, and other like details shall be installed as applicable, and as recommended by the approved membrane manufacturer. Membrane terminations shall be completed in accordance with manufacturer's recommendations.
- 3.3.15 Metal flashings shall be installed as indicated, in accordance with RCABC flashing details and Section 07 62 00, "Sheet Metal Flashing and Trim".
- 3.3.16 Sealant shall be applied to metal flashing and coping joints in accordance with Section 07 92 10, "Joint Sealing".
- 3.4 FLOOD TESTING
- 3.4.1 Upon completion of membrane roofing and prior to Substantial Performance, the Contractor shall plug all drains and use sandbags or other means to contain 50 mm of water over the membrane for a one-hour test. After testing, all leaks shall be repaired and the test shall be repeated until the system is proven satisfactory.
- 3.5 ADJUST AND CLEAN

- 3.5.1 All drips or smears, on exposed finished surfaces or on surfaces to be subsequently finished, shall be repaired, removed and cleaned immediately.
- 3.5.2 All adjacent surfaces shall be protected from damage due to membrane roofing operations.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- 1.1.1 The Work includes furnishing of all labour, material, plant and equipment required for the fabrication and installation of gutters, sheet metal flashings to roofing, membrane waterproofing, stainless steel gutter straps and strainers to gutters.

1.2 QUALITY CONTROL

- 1.2.1 The sheet metal fabrication and installation shall be performed in accordance with the RCABC manual.
- 1.2.2 The sheet metal flashing and trim shall be inspected continuously during the installation by the inspection agency appointed by RCABC and paid for by the Contractor.

1.3 REFERENCES

- 1.3.1 Roofing Contractors' Association (RCABC) of British Columbia: "Roofing Practices Manual".
- 1.3.2 CSA-B111: "Wire Nails, Spikes and Staples".
- 1.3.3 CAN/CGSB-1.108-M: "Bituminous Solvent Type Paint".
- 1.3.4 CAN/CGSB-37.5-M: "Cutback Asphalt and Plastic Cement".
- 1.3.5 ASTM A525M: "Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)".
- 1.3.6 ASTM A526: "Specification for Commercial Quality Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process".

1.4 SUBMITTALS

- 1.4.1 Submittals shall be made in accordance with the General Requirements and shall include:
 - 1.4.1.1 Contractor's drawings clearly indicating materials, colours, thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcements, details and accessories;
 - 1.4.1.2 Contractor's drawings for gutters, overflows and strainers, showing each component, each joint condition, sealing provision, fasteners and relation to other Work;
 - 1.4.1.3 Duplicate samples of sealants and gasket materials and of each type of sheet metal product;

- 1.4.1.4 Each sample shall be at least 100 mm square and tagged with name of product, colour, source and location in the structure; and
- 1.4.1.5 Two copies of inspection agency reports and the standard RCABC written guarantee on the approved form.
- 1.5 DELIVERY, STORAGE AND HANDLING
 - 1.5.1 Materials shall be stored raised above ground, protected from elements and damage from corrosion. Damaged materials shall be replaced.
- 1.6 MEASUREMENT PROCEDURES
 - 1.6.1 No measurement will be made under this Section. Include Sheet Metal Flashing and Trim costs in applicable lump sum prices of members to which they are applied.

PART 2 - PRODUCTS

- 2.1 Materials
 - 2.1.1 Galvanized steel flashing and trim shall be minimum 0.8 mm thick zinc coated steel sheet, zinc coating shall be minimum 380 g per square metre, to ASTM A525 and AS7M A526. Heavier gauge shall be used as detailed or required by RCABC.
 - 2.1.2 Prepainted flashings shall be minimum 0.8 mm thick zinc coated steel. Colour shall be as indicated in Material Finish and Colour Schedule.
 - 2.1.3 Stainless steel flashing shall be 0.635 mm, type 302 or 304, No. 4 finish.
 - 2.1.4 Fasteners: shall be galvanized steel to CSA-BIII.
 - 2.1.5 Stainless Steel Straps: minimum 0.8 mm thick, type 302 or 304.
 - 2.1.6 Aluminum Strainers: as indicated.
 - 2.1.7 Solder: 50 percent pig lead and 50 percent block tin.
 - 2.1.8 Flux: commercial quality as recommended by sheet metal manufacturer.
 - 2.1.9 Bituminous Paint: to CAN/CGSB-1.108-M.
 - 2.1.10 Plastic Cement: to CAN/CGSB-37.5-M.
 - 2.1.11 Sealant: in accordance with Section 07 92 10, "Joint Sealing".

2.1.12 Materials shall be verified by compatibility with roofing system. If not compatible, appropriate material shall be proposed and submitted for review by the Owner before application.

2.2 FABRICATION

2.2.1 Minimum lengths shall be 2500 mm and maximum lengths shall be 3000 mm for locations where long runs of sheet metal flashing are required.

2.2.2 End-to-end joints shall be standing lock type.

2.2.3 Where exposed joints are necessary, these joints shall be formed to create flush butt hairline joints.

2.2.4 All edges shall be hemmed a minimum of 10 mm to provide a safe, stiff edge.

PART 3 - EXECUTION

3.1 INSPECTION

3.1.1 The Work Site conditions shall be examined and the Contractor shall ascertain that all substrate and backing material is acceptable for proper fastening of sheet metal Work.

3.1.2 Previously executed Work shall be inspected and measurements obtained to confirm the dimensions on Contractor's drawings.

3.2 INSTALLATION

3.2.1 Stainless steel straps and sheet metal hook strips shall be stripped to required widths and brake shaped to the profile.

3.2.2 Flashings over 600 mm high shall be formed in standing seam construction in 600 mm widths.

3.2.3 Seams shall be capped and locked; exposed edges folded back 13 mm. Mitre and solder corners. Vertical seams shall be slip seams.

3.2.4 Continuous inserts shall be provided where flashings are built into vertical or horizontal surfaces. Continuous hook strips shall be installed with 190 mm splayed drip at fascias, copings and tops of parapets to receive flashings, secured at not over 450 mm on centres.

3.2.5 Sections shall be formed square, true and accurate to size, free from distortion and other defects detrimental to performance and appearance,

3.2.6 Isolation coating shall be applied to metal surfaces to be embedded or in contact with concrete or mortar.

- 3.2.7 Fasteners shall be concealed. Surface fasteners shall not be used for flashings.
 - 3.2.8 Pre-painted flashings around louvres shall be installed as detailed.
 - 3.2.9 Membrane flashings shall be counterflashed at intersections with vertical surfaces and curbs. Joints shall be flashed using s-lock, forming tight fit over hook strips.
 - 3.2.10 End Joints and other locations shall be caulked as indicated between the flashings and other materials and all caulking shall be neatly pointed.
- 3.3 CLEAN-UP
- 3.3.1 Upon completion of Work all resulting debris and equipment shall be removed from the Work Site and all sheet metal Work shall be cleaned and left free of dents and other blemishes.
 - 3.3.2 Where other work must continue over the finished sheet metal flashing and trim, the surfaces shall be protected with suitable materials to prevent damage to sheet metal Work.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- 1.1.1 The Work includes furnishing of all labour, material and equipment for the supply and installation of sealants and caulking, including all related cleaning, priming, backing and taping.

1.2 QUALITY CONTROL

- 1.2.1 Installation shall be in accordance with manufacturer's published instructions. The equipment used shall be that recommended by the manufacturer of sealants.
- 1.2.2 Installation shall be continuously inspected by the representative of manufacturer of sealants used during the joint preparation and application of sealants.

1.3 REFERENCES

- 1.3.1 CAN/CGSB-19.24-M: "Multi-Component, Chemical Curing Sealing Compound".
- 1.3.2 CAN/CGSB-19.18-M: "Sealing Compound, One Component, Silicone Base, Solvent Curing".
- 1.3.3 CAN/CGSB-19.21-M: "Sealing and Bedding Compound, Acoustical".
- 1.3.4 CAN/CGSB-19.22-M: "Mildew Resistant Sealing Compound for Tubs and Tile".

1.4 SUBMITTALS

- 1.4.1 Submittals shall be made in accordance with the General Requirements
- 1.4.2 Manufacturer's specifications, application and maintenance instructions, and test reports shall be submitted to the Owner for reference.
- 1.4.3 Samples of joint sealants shall be submitted in quadruplicate. Joint sealants shall be adhered to samples of substrate material and shall be in minimum lengths of 300 mm.
- 1.4.4 Samples shall be for each colour and for each type of sealant, for each substrate material.
- 1.4.5 Samples shall be tagged identifying product, date, colour and curing conditions.
- 1.4.6 The manufacturer shall demonstrate the compatibility of the sealants with substrate materials, with other sealing materials, and the durability, adhesion and non-staining properties of the products.

1.4.7 The manufacturer's representative shall, following his regular inspection, submit two copies of his report. The report shall comment upon the quality of application and conformance to recommendations.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Products shall be delivered in original sealed containers with manufacturer's labels intact.

1.5.2 Labels shall indicate manufacturer's name, brand and other information indicating conformance with standards and reviewed samples.

1.5.3 Containers shall not be removed from the Work Site prior to Substantial Performance.

1.5.4 Materials shall be stored according to manufacturer's instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

1.6.1 Manufacturer's directions shall be followed for weather and temperature conditions during the application.

1.7 MEASUREMENT PROCEDURES

1.7.1 No measurement will be made under this Section. Include Joint Sealing costs in applicable lump sum prices of members to which they are applied.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Silicone sealants shall conform to CAN/CGSB-19.18-M and shall be one component silicone base chemical curing.

2.1.2 For non-porous surfaces such as glass or metal where there will be dynamic movement of +25 percent, the sealant shall be Type I silicone.

2.1.3 For porous surfaces such as concrete or masonry other than paving and platform surfaces where there will be dynamic movement of + 40 percent, the sealant shall be Type 2 silicone.

2.1.4 Silicone caulking in washrooms plumbing fixtures, and ceramic tile, shall be white, mildew resistant silicone, conforming to CAN/CGSC-19.22-M.

2.1.5 Sealants for the application at platform expansion joints, control joints and platform paving and platform architectural precast concrete joints shall be epoxidised polyurethane

three component sealant conforming to CAN/CGSB-19.24-M, Type 1, Class B, Shore hardness of 35, Tremco DYMERIC.

2.1.6 Sealants for the application at paving and architectural precast concrete joints other than in platform areas shall be polysulfide or polyurethane multi-component sealants conforming to CAN/CGSB-19.24-M, Type 1, Class B for horizontal surfaces, and to CAN/CGSB-19.24-M, Type 2, Class B for vertical joints. Black sealant shall be used for pre cast stair treads on either side of the safety edge with concrete.

2.1.7 Small joint sealant used for joints in metal frames shall be TREMCO Small Joint Sealant, or equivalent by other manufacturers, clear acrylic sealant.

2.1.10 Acoustic sealant shall be one component, gun grade, non-staining, non-hardening, permanently flexible, based on synthetic rubber and conforming to CAN/CGSB -19.21-M.

2.1.11 Colours shall be in accordance with Material Finish and Colour Schedule.

2.1.12 Sealants for use with preformed two-ply roofing membrane gutter edges shall be silicone, low modulus, capable of dynamic movement of +50 percent, Type 2, alcohol release, conforming to CAN/CGSB-19.18-M.

2.2 ACCESSORY MATERIALS

2.2.1 Primers shall be types recommended by manufacturer of sealant.

2.2.2 Bond breaker tapes shall be adhesion backed polyethylene which will not bond to sealants.

2.2.3 Backing rods shall be either closed cell foam composed of polyethylene, urethane, neoprene or vinyl as recommended by the sealant manufacturer.

2.2.4 Equipment shall be new and clean, suitable for each application in order to attain perfectly straight and smooth surfaces.

2.2.5 Colour selection shall be in accordance with Material Finish and Colour Schedule.

PART 3 - EXECUTION

3.1 INSPECTION

3.1.1 Conditions shall be examined by the Contractor and sealant manufacturer's representative at all areas of installation. Compliance with manufacturer's requirements for each joint application shall be ascertained prior to commencement of Work.

3.1.2 Joints shall be inspected and corrected to obtain the following width to depth ratios:

- 3.1.2.1 minimum joint size: 6.0 by 6.0 mm;
 - 3.1.2.2 joints between 6.0 and 12mm wide shall have depth equal to width;
 - 3.1.2.3 joints between 12 and 25 mm wide shall have depth equal to 50 percent of width; and
 - 3.1.2.4 joints between 25 and 50 mm wide shall have maximum depth of 12 mm.
- 3.2 PREPARATION
- 3.2.1 Joints shall be cleaned with solvent approved by sealant manufacturer to assure removal of any trace of form release or curing agent or any other substance which may impair the adhesion of the sealant to the substrates.
 - 3.2.2 Substrates shall be tested as required to determine adhesion properties of surfaces to be caulked.
 - 3.2.3 Bond breaker tape shall be applied where required to avoid adhesion to adjacent surfaces indicated on Drawings. Taped areas must be sealed immediately after taping.
 - 3.2.4 Backing rods shall be placed to suit size of joint. Rods shall be sized for 25 to 35 percent compression, and shall have its own release agent or be covered with bond breaking tape.
- 3.3 INSTALLATION
- 3.3.1 Masking tape shall be applied to adjoining finishes.
 - 3.3.2 Areas where bond breaking tape has been installed shall be sealed immediately after taping.
 - 3.3.3 Primer application shall follow respective sealant manufacturer's recommendations.
 - 3.3.4 Sealant components shall be carefully mixed according to respective sealant manufacturer's instructions. Preparation shall not be used beyond its recommended pot life.
- 3.4 CLEAN-UP
- 3.4.1 Masking, excess sealant, droppings, and misapplied sealants shall be removed with aid of cleaners and equipment recommended by manufacturer of sealants.
 - 3.4.2 Surfaces damaged as a result of the Work of this Section shall be repaired or replaced.

END OF SECTION

PART 1 General

1.1 SUMMARY

- 1.1.1 Provide structural glass assemblies, vertical and horizontal (canopies) and glass guards, with accessories for a complete system as indicated and specified.
- 1.1.2 Quality Control: Refer to the General Requirements.

1.2 REFERENCES

- 1.2.1 Governing codes and standards shall be the latest revision and include the following:
- 1.2.2 ASTM A 36/A36M, Carbon Structural Steel.
- 1.2.3 ASTM A 666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- 1.2.4 ASTM E 997 Standard Test Method for Structural Performance of Glass in Exterior Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Destructive Methods.
- 1.2.5 ASTM E 1233 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential
- 1.2.6 ASTM E 1886 Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

1.3 SYSTEM DESCRIPTION

- 1.3.1 Stainless steel connection system designed to be attached to pre-drilled structural steel and once attached to structure to accept structural glass panels.
- 1.3.2 Spider brackets are bolted to structure with base bolts through the spider and holes drilled through the structure.
- 1.3.3 Stainless steel components with one or two arms, or points, are then connected to the structure.
- 1.3.4 Structural glazing with pre-drilled holes is assembled with glazed bolt assembly bolts threaded through. Glazed/bolt assembly is fastened to spider feet with nuts and other system components that are added to extend and support the system.

1.4 PERFORMANCE REQUIREMENTS

- 1.4.1 General Performance: Structural glass assemblies shall withstand effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- 1.4.2 Structural Performance: Structural glass assemblies shall withstand effects of gravity loads and the following loads and stresses within limits and under conditions indicated on Drawings and as follows:
 - 1.4.2.1 Wind Loads: In accordance with Code requirements.
 - 1.4.2.2 Snow Loads
 - 1.4.2.3 Normal use loadings (e.g. such as passengers leaning against wall panels).
 - 1.4.2.4 Deflection Limits: Deflection normal to glazing plane is limited to 1/175 of clear span or 19 mm (3/4 inch), whichever is smaller or as indicated on Drawings and as required by Building Code or By-law as recognized by authority having jurisdiction, for post disaster building requirements.
 - 1.4.2.5 Seismic Loads: In accordance with Code requirements.
 - 1.4.2.6 Impact Loads: In accordance with Code requirements,

1.5 SUBMITTALS

- 1.5.1 Submit in accordance with the General Requirements.
- 1.5.2 Product Data:
 - 1.5.2.1 Provide product data for each product indicated.
 - 1.5.2.2 Maintenance Data: Include requirements for periodic inspection, maintenance and cleaning requirements.
- 1.5.3 Shop Drawings:
 - 1.5.3.1 Shop drawings shall be prepared under the supervision, and signed and sealed by a structural engineer registered to practice in the Province of British Columbia. Field measure prior to shop drawing production.
 - 1.5.3.2 Include analysis data.
 - 1.5.3.3 Show fabrication and installation details.

- 1.5.3.4 Plans, elevations, and sections, giving sizes, quantities, details, materials, fastening, connections and accessories.
- 1.5.3.5 Details of fittings and glazing, including isometric drawings of patch and rail fittings and stainless steel spider connection system.
- 1.5.4 Letters of Assurance: Provide signed and sealed Letters of Assurance as required by the Authority having Jurisdiction. Coordinate with Section 08 80 50 Glazing.
- 1.5.5 Samples: For each type of exposed finish indicated.
- 1.5.6 Product test reports.
- 1.5.7 Warranty: Sample of special warranty.
- 1.6 **QUALITY ASSURANCE**
 - 1.6.1 Installer Qualifications: Manufacturer's authorized Representative with at least three years' experience performing similar installations.
 - 1.6.2 Source Limitations: Obtain Structural glass assemblies from single source from single manufacturer.
 - 1.6.3 Pre-installation Conference: Conduct conference at Project site. Review preparation, sequencing and installation requirements.
- 1.7 **DELIVERY, STORAGE AND HANDLING**
 - 1.7.1 Deliver units in protective wrappings with units clearly marked to assist in site assembly.
 - 1.7.2 Store units in vertical position, off ground, in conditioned space with protective spacers between units.
 - 1.7.3 Prevent damage to units during loading at fabricators, unloading at site and before during and after installation.
- 1.8 **PROJECT CONDITIONS**
 - 1.8.1 Do not install stainless steel components in contact with galvanized steel.
 - 1.8.2 Do not install units when temperature is less than 0 degrees Celsius.
- 1.9 **WARRANTY**
 - 1.9.1 Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of Structural glass assemblies that do not comply with

requirements or that fail in materials or workmanship within specified warranty period.

1.9.1.1 Warranty Period: Two years from date of Substantial Performance.

1.10 MEASUREMENT AND PAYMENT

1.10.1 Payment for Elevator and Canopy Structural Glazed Assembly shall be made at the Lump Sum Price bid. The Lump Sum Price shall include all submittals, quality control, and complete assembly materials and work required under this section and Section 08 80 50, Section 07 92 10 and other related sections.

1.10.2 Payment for Elevator Enclosure Finishing shall be made at the Lump Sum Price bid. The Lump Sum Price shall include the cost of roofing and waterproofing, roof drainage piping, flashing and trim, louvers and vents, sealants and damp-proofing. The Lump Sum Price shall also include all submittals, quality control, materials and work required under this section, Section 07 53 24, Section 07 62 00, Section 07 92 10, Section 08 90 00, and other related sections.

1.10.3 Payment for Glass Enclosure of Curb Trench Lighting shall be made at the Lump Sum Price bid. The Lump Sum Price shall include all submittals, quality control, materials and work required under this section, Section 08 80 50 and Section 07 92 10 for the tempered glass enclosure with waterproofing joint sealant.

2.0 Products

2.1 MANUFACTURERS

2.1.1 Subject to compliance with specifications the following manufacturers are acceptable:

2.1.1.1 Stella Custom Glass Hardware, Inc. Contact: Roy Lamont T 604 231-5892, F 604 231-5893 E: royl@stellassemblies.com.

2.1.1.2 Or approved alternate.

2.2 MATERIALS

2.2.1 Material: Minimum AISI type 316 stainless steel with stainless steel nuts and washers of matching alloy group.

2.2.2 Stainless Steel Components: Conforming to ASTM A 666.

2.2.3 Stainless Steel Nuts: Conforming to ASTM F594 unless otherwise specified.

2.2.3.1 Finishes:

- 2.2.3.1.1 Cast Stainless Steel: Brushed #4 finish.
- 2.2.3.1.2 Bolts: Fine machine finish.
- 2.2.4 Materials: Capable of withstanding operating temperatures from a range of -45 degrees C (-50 degrees F) to +50 degrees C (120 degrees F) and able to withstand degradation due to ultraviolet exposure for five years.

2.3 COMPONENTS

- 2.3.1 W-1 Glazed Elevator Shaft Wall Panels:
 - 2.3.1.1 Spider Connectors: Cast 316 stainless steel. Finish: Satin.
 - 2.3.1.2 Series: spider assemblies to be selected upon completion of final design by Stella Custom Glass Hardware Inc. or approved alternative.
- 2.3.2 Specific spider bracket hardware to be selected upon completion of final design
- 2.3.3 Bolts:
 - 2.3.3.1 Base bolts for fixing cast stainless steel spider supports to structure. Diameter and threading sized to resist wind load, dead load and seismic load as indicated on Drawings. Finish: Ex works
 - 2.3.3.2 Non-articulating Bolts - Bolts Glass to Spider: Stainless steel. Diameter and threading sized to suit applications indicated. Finish: Ex works.
- 2.3.4 Gaskets:
 - 2.3.4.1 Gaskets for Base Bolts to insulate stainless steel from structure: CG608 – 0.8mm
 - 2.3.4.2 Front Disk at Base Bolts to prevent glass to metal contact: CG608 – 1,6mm.
 - 2.3.4.3 Back Disk at Base Bolts to prevent glass to metal contact: CG608 – 1,6mm. _
- 2.3.5 Non Articulating Bolts: Stainless steel, diameter and thread sized to resist wind load, dead load and seismic load as indicated on Drawings.
 - 2.3.5.1 Circular clamping plates: Stainless steel tapered shoulder. Diameter and thickness to resist wind load, dead load and seismic load as indicated on drawings. Finish: machined, Type NB1 Manufacturer: Stella Custom Glass Hardware or approved alternate.
 - 2.3.5.2 Gaskets for Through-Glass Bolts:

- 2.3.5.2.1 Type CG608: Vulcanized fibre, Type Vellumoid Vellotherm 650 as distributed by Custom Gaskets or approved alternative.
- 2.3.5.2.2 Type CG535: Solid neoprene, 60 durometre hardness, as distributed by Custom Gaskets or approved alternative.
- 2.3.6 Custom Nuts:
 - 2.3.6.1 Base bolts: Tamper resistant, stainless steel nuts, sized to suit base bolts and spider brackets. Provide 2 per spider bracket. Manufacturer: Stella Custom Glass Hardware or approved alternate.
 - 2.3.6.2 Non Articulating bolts: Tamper resistant, stainless steel nuts, sized to suit base bolts and spider brackets. Provide 1 per non articulating bolt. Manufacturer: Stella Custom Glass Hardware or approved alternate.
- 2.3.7 Spacer Ferrules: Provide in holes through glass to prevent metal to glass contact. Polyurethane ferrule bushing Minimum 90 Duro and strength of 31MPa. Manufacturer's standard to protect glass from contact with bolts.).
 - 2.3.7.1 Bushing Inside Diameter: to suit outside diameter of bolt.
 - 2.3.7.2 Bushing Outside Diameter: to suit diameter of hole in glass.
- 2.3.8 Structural Glass: As specified in Section 08 80 50 Glazing and to suit the installation as required by the Engineer providing the Letters of Assurance.

2.4 ACCESSORIES

- 2.4.1 Sealant / Caulking: One-component, neutral-cure, RTV (room temperature vulcanizing) silicone rubber sealant conforming to ASTM C920, Type S, Grade NS, Class 50, Use NT, G, A, and O for structural and non-structural glazing, Dow Corning 795 Silicone Building Sealant or approved alternative. Colour to be selected by Architect from manufacturer's full range.
- 2.4.2 Glazing Holes: 22 mm diameter minimum unless indicated otherwise, drilled in glass by glazing fabricator. Refer to section 08 80 50 Glazing.
- 2.4.3 Other Structural Sealants: All sealants to be recommended and verified by structural glass assembly unit manufacturer.
 - 2.4.3.1 Tremco Spectrem 2 High Performance Silicone Sealant
 - 2.4.3.2 Sikasil WS 295 Structural Glazing Silicone Sealant
 - 2.4.3.3 Approved alternate

2.4.4 Structural Glazing Tape: All glazing tape to be recommended and verified by structural glass assembly unit manufacturer. Structural glazing tape shall be from same manufacturer as structural sealant unless otherwise approved and when so general contractor to provide written confirmation from each manufacturer regarding their products compatibility with the other product.

2.4.4.1 Tremco SGT-900 Series Structural Glazing Tape

2.4.4.2 Sika Spacer Tape HD

2.4.4.3 Approved alternate

2.4.5 Thread Locking Fluid: Loctite 262 by Loctite or approved alternative.

2.5 FABRICATION

2.5.1 Provide holes and cut-outs in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

2.5.1.1 Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

2.5.2 Factory assemble components and factory install hardware and fittings to greatest extent possible.

2.6 FINISHES

2.6.1 Stainless Steel: Directional satin finish No. 4, grind and polish surfaces to produce uniform finish, free of cross scratches.

2.6.2 Machined Stainless Steel: Fine machined showing concentric circles and free of cross scratches.

3.0 Execution

3.1 EXAMINATION

3.1.1 Examine areas to receive structural glass assemblies with Installer present. Correct unsatisfactory conditions.

3.1.2 Start of work indicates acceptance of conditions.

3.2 PREPARATION

3.2.1 Coordinate installation requirements with glazing fabricator.

3.2.2 Shop Preparation:

- 3.2.2.1 Assemble units in shop as much as possible.
- 3.2.2.2 Ensure holes in glass are in correct locations and have correct dimensions and anti-graffiti film has been applied and trimmed as required prior to assembly.
- 3.2.2.3 Ensure glass -to -metal gaskets are installed prior to installation of bushings and brackets.
- 3.2.2.4 Prior to assembly ensure: Inside diameter of bushing suits outside diameter of bolt. Outside diameter of bushing suits diameter of hole in glass.

3.2.3 Field Preparation:

- 3.2.3.1 Ensure surfaces to receive units are plumb level and true, surfaces are clean and free of debris and foreign matter.
- 3.2.3.2 Ensure metal to metal gaskets are secured in place where substrate is dissimilar metal to avoid galvanic action.
- 3.2.3.3 Ensure calibration on torque wrench is accurate and has been calibrated within the last 6 months prior to installation.

3.3 **INSTALLATION**

- 3.3.1 Install Structural glass assemblies and associated components according to manufacturer's written instructions, reviewed Shop Drawings and Code requirements.
- 3.3.2 Set units level, plumb, and true to line, with uniform joints.
- 3.3.3 Fully support units before during and after installation to limit racking.
- 3.3.4 Maintain uniform clearances between adjacent components and apply appropriate glazing tape, gaskets or beads as required and where applicable to prevent glass front being in direct contact with metal or other building materials and components.
- 3.3.5 Size and install all glazing in a manner that will allow for expansion and contraction without compromising weather seals and structural glass connections.
- 3.3.6 Torque:
 - 3.3.6.1 Apply torque bolts with calibrated torque wrench as indicated on reviewed Shop Drawings. Apply thread locking fluid to threads during final assembly.

3.3.7 Testing:

3.3.7.1 10% of each set of point supported bolts shall be torque tested to originally specified loads. If any of the tested systems fail to achieve the specified torque load within the limits as defined on the Drawings, all assemblies of same type as the failed assembly shall be tested and rectified, unless otherwise instructed by Consultant.

3.3.7.2 Perform torque test to the originally specified loads. Check 10% of gaskets for signs of degradation and permanent deformation. If any of the tested / inspected systems fail to meet the specifications within the limits as defined on the Drawings, all assemblies of the same type as the failed assembly shall be tested and rectified.

3.3.8 Install joint sealants to produce weather tight installation using structural glass assembly manufacturer's recommended sealant.

3.4 **ADJUSTING REPAIRING AND CLEANING**

3.4.1 Adjust units so they are plumb and level with even joints. Apply manufacturer's recommended sealant and glazing tape and or other accessories where applicable between units where indicated and where system abuts other construction.

3.4.2 Repair damaged units or replace units that in Consultant's opinion do not meet specifications.

3.4.3 Repair damaged finishes including anti-graffiti film to Consultant's complete satisfaction.

3.4.4 Cleaning: After the system has been fully installed, remove surface dirt and grit and wash with soft cleaning cloths and soapy water. Rinse well.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

PART 1 - GENERAL

1.1 WORK INCLUDED

1.1.1 The Work includes the furnishing of all labour, material, parts and equipment required for the supply and installation of glass and glazing as shown on Drawings to mullionless glass metal support brackets. Provide glass, glazing and accessories for a complete system as indicated and specified.

1.1.2 Provide glazing for elevator hoistway, and canopy glazing assemblies.

1.2 QUALITY CONTROL

1.2.1 Installation shall be in accordance with Glazing Contractors Association of BC, "Glazing Systems Specifications Manual", and shall be performed by a glazing Contractor who is a certified member of and in good standing with the "Glazing Contractors Association".

1.2.2 Installation shall meet or exceed the minimum requirements of the current edition of all governing and local codes including their latest revisions.

1.2.3 Pre-construction Adhesion and Compatibility Testing: Submit samples of each glazing material type, tape sealant, gasket and glazing accessory that will contact or affect elastomeric glazing sealants to elastomeric glazing sealant manufacturers, for testing according to ASTM C 1087.

1.2.4 One year written guarantee shall be provided to cover defects in workmanship and installation of accessory materials to all glazing.

1.3 PERFORMANCE REQUIREMENTS

1.3.1 Meet requirements of Building Code and By-law as recognized by authority having jurisdiction, as applicable, and this Specification. Where there are conflicting requirements, inform the Architect for direction and resolution.

1.3.2 General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

1.3.3 Glass Design: Confirm glass thicknesses by engineering analysis of Project loads and in-service conditions. Provide glass lites in thicknesses indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1.3.4 Glass Thicknesses: Select minimum glass thicknesses to comply with Building Code and By-law recognized by authority having jurisdiction, CAN/CGSB 12.20 M, and as follows:

1.3.5 Specified Design Wind Loads: As required by Code.

- 1.3.6 Specified Design Snow Loads: As required by Code.
- 1.3.7 Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
- 1.3.8 Load Duration: 60 seconds or less.
- 1.3.9 Probability of Breakage for Sloped Canopy Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.
- 1.3.10 Load Duration: 30 days.
- 1.3.11 Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
- 1.3.12 Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint colour indicated throughout Project.
- 1.3.13 Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and night time-sky heat loss.
- 1.3.14 Temperature Change (Range): -20 to 40 deg C ambient; 75 deg C material surfaces.
- 1.3.15 Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 - 1.3.16 For monolithic-glass lites, properties are based on units with lites 6.0 mm.
 - 1.3.17 For laminated-glass lites, properties are based on products of construction indicated.
- 1.4 REFERENCES
 - 1.4.1 CAN/CGSB-12.10-M76, "Glass, Heat and Light Reflecting".
 - 1.4.2 ASTM C920, Elastomeric Joint Sealants.
 - 1.4.3 ASTM C 1028, Standard Specification for Heat-Treated Flat Glass -Kind HS, Kind FT Coated and Uncoated Glass.
 - 1.4.4 ASTM C1193, Use of Joint Sealants.
 - 1.4.5 ASTM D412, Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers -Tension.
 - 1.4.6 ASTM D1149, Test Method for Rubber Deterioration -Surface Ozone Cracking in a Chamber.

- 1.4.7 ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.
- 1.4.8 CAN/CSA B44-04: "Safety Code for Elevators and Escalators";
- 1.4.9 B.C. Elevating Devices Safety Act and Regulation;
- 1.4.10 CAN/CGSB 12.1 Tempered or Laminated Safety Glass.
- 1.4.11 CAN/CGSB-12.20 Structural Design of Glass for Buildings.
- 1.4.12 CAN/CGSB-12.10-M76, "Glass, Heat and Light Reflecting".
- 1.4.13 National Building Code current edition
- 1.4.14 B.C. Building Code, 2006 edition (BCBC).
- 1.4.15 Vancouver Building By-Law, 2007 Edition (VBBL).
- 1.4.16 GANA (Glass Association of North America), Glazing Manual.
- 1.4.17 GANA, Laminated Glass Design Guide.
- 1.4.18 Glazing Contractors Association of BC, Glazing Systems Specifications Manual.
- 1.4.19 Laminators Safety Glass Association, Standards Manual.
- 1.5 SUBMITTALS
 - 1.5.1 Submittals shall be made in accordance the General Requirements
 - 1.5.2 Two 300 mm. x 300 mm size samples of glass shall be submitted.
 - 1.5.3 Product Data: For each glass product and glazing material indicated.
 - 1.5.4 Shop Drawings:
 - 1.5.4.1 Shop drawings shall be prepared under the supervision of, and signed and sealed by a structural engineer registered to practice in the Province of British Columbia. Field measure prior to shop drawing production.
 - 1.5.4.2 Include structural analysis data prepared by engineer sealing shop drawings.
 - 1.5.4.3 Furnish complete shop and erection drawings for review prior to fabrication. Do not fabricate work until Shop Drawings and other related submittals and samples have been reviewed by the Architect.
 - 1.5.4.4 Indicate colours, sizes, quantities, thicknesses, materials, glass types, glazing compounds, sealants, anchorage and fastening details, hardware, glazing methods, and integration with adjacent building systems.

- 1.5.5 Glazing Schedule: Use same designations indicated on Drawings.
- 1.5.6 Pre-Construction Adhesion and Compatibility Test Report: From glazing sealant manufacturer.
- 1.5.7 Letters of Assurance: Submit signed and sealed Letters of Assurance from engineer sealing Shop Drawings in accordance with requirements of the authority having jurisdiction.
- 1.5.8 Maintenance instructions for each type of glass shall be submitted for the inclusion in maintenance manuals.

1.6 DELIVERY, STORAGE AND HANDLING

- 1.6.1 Glass shall be delivered in crates; other components shall be in original containers with manufacturer's labels intact and all materials undamaged.
- 1.6.2 Containers shall not be removed from the Work Site prior to Substantial Performance.
- 1.6.3 Materials shall be stored according to manufacturer's instructions on a dry floor in a weatherproof enclosure. Coordinate delivery and arrange storage to keep handling to a minimum.
- 1.6.4 Maintain responsibility for breakage regardless of location, remove any broken or otherwise damaged materials from the job site and replace with acceptable materials at no cost to the Project.

1.7 MEASUREMENT PROCEDURES

- 1.7.1 No measurement will be made under this Section. Include Glazing costs in applicable lump sum prices of members to which they are applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 2.1.1 Subject to compliance with specifications the following manufacturers are acceptable for the products indicated:
- 2.1.2 AFG Industries Inc.
- 2.1.3 Canadian Pittsburgh Industries Ltd.
- 2.1.4 LOF
- 2.1.5 Pilkington Building Products North America.
- 2.1.6 PPG Industries, Inc.

- 2.1.7 Tempa.
- 2.1.8 Wescan.
- 2.1.9 Or approved alternative.

2.2 GLASS MATERIALS

- 2.2.1 Tempered Safety glass: shall conform to CAN/CGSB-12.1-M Type 1, Class A.
- 2.2.2 Laminated glass: shall conform to CAN/CGSB-12.2-M. Two layers of heat strengthened glass with an 0.76 mm thick polyvinyl butyral (PVB) interlayer shall be laminated together.
- 2.2.3 **Glass Types and Locations**
- 2.2.4 **GL-1: Elevator Hoistway Glazing**
- 2.2.5 Provide glazing in compliance with CAN/CSA B44-04/Safety Code for Elevators and Escalators and B.C. Elevating Devices Safety Act and Regulation with solar heat gain reducing properties.
- 2.2.6 Anti-Graffiti Film: Apply to exposed exterior face of glass to whole panels on sides where panels are wholly or partly within 0 - 3000 mm AFF.
- 2.2.7 **GL-2: Clear Laminated and Tempered**
- 2.2.8 Locations: Canopy over elevator entry at the viewing platform level.
- 2.2.9 Conforming to CAN/CGSB 12.1 with plastic interlayer thickness 2.29 mm (0.090 inch) with a proven record of no tendency to bubble, discolour, or loose physical and mechanical properties after laminating glass lites and installations.
- 2.2.10 Thickness: To be determined by Glazing Contractor's Engineer
- 2.2.11 Conforming to CAN/CGSB 12.1 with plastic interlayer thickness 2.29 mm (0.090 inch) with a proven record of no tendency to bubble, discolour, or loose physical and mechanical properties after laminating glass lites and installations.
- 2.2.12 Thickness: To be determined by Glazing Contractor's Engineer

2.3 GLAZING AND SEALING COMPOUND MATERIALS

- 2.3.1 Sealing materials: shall be in conformance with Section 07 92 10, "Joint Sealing".
- 2.3.2 Glazing Tape: Non-shrinking butyl rubber tape with self-adhesive surface, minimum 4.8mm thick. Approved manufacturers are Tremco Polyshim II tape; PTI 606 or approved alternative. It shall be preformed and compatible with sealant system used.

2.3.3 Equipment: only new and clean tools suitable for each application shall be used in order to attain straight and smooth surfaces.

2.3.4 Solvent Cleaner: As required for above glazing materials and as recommended by their approved manufacturer.

2.4 GLAZING SEALANTS

2.4.1.1 General: Provide products of type indicated, complying with the following requirements:

2.4.1.2 Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2.4.1.3 Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

2.4.1.4 Colours of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.5 ACCESSORIES

2.5.1.1 General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

2.5.1.2 Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

2.5.1.3 Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

2.5.1.4 Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2.5.1.5 Anti-Graffiti Film:

Film Thickness: minimum thickness 6 mils, with minimum tensile strength of 25,000 lbs/sq. inch and melting point of 260 degrees C or higher. Low E caution: when film is installed on double glazed insulating units with a Low E coating the film-to-glass application rating maybe affected increasing potential for glass breakage, and eliminating manufacturer's warranty coverage eligibility.

Acceptable Products:

Graffitigard, by Bekaert Specialty Films a Solar Guard product distributed by Newco Products Ltd. Contact Leah Newcombe 604 437-3111 F: 604 437-4477. E: newco@newcoproducts.bc.ca.

Llumar Magnum Graffiti Film by Llumar.

Scotchgard Anti-Graffiti Window Film (AG-7) by 3M Building & Commercial Services Division, 3M Center, Building 223-2N-08, St. Paul, MN 5514-1000

Or approved alternative.

2.6 FABRICATION

2.6.1.1 Take site measurements prior to shop fabrication.

2.6.1.2 Fabricate units in largest practical size for handling, transport and installation. Trial assemble large units in shop and match-mark for field assembly.

2.6.1.3 Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.7 FABRICATION OF STRUCTURAL GLASS

2.7.1.1 All edgework, holes and notches in the tempered glass panels will be completed before tempering and shall comply with the requirements of the manufacturer and as stated below.

2.7.1.2 Dimensional tolerance on panel size will be ± 1 mm of the theoretical dimension required.

2.7.1.3 Squareness of each panel will be within 3 mm.

2.7.1.4 Bow tolerance is 0.1%

2.7.1.5 The positional tolerances on all holes will be ± 1 mm from a single datum point.

2.7.1.6 All exposed edges shall be ground and polished unless otherwise noted.

2.7.1.7 Fabricate structural glass to thicknesses indicated on reviewed Shop Drawings.

2.7.1.8 Drill holes in structural glass before glass is fully tempered. Drill holes in locations indicated on reviewed Shop Drawings in accordance with ASTM C 1028.

2.7.1.9 Apply anti-graffiti film in accordance with manufacturer's instructions. Remove a circular portion of anti-graffiti film from structural glass units to suit size of structural glass assembly components indicated on Structural Glass Assemblies reviewed Shop Drawings.

2.7.1.10 Butt glass edges shall be ground and swiped.

PART 3 - EXECUTION

3.1 INSPECTION

- 3.1.1 Conditions at all areas of installation shall be examined for compliance with manufacturer's requirements for glass installation and joint sealant application with Glazing Contractor Installer present.
- 3.1.2 Dimensions shall be verified prior to manufacture or cutting of glass, and again before installation.
- 3.1.3 Do not perform glazing operations when temperature is less than 5 degrees Celsius.
- 3.1.4 Start of the Work indicates the Glazing Contractor's acceptance of conditions.

3.2 PREPARATION

- 3.2.1 Protective coatings shall be removed and contact surfaces cleaned with solvent and wiped dry.
- 3.2.2 Primer shall be applied to contact surfaces in accordance with manufacturer's recommendations.
- 3.2.3 Cleaning agent used before sealant application to glass and metal surfaces shall be as recommended by glass manufacturer.

3.3 INSTALLATION

- 3.3.1 Perform glazing in accordance with reviewed Shop Drawings, manufacturer's written specifications and Code requirements. Perimeter clearance shall be sufficient to avoid point loading and provide for sufficient clearance of glass to metal.
- 3.3.2 Install glass so that widths of less than 300 mm do not occur unless approved by the Architect.
- 3.3.3 Perform glazing only temperature is above 5 degrees C or more. Where anti-graffiti film is used outdoor installations must be done when the temperature is expected to remain above freezing for at least 15 days. Indoor installations should be done when the inside surface of the glass is also above freezing which is typical with most double pane windows.
- 3.3.4 Install glass in frames without bending or twisting, with planes true and parallel to frame faces, with thickness or bedding even and regular all around.
- 3.3.5 Place setting blocks at one quarter (1/4) points along glazing channel or as specified by the manufacturer.
- 3.3.6 Cut glazing tape to length and install against permanent stop, 1/32" sightline.
- 3.3.7 Remove paper backing from tape.

- 3.3.8 Place glazing tape on free perimeter of glass in manner described above.
- 3.3.9 Install glass resting on setting blocks, pressed against tape with sufficient pressure to ensure full contact and adhesion with perimeter.
- 3.3.10 Install removable stops avoiding displacement of tape and exert pressure for full continuous contact.
- 3.3.11 Neatly trim off excess tape to sightline.

3.4 PROTECTION MARKINGS

- 3.4.1 After installation, smear glass with whiting or other suitable marking to indicate that openings have been closed in.
- 3.4.2 Material for protection markings on glass, such as adhesives for the manufacturer's labels, shall be either neutral or slightly acidic. In no case shall such materials be alkaline. Staining of glass or other surfaces by alkaline materials will be cause for rejection.

3.5 LABELS

- 3.5.1 Remove manufacturer's labels or grade marks on glass except as required by code for safety glass identification.

3.6 ADJUST AND CLEAN

- 3.6.1 At completion of glazing of each unit, remove surplus compounds from adjacent surfaces and glazing sections.
- 3.6.2 Immediately clean off smears and other marks caused by own forces during erection of glass and glazing.
- 3.6.3 Upon completion of work, remove protective coverings and paper labels from exposed surfaces, and make surfaces free of smears, marks and discolouration.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

PART 1 General

1.1. SUMMARY

- 1.1.1. Furnish and install louvers, bird screens, blank-off panels, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.
- 1.1.2. The louvers to be furnished include the following:
 - 1.1.2.1. Type 1: fixed extruded storm resistant louvers to be located around upper portion of elevator shaft
 - 1.1.2.2. Type 2: Ventilation louvers with blades not exceeding 50mm in depth to be located above elevator doors

1.2. REFERENCES

- 1.2.1. Air Movement and Control Association International, Inc.
 - 1.2.1.1. AMCA Standard 500-L-99 Laboratory Methods of Testing Louvers for Rating
 - 1.2.1.2. AMCA Publication 501 Application Manual for Louvers
- 1.2.2. The Aluminum Association Incorporated
 - 1.2.2.1. Aluminum Standards and Data
 - 1.2.2.2. Specifications and Guidelines for Aluminum Structures
- 1.2.3. American Society of Civil Engineers
 - 1.2.3.1. Minimum Design Loads for Buildings and Other Structures
- 1.2.4. American Society for Testing and Materials
 - 1.2.4.1. ASTM B209
 - 1.2.4.2. ASTM B211
 - 1.2.4.3. ASTM B221
 - 1.2.4.4. ASTM E90-90

1.2.5. Architectural Aluminum Manufacturers Association

1.2.5.1. AAMA 800 Voluntary Specifications and Test Methods for Sealants

1.2.5.2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.

1.2.5.3. AAMA TIR Metal Curtain Wall Fasteners

1.2.5.4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels

1.2.6. Canadian Standards Association

1.2.6.1. CAN3-S157-M83 Strength Design in Aluminum

1.2.6.2. S136 94 Cold Formed Steel Structural Members

1.3. SUBMITTALS

1.3.1. Product Data

1.3.1.1. Air flow and water entrainment performance test results.

1.3.1.2. Material types and thickness.

1.3.2. Shop Drawings

1.3.2.1. Include elevations, sections and specific details for each louver.

1.3.2.2. Show anchorage details and connections for all component parts.

1.3.2.3. Include signed and sealed structural calculations.

1.3.3. Samples

1.3.3.1. Submit color chips for approval.

1.4. QUALITY ASSURANCE

1.4.1. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years experience in the design and manufacturing of work similar to that shown and required.

- 1.4.2. Performance Requirements: Provide AMCA and BSRIA test data as required to confirm that the louvers have the specified air and water performance characteristics.
- 1.4.3. Acoustical Performance: Where applicable, submit test reports to confirm that the louvers meet the specified STC and Noise Reduction requirements.
- 1.4.4. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be 1/180 or 0.75 inch, whichever is less. Maximum allowable deflection for the louver blades to be 1/120 or 0.50 inch across the weak axis, whichever is less.
- 1.4.5. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the state of New Jersey (or Mississauga, Ontario).
- 1.4.6. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

1.5. DELIVERY, STORAGE AND HANDLING

- 1.5.1. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.
- 1.5.2. Storage:
 - 1.5.2.1. Material may be stored flat, on end or on its side.
 - 1.5.2.2. Material may be stored either indoors or outdoors.
 - 1.5.2.3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
 - 1.5.2.4. If stored outdoors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.
- 1.5.3. Handling:
 - 1.5.3.1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.

1.5.3.2. Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position.

1.5.3.3. Louver sections should only be lifted and carried by the jambs. Heads, sills and blades are not to be used for lifting or hoisting louver sections.

1.6. MEASUREMENT PROCEDURES

1.6.1. No measurement will be made under this Section. Include Louvers and Vents costs in applicable lump sum prices of members to which they are applied.

PART 2 Products

2.1. MANUFACTURERS

2.1.1. The louvers and related materials herein specified and indicated on the drawings shall be as manufactured by:

2.1.1.1. Construction Specialties LTD.

2.1.1.2. Or approved equivalent

2.2. MATERIALS

2.2.1. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.

2.2.2. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

2.3. FABRICATION, GENERAL

2.3.1. Provide louver models, bird screens, blank-off panels, structural supports and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.

2.3.2. Louvers to be mechanically assembled using stainless steel or aluminum fasteners.

2.3.3. Include supports, anchorage, and accessories required for complete assembly.

2.4. LOUVER MODELS

A. C/S 4” (101.6mm) Deep Storm Resistant Fixed Horizontal Louver Model RS-4300

1. **Material:** Heads, sills, jambs and mullions to be one-piece structural aluminum members with integral caulking slot and retaining beads. Mullions shall be sliding interlock with integral drains. Blades to be one-piece aluminum extrusions with front lip gutter and multiple secondary gutters designed to catch and direct water to jamb and mullion downspouts. Louvers to be supplied with 4” (101.6mm) high by full depth sill flashings formed from minimum 0.050” (1.27mm) thick aluminum. Sill flashings to have welded side panels. Louvers and sill flashings to be installed in accordance with the manufacturer’s recommended procedures to ensure complete water integrity performance of the louver system. Material thickness to be as follows: Heads, sills, jambs and mullions: 0.081” (2.06mm). Fixed blades: 0.060” (1.52mm).
2. **AMCA Performance:** A 4’ x 4’ unit shall conform to the following:

Free Area	7.51 sq. ft. (0.70 sq. m.)
Intake Pressure drop at 900 fpm free area velocity (274 m/min)	0.226 in. H ₂ O (5.74 mm)

3. **Wind Driven Rain Performance:** The louver test was based on a 39.370”(1.00m) x 39.370” (1.00 m) core area. Unit tested at a rainfall rate of 3.0 inches per hour (75 mm/hr) and with a wind directed to the face of the louver at a velocity 29.1-mph (13 m/s). The test data shall show the water penetration effectiveness rating at each corresponding ventilation rate.

Core Ventilation Rate (m/s):	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
Core Ventilation Rate (ft/min):	0	98	197	295	394	492	591	689
Free Area Ventilation Rate (ft/min):	0	188	379	567	757	946	1135	1324
Rating effectiveness:	A	A	B	B	C	C	D	D
Effectiveness Rating:	A = 1 to 0.99		B = 0.989 to 0.95		C = 0.949 to 0.80		D = 0.80 to 0	

B. C/S 1 3/8” (34.9mm) Deep Fixed Thinline A Frame Louver Model 1242

1. **Material:** Frames and blades to be extruded aluminum sections. All frames to be neatly mitered at corners and reinforced with corner brackets. Material thickness to be as follows: Heads, sills jambs and mullions: 0.052” (1.32mm). Blades: 0.064” (1.63mm).
2. **AMCA Performance:** A 4’ x 4’ unit shall conform to the following:

Free Area 7.38 sq. ft. (0.69 sq. m.)
Intake Pressure drop at 700 fpm (213 m/min) free area velocity 0.044 in. H₂O
(1.12mm)
Exhaust pressure drop at 1000 fpm free area velocity (305 m/min) 0.085 in. H₂O
(2.16mm)

2.5. FINISHES

2.5.1. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.

2.5.2. Powder Coating

2.5.2.1. All louvers shall be finished with C/S Powder Coat, a coating to be 1.5 to 3 mil. thick full strength 100% resin Fluoropolymer coating. Finish to allow zero VOCs to be emitted into facility of application. Finish to adhere to a 4H Hardness rating.

2.5.2.2. All finishing procedures shall be one continuous operation in the plant of the manufacturer. The coating shall meet or exceed all requirements of AAMA specification 2605 "Voluntary Specification for High Performance Organic Coatings on Architectural extrusions and Panels."

2.5.2.3. The louver manufacturer shall supply an industry standard 20-year limited warranty against failure or excessive fading of the Fluoropolymer Powder Coat finish. This limited warranty shall begin on the date of material shipment.

2.5.2.4. Colour to be chosen by architect

2.6. BIRD AND INSECT SCREENS

2.6.1. Unless otherwise indicated, all louvers to be furnished with mill finish insect screens.

2.6.2. Screens to be 18 x 16 aluminum mesh 0.011" (0.279mm) diameter wire insect screens secured within 0.055" (1.40mm) thick extruded aluminum frames. Frames to have mitered corners and corner locks.

2.7. BLANK OFFS

- 2.7.1. Furnish where indicated on the drawings blank-off panels fabricated by the louver manufacturer.
- 2.7.2. Blank-off panels to be 1" (25.4mm) thick and to be faced on both sides with 0.032" (0.81 mm) thick aluminum sheet. Panels to be fabricated with an expanded polystyrene (EPS) core having an R-value of 4 (0F*ft²*h/Btu). Panel perimeter frame to be 0.050" (1.27mm) thick-formed aluminum channels. Panel frame to be mitered at the corners. Panels to be finished to match louvers.
- 2.7.3. Blank-off panels to be 2" (50.8mm) thick and to be faced on both sides with 0.032" (0.81 mm) thick aluminum sheet. Panels to be fabricated with an expanded polystyrene (EPS) core having an R-value of 8 (0F*ft²*h/Btu). Panel perimeter frame to be 0.050" (1.27mm) thick-formed aluminum channels. Panel frame to be mitered at the corners. Panels to be finished to match louvers.

PART 3 Execution

3.1. EXAMINATION

- 3.1.1. Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

3.2. INSTALLATION

- 3.2.1. Comply with manufacturer's instructions and recommendations for installation of the work.
- 3.2.2. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.
- 3.2.3. Anchor louvers to the building substructure as indicated on architectural drawings.
- 3.2.4. Erection Tolerances:
 - 3.2.4.1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
 - 3.2.4.2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.

- 3.2.5. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- 3.2.6. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- 3.2.7. Set units level, plumb and true to line, with uniform joints.

3.3. PROTECTION

- 3.3.1. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.4. ADJUSTING AND CLEANING

- 3.4.1. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.
- 3.4.2. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.
- 3.4.3. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Consultant, remove damaged materials and replace with new materials.
 - 3.4.3.1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

End of Section

1 General

1.1 WORK INCLUDED

- .1 Degreasing surfaces.
- .2 Surface profiling.
- .3 Washing and rinsing.

1.2 REFERENCES

- .1 Publications
 - .1 American Galvanizers Association (AGA)
 - .1 Inspection of Products Hot-Dip Galvanized After Fabrication
 - .2 Duplex Systems: Painting Over Hot-Dip Galvanized Steel
 - .2 Elsevier, van Eijnsbergen, J.F.H., New York, 1994:
 - .1 Duplex Systems - Hot-Dip Galvanizing Plus Painting
 - .2 Wet Storage Stain
- .2 American Society for Testing and Materials (ASTM):
 - .1 A 123 /123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 A 153/A 153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - .3 A 780 Repair of Damaged Hot-Dip Galvanized Coatings
 - .4 B 201 Testing Chromate Coatings on Zinc and Cadmium Surfaces
 - .5 D 6386 Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
 - .6 E 376 Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods
- .3 U.S. Federal Specifications
 - .1 DOD-P-21035, Paint, High Zinc Dust Content, Galvanizing Repair
 - .2 MIL-P-26915, Primer Coating, Zinc Dust Pigmented
- .4 The Society for Protective Coatings (SSPC)
 - .1 Surface Preparation Specification No. 1 Solvent Cleaning
 - .2 Surface Preparation Specification No. 2 Hand Tool Cleaning
 - .3 Surface Preparation Specification No. 3 Power Tool Cleaning
 - .4 Surface Preparation Specification No. 7 Brush-Off Blast Cleaning

1.3 QUALITY ASSURANCE

- .1 Coating Applicator: Company specializing in painting or Hot-Dip galvanizing after fabrication.

1.4 SUBMITTALS

- .1 Submit one original and two copies of the coating applicator's notarized Certificate of Compliance that the prepared hot-dip galvanized coating surface meets or exceeds the requirements for successful painting of the surface.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Store and protect products under the provisions of Section 05 12 23S.
- .2 Load and store galvanized articles in accordance with accepted industry standards.

1.6 PAYMENT

- .1 No separate payment will be made under this section. Costs associated with preparation of hot-dipped galvanized surfaces for painting shall be included in the Lump Sum bid price for supply and install of associated structural steel.

2 Products

2.1 ACCEPTABLE SURFACE PREPARERS

- .1 Members of the American Galvanizers Association or equal, such as painting contractors, approved by the architect and/or engineer. A list of American Galvanizers Association members is available upon request.

2.2 HOT-DIP GALVANIZED MATERIALS

- .1 Material for surface preparation to be suitable for painting is required to be Hot-Dip galvanized as described in ASTM A 123/A 123M and A 153/A 153M. Hot-Dip galvanized articles and fabrications may be newly galvanized, partially weathered or completely weathered.

2.3 HOT-DIP GALVANIZING REQUIREMENTS

- .1 Hot-Dip galvanizing practices shall be in accordance with the applicable portions of ASTM A 123/123M or A 153/A 153M.
- .2 Water quenching or chromate conversion coating should be avoided as these processes interfere with paint adhesion and surface preparation.

3 Execution

3.1 SURFACE SMOOTHING

- .1 The following process should only be used if high spots of zinc are visible on the parts to be painted.
 - .1 Zinc high spots, such as a metal drip line, should be removed by cleaning with hand or power tools as described in SSPC Surface Preparation Specification 2 or 3. The zinc should be removed until it is level with the surrounding area, taking care that the base coating is not removed by the cleaning methods.
 - .2 After cleaning, the surface shall be inspected for conformance to the required zinc thickness in accordance with ASTM A 123/A 123M or A 153/A 153M

utilizing a magnetic-field-type thickness instrument in accordance with ASTM E 376. Any item falling below the required zinc thickness, before or after removal of any high spots, shall be repaired in accordance with ASTM A 780.

3.2 AQUEOUS ALKALINE CLEANING

- .1 This surface cleaning is required for all galvanized steel parts, except for those that have been galvanized less than 24 hours.
 - .1 An alkaline solution, pH in the range of 11 to 12 but not greater than 13, can be used to remove traces of oil, grease or dirt.
 - .2 This solution can be applied through immersion in a tank filled with the solution, sprayed on, or brushed on with a soft bristle brush, usually nylon and not steel or copper.
 - .3 When dipping or spraying, the solution works best in the temperature range from 60 to 85 C (140 to 185F).
 - .4 After cleaning, rinse thoroughly in hot water or water under pressure. Allow to dry completely before proceeding.

3.3 SOLVENT CLEANING

- .1 This is an alternative to Section 3.2.
 - .1 Typical cleaning solvents, such as mineral spirits or high-flash naphtha, can be used to remove oil and grease. The procedure to be used is as specified in SSPC Surface Preparation Specification 1.
- .2 Proper rags or brushes should be used to wipe the galvanized parts. Small parts may be dipped or cleaned in ultrasonic baths of solvents.
- .3 After cleaning, rinse thoroughly in hot water or water under pressure. Allow to dry completely before proceeding.

3.4 HAND- OR POWER-TOOL CLEANING

- .1 The following process should be used only if there is visible evidence of wet storage stain on the galvanized surface.
 - .1 Hand- or power-tool cleaning may be used to clean light deposits of zinc reaction by-products, such as wet storage stain, as specified in SSPC Surface Preparation Specification 2 or 3.

3.5 SWEEP BLASTING

- .1 This process is required for all galvanized parts, except those that have been exposed to the environment for more than one year.
 - .1 Abrasive sweep or brush blasting which uses a rapid nozzle movement will roughen the galvanized surface profile. The abrasive material must be chosen with care to provide a stripping action without removing excess zinc layers. Follow the procedures detailed in ASTM D 6386 for abrasive sweep blasting.

.2 Following abrasive blast cleaning, surfaces should be blown down with clean, compressed air.

3.6 ZINC PHOSPHATE TREATMENT

.1 This is an alternate process for Section 3.5.

.1 This conversion-coating process consists of treating the newly galvanized zinc surface with an acidic zinc phosphate solution containing oxidizing agents and other salts for accelerating the conversion action. Follow the procedures detailed in ASTM D 6386 for zinc phosphate treatment.

.2 After 3 to 6 minutes, the surface should be washed with clean water and allowed to completely dry before application of the paint system.

3.7 WASH PRIMER TREATMENT

.1 This is an alternate process for Section 3.5.

.1 This process involves the use of a metal conditioner to neutralize surface oxides and hydroxides and to etch the surface. Follow the procedures detailed in ASTM D 6386 for wash primer treatment.

.2 For drying time prior to top coating, follow the manufacturer's instructions. This wash-primer treatment may be better suited to certain types of paint systems.

3.8 ACRYLIC PASSIVATION/PRETREATMENT

.1 This is an alternate process for Section 3.5.

.1 The passivation/pretreatment process consists of applying an acidic acrylic solution to the newly galvanized surface and then allowing it to dry, forming a thin film coating. Follow the procedures detailed in ASTM D 6386 for acrylic passivation/pretreatment.

.2 Painting is possible any time during a period of four months after application as long as the surface is free of visible zinc oxides or zinc hydroxides.

3.9 REPAIR OF DAMAGED COATING

.1 The following process should be used only if there is visible damage to the zinc coating.

.1 The maximum area to be repaired is defined in accordance with ASTM A 123/A 123M Section 6.2, current edition.

.2 The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.

.1 Repair areas damaged by welding, flame cutting or during handling, transport or erection, by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 4.8 mm (3/16") in width. Minimum thickness requirements for the repair are those described in ASTM A 123/A 123 M Section 6.2 current edition.

END OF SECTION

1 General

1.1 SCOPE

- .1 Coat structural steel as indicated on the drawings. Coating shall be carried out in accordance with the BC Ministry of Transportation 2012 Standard Specifications for Highway Construction, Section 216 – Coating of Steelwork, Section 308 – Coating Systems, and the Coating Systems identified in the Ministry of Transportation and Infrastructure Recognized Products List, latest edition.
- .2 Inspection quality control, hold-points, inspection access and thickness measurements shall be in accordance with BC Ministry of Transportation 2012 Standard Specifications for Highway Construction, Section 216 – Coating of Steelwork.
- .3 The specification is available on line at:
http://www.th.gov.bc.ca/publications/const_maint/contract_serv/standardspecs.htm
- .4 Reference to “the Ministry” shall be replaced by “the Consultant”.

1.2 PAYMENT

- .1 Any payment clauses within the BC Ministry of Transportation 2012 Standard Specifications for Highway Construction will not apply to this project.
- .2 No separate payment will be made for coating of structural steel. Costs associated with coating of structural steelwork shall be included in the Lump Sum bid price for Supply and Install Structural Steel. Include costs for all required items in the applicable lump sum.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

PART 1 - GENERAL

1.1 CONTENTS

1.1.1 This Section specifies the requirements for the design, supply, installation and maintenance of Machine Room-Less (MRL) traction passenger electric elevators. This gearless, energy efficient design utilizes a permanent magnet motor which is cab roof mounted and replaces the traditional hydraulic elevator. Elevator work includes:

1.1.1.1 Machine- room-less electric traction passenger elevator.

1.1.1.2 Elevator car enclosures, hoistway entrances and signal equipment.

1.1.1.3 Accessibility provisions for physically disabled persons.

1.1.1.4 Equipment, machines, controls, systems and devices as required for safety operating the specified elevators and their rated speed and capacity.

1.1.1.5 Materials and accessories as required to completing elevator installation.

1.1.2 Work Required:

1.1.2.1 The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.

1.1.2.2 All work shall be performed in a first class, safe and workmanlike manner.

1.1.2.3 In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation

1.1.3 Related work not specified herein: The following sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer.

1.1.3.1 Electrical power for elevator installation and testing.

1.1.3.2 Disconnecting device to elevator equipment prior to activation of sprinkler system.

1.1.3.3 The installation of dedicated GFCI receptacles in the pit and overhead (with Machine room-less).

1.1.3.4 Lighting in controller area, machine area and pit.

1.1.3.5 Wiring for telephone service to controller.

1.2 APPLICABLE CODES

1.2.1 Comply with applicable building and elevator codes at the project site, including but not limited to the following:

- 1.2.1.1 ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
- 1.2.1.2 ANSI/NFPA 70, National Electrical Code.
- 1.2.1.3 ANSI/NFPA 80, Fire Doors and Windows.
- 1.2.1.4 ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
- 1.2.1.5 ANSI/UL 10B, Fire Tests of Door Assemblies.
- 1.2.1.6 CAN/CSA C22.1, Canadian Electrical Code.
- 1.2.1.7 CAN/CSA-B44, Safety Code for Elevators and Escalators.
- 1.2.1.8 EN 12016 (May 1998): “EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity”
- 1.2.1.9 British Columbia Building Code 2012
- 1.2.1.10 All other local applicable codes.

1.3 SYSTEM DESCRIPTION

- 1.3.1 Equipment Description: gearless traction elevator with Machine-Roomless application.
- 1.3.2 All elevators shall have automatic operation with the elevator cab of a configuration and adequate clear inside finish dimensions to be accessible to handicapped and general public as well as to accommodate a patient stretcher in the prone position.
- 1.3.3 Elevator shall be available for access by firemen
- 1.3.4 Drive: Regenerative
- 1.3.5 Travel (maximum): as indicated
- 1.3.6 Landings served: as indicated
- 1.3.7 Rated Capacity: 2500 lb.
- 1.3.8 Rated Speed: 200 fpm.

- 1.3.9 Minimum car dimensions: as indicated
- 1.3.10 Entrance Height: 7' 0" (2134 mm)
- 1.3.11 Main Power Supply: 600 volts, three-phase, 60 hertz
- 1.3.12 Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
- 1.3.13 Machine Location: Inside the hoistway at the top of the hoistway.
- 1.3.14 Signals: car and hall registration lights, alarm, car lantern and car position indicator for all elevators.
- 1.3.15 Controller Location: Machine-RoomLess Controller(s) shall be located at the front opening of the top terminal landing in entrance frame or remote closet close to the elevator shaft as indicated.
- 1.3.16 Performance:
 - 1.3.16.1 Car Speed: + 3 % of contract speed under any loading condition or direction of travel.
 - 1.3.16.2 Car Capacity: Safely lower, stop and hold up to 120% of rated load. (code required).
- 1.3.17 Ride Quality:
 - 1.3.17.1 Vertical Vibration (maximum): 12 milli-g
 - 1.3.17.2 Horizontal Vibration (maximum): 12 milli-g
 - 1.3.17.3 Vertical Jerk (maximum): 4.59 ± 1.0 ft./ sec³ (1.4 ± 0.3 m/ sec³)
 - 1.3.17.4 Acceleration/Deceleration (maximum): 1.64 ft./ sec² (0.5 m/ sec²)
 - 1.3.17.5 In Car Noise: 55 – 60 dB(A)
 - 1.3.17.6 Stopping Accuracy: ± 0.5 in. (± 12 mm) max, ± 0.25 in. (± 6 mm) Typical
 - 1.3.17.7 Re-leveling Distance: ± 0.5 in. (± 12 mm)
- 1.3.18 Operation:

Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

1.3.19 Additional features

- 1.3.19.1 sound isolation features,
- 1.3.19.2 emergency car lighting,
- 1.3.19.3 telephone cabinet with telephone handset
- 1.3.19.4 car fan,
- 1.3.19.5 car exit hatch

1.3.20 Door Control Features:

- 1.3.20.1 Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
- 1.3.20.2 Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
- 1.3.20.3 Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening. Under normal operation and for any door position, the system shall detect as a blockage an opaque object that is equal to or greater than 1.3 inches (33 mm) in diameter when inserted between the car doors at vertical positions from within 1 inch (25 mm) above the sill to 71 inches (1800 mm) above the sill. Under degraded conditions (one or more blocked or failed beams), the primary protection shall detect opaque objects that are equal to or greater than 4" (100 mm) in diameter for the same vertical coverage. If the system performance is degraded to the point that the 4" object cannot be detected, the system shall maintain the doors open or permit closing only under nudging force conditions.
- 1.3.20.4 Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

1.4 SUBMITTALS

- 1.4.1 Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
 - 1.4.1.1 Signal and operating fixtures, operating panels and indicators.

- 1.4.1.2 Cab design, dimensions and layout.
- 1.4.1.3 Hoistway-door and frame details.
- 1.4.1.4 Electrical characteristics and connection requirements.
- 1.4.1.5 Expected heat dissipation of elevator equipment in control room space and machine space (BTU).
- 1.4.1.6 Color selection chart for Cab and Entrances.
- 1.4.2 Shop Drawings: Submit approval layout drawings. Include the following:
 - 1.4.2.1 Car, guide rails, buffers and other components in hoistway.
 - 1.4.2.2 Maximum rail bracket spacing.
 - 1.4.2.3 Maximum loads imposed on guide rails requiring load transfer to building structure.
 - 1.4.2.4 Clearances and travel of car.
 - 1.4.2.5 Clear inside hoistway and pit dimensions.
 - 1.4.2.6 Location and sizes of access doors, hoistway entrances and frames.
- 1.4.3 Operations and maintenance data in accordance with this Section:
 - 1.4.3.1 Manufacturer's standard operations and maintenance manual, including description of elevator system's method of operations and control, including special or non-standard features provided.
 - 1.4.3.2 parts catalogues giving complete list of repair and replacement parts with identifying numbers; and
 - 1.4.3.3 legible schematic wiring diagrams covering electrical equipment as supplied and installed, including changes made in final work, with symbols listed corresponding to identity markings on both elevator control closet/room and elevator equipment.

1.5 QUALITY ASSURANCE

- 1.5.1 Manufacturer: Elevator manufacturer shall be ISO 9001 certified
- 1.5.2 Installer: Elevators shall be installed by the manufacturer

- 1.5.3 Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.6 DELIVERY, STORAGE AND HANDLING

- 1.6.1 Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the Contractor will be responsible to provide a proper and suitable storage area on or off the premises.

Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.7 WARRANTY

- 1.7.1 Correct defective material or workmanship that develops within one year form date of final acceptance of work at no additional cost, unless due to ordinary wear, or improper use or care.
- 1.7.2 Defective is defined to include, but not to be limited to: operation or control system failures, performance below required minimum, excessive wear, unusual deterioration or aging of materials and finishes, unsafe conditions, the need of excessive maintenance, abnormal noise or vibration, and similar unsatisfactory conditions.
- 1.7.3 Make modifications, adjustments, and improvements to meet performance requirements in Part 2 and 3.
- 1.7.4 The elevator control system must:
- 1) Provide in the controller the necessary devices to run the elevator in inspection operation.
 - 2) Provide on top of the car the necessary devices to run the elevator in inspection operation.
 - 3) Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
 - 4) Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
 - 5) Provide the means from the controller to reset the governor over speed switch and also trip the governor.
 - 6) Provide the means from the controller to reset the emergency brake when set because of an

unintended car movement or ascending car over speed.

7) Provide the means from the controller to reset elevator earthquake operation.

1.8 TEMPORARY CONDITIONS

- 1.8.1 Provide all necessary protection to prevent damage to elevator used for construction purposes before Substantial Completion.
- 1.8.2 Provide temporary enclosures, coverings, guards, barriers and other devices required to protect the elevator car enclosures, hoistway entrances, signal fixtures and related materials, components and finishes from damage.
- 1.8.3 Elevators shall be free of damage or deterioration at time of Substantial Completion
- 1.8.4 The Contractor shall be responsible for providing temporary power and other utilities and all temporary hoisting equipment required for the installation of elevators.

1.9 PERMITS AND INSPECTIONS

- 1.9.1 The Contractor shall obtain and pay for necessary municipal and provincial inspection and permits, fees and licenses for the elevator in conformance with the General Requirements and make such tests as are called for by their regulations. The tests shall be made in the presence of the authorized representatives of such authorities

1.10 MEASUREMENT AND PAYMENT

- 1.10.1 Payment for Machine Room-Less (MRL) Traction Passenger Electric Elevator shall be made at the Lump Sum Price bid. The Lump Sum Price shall include all submittals, quality control, and complete assembly materials and work required under this section, Section 26 00 10 and other related sections.

2.1 DESIGN AND SPECIFICATIONS

- 2.1.1 Provide machine-roomless traction passenger elevators from approved manufacturer including control system. Specifically, the system shall consist of the following components:
- 2.1.2 An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
- 2.1.3 Polyurethane Coated-Steel Belts (CSB's) for elevator hoisting purposes.
- 2.1.4 Approved Installer: Otis Elevator or approved equivalent

2.2 EQUIPMENT: CONTROLLER COMPONENTS

- 2.2.1 Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
- 2.2.2 All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.
- 2.2.3 Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
- 2.2.4 Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
- 2.2.5 Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): “EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity”
- 2.2.6 Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

2.3 EQUIPMENT: MACHINE AND GOVERNOR

- 2.3.1 Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.
- 2.3.2 Governor: The governor shall be a tension type car-mounted governor.
- 2.3.3 Buffers, Car and Counterweight: Polyurethane type buffers shall be used.
- 2.3.4 Hoistway Operating Devices:
 - 2.3.4.1 Emergency stop switch in the pit
 - 2.3.4.2 Terminal stopping switches.
- 2.3.5 Positioning System: Consists of an encoder, reader box, and door zone vanes.
- 2.3.6 Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.
- 2.3.7 Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords.

- 2.3.8 Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.
- 2.3.9 Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.
- 2.3.10 Hoistway Entrances:
- 2.3.10.1 Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
 - 2.3.10.2 Sills shall be extruded aluminum.
 - 2.3.10.3 Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
 - 2.3.10.4 Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour (for M1, M2, M3, D1, and D2 Entrance Arrangements or 1 hour for D3 Entrance Arrangement).
 - 2.3.10.5 Entrance marking plates: Entrance jambs shall be marked with 4" x 4" (102 mm x 102 mm) plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
 - 2.3.10.6 Sight Guards: Sight guards shall be furnished with all doors and are to be of the same finish as the door panel

2.4 EQUIPMENT: CAR COMPONENTS

- 2.4.1 Carframe and Safety: A carframe fabricated from formed or structural steel members conforming to CAN/CSA-B44-07 shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the carframe and shall be Type "B", flexible guide clamp type.
- 2.4.2 The car shell walls shall be furniture steel core with stainless steel finish. Where walls contain doors, the wall return panels shall be formed stainless steel, No. 4 Finish. The car ceiling shall be furniture steel, finished to semi-gloss enamel. The car ceiling shall be furniture steel, finished to semi-gloss enamel.
- 2.4.3 Stainless steel handrails that conform to Handicap code requirements shall be provided on side and rear walls that do not contain doors.
- 2.4.4 The car entrance shall be provided with single or two speed slide door of stainless steel #4 and. The car entrance soffit, jamb and transom shall be formed stainless steel to match adjacent wall finish.

- 2.4.5 Lighting shall consist of overhead warm white fluorescent fixtures that provide a maintained illumination level of 100 lux minimum at car floor level. Provide with LED fixtures if available.
- 2.4.6 Emergency exit in car canopy shall be in accordance with code.
- 2.4.7 Fan: A one-speed 120 VAC fan will be mounted to the structural ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan
- 2.4.8 Floor shall be BASF SRS Degadur flooring system, chamfered corners, Degadur 332 flexible resin base coat, fine flake (paint chip), 3 to 4 layers of clear top coat, granite texture.
- 2.4.9 Interior finishes of elevator cab enclosures shall conform to the Flame Spread Ratings and Smoke Developed Classifications of current British Columbia Building Code (BCBC). Colour of plastic laminate shall be as selected by Owner from full colour range available.
- 2.4.10 Recessed enclosures for operating and control functions and emergency telephone cabinet shall be airtight to the car exterior.
- 2.4.11 Cab ceiling shall be perforated 1.5 mm stainless steel No.4 finish, secured with vandal proof stainless steel fastening.
- 2.4.12 Car door panels: minimum 16 gauge stainless steel.
- 2.4.13 Threshold: Extruded Aluminum
- 2.4.14 Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
- 2.4.15 Guides: The car shall have 3” dia. roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom.
- 2.4.16 Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.

2.5 CAR OPERATING PANEL

- 2.5.1 The flush mounted operating station shall be furnished in the car containing push-buttons marked to correspond with the landings served, car stop key switch, emergency alarm button, door open button (door open and door close buttons will be accepted) and a key operated light/fan switch. The emergency call button shall be connected to an alarm bell.
- 2.5.2 If the dimensions of the cab are not large enough to allow a person in a wheelchair or scooter to turn their wheelchair or scooter around to reach the interior operating panel, then a second operating panel is required on the other side of the cab.

- 2.5.3 The operating and emergency control function markings on the flush buttons of the operating panel shall be marked with raised and tactile letters or symbols on the buttons to meet the requirements of the blind and visually impaired.
- 2.5.4 To the right of the control function button shall be located an engraved and coloured floor identification legend, maximum of eight letters, as determined by the Owner.
- 2.5.5 Car operating panel shall be mounted to allow for use by handicapped persons in accordance with the BCBC.
- 2.5.6 Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.

2.6 EMERGENCY CAR LIGHTING

- 2.6.1 Emergency car lighting shall be provided by a battery operated emergency lighting unit that is constructed in accordance with CSA C22.2 No. 141, "Unit Equipment for Emergency Lighting". Emergency lighting unit to be CSA approved and bear CSA label. Period of operation shall be 60 minutes minimum.

2.7 TELEPHONE COMPARTMENT

- 2.7.1 A telephone compartment, 350mm high x 200mm wide x 200mm deep (internally) shall be provided in the car operating panel, with a hinged, stainless steel door. Necessary wiring shall be included in the car travelling cable terminating in the controller in the elevator control closet/room.

2.8 HALL STATIONS

- 2.8.1 A singled flush mounted call button shall be furnished at each terminal and directional arrow buttons of manufacturer's standard design at all intermediate landings. Buttons shall be provided with an extra set of normally open contacts to be used to signal control centre when elevator is shut down on restricted access mode.
- 2.8.2 Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound in accordance with requirements for handicap accessibility
- 2.8.3 A keyed switch for elevator maintenance shall be provided to control power source for "in service" function.
- 2.8.4 A keyed switch for elevators shall be provided for fireman access located at the grade or street level landing station. Firemen's access keys shall have priority over other keyed switches.

- 2.8.5 A keyed switch shall be provided for hoist way access when the elevator is shut down on restricted access mode.
- 2.8.6 Hall call box: space above the box to be used for a speaker, and below the box for a microphone requiring 100 x 73 and 50 x 73mm respectively.
- 2.8.7 Exposed cover plate to accommodate switches, buttons and accessories shall be of brushed stainless steel and incorporate a graphic sign reading IN CASE OF FIRE USE STAIRS, etched in red. This plate shall be extended top and bottom to cover area of speaker and microphone, and provided with two studs each for the speaker and microphone.
- 2.8.8 A speaker and microphone shall be supplied and mounted to the back of the faceplate. See also Clause 2.17.8 of the Section.
- 2.8.9 The faceplate shall be drilled by the Contractor with 2mm diameter holes at 9mm on centre horizontally and diagonally. The speaker area shall contain perforations within a 50mm diameter area, and the microphone 20mm diameter area on the centreline of these devices.
- 2.8.10 The Contractor shall provide two pairs of 22 gauge audio shielded wires from each hall call panel location to a cross connect field in the elevator machine room. The other end of these wires shall be connected to the speaker and microphone.
- 2.8.11 The Contractor shall provide access to momentary dry relay contacts which are activated when the hall call button is pressed under restricted access control.

2.9 TERMINAL LIMIT SWITCHES

- 2.9.1 Terminal limit switches shall be provided in the hoist way designed to automatically stop the car at the terminal landings.

2.10 ILLUMINATED HALL BUTTONS

- 2.10.1 Call registration lights shall be provided in each hall push button unit. When a button is pressed it shall illuminate, signaling that the call has been registered. Each button shall remain illuminated until the call has been answered.

2.11 ILLUMINATED CAR BUTTONS

- 2.11.1 Call registration lights shall be provided in each car button. When a button is pressed it shall illuminate, signaling that the call has been registered. Each button shall remain illuminated until the call has been answered.

2.12 HOIST WAY ENTRANCES

- 2.12.1 A hoist way entrance shall be provided for each landing served, both front and rear where applicable. Entrances shall consist of flush metal doors, built-in hanger assembly, frames

assembled for unit installation, extruded aluminium sill, fascia, toe guard, hanger cover, header, hanger track assembly and structural supports. Fascia plates shall be furnished and mounted both front and rear of each hoist way, where applicable. The hoistway elevator shaft doors shall be stainless steel doors to match the same dimensions, materials and design as the elevator cab doors.

2.12.2 Hoistway entrance frames shall be stainless steel.

2.12.3 Hoistway doors shall be flush type stainless steel.

2.12.4 Sills, struts, headers, hanger covers and unit frames shall be erected prior installation of glazing and set in proper relation to the car guide rails. Door panels shall be installed after the glazing is finished.

2.13 PIT EMERGENCY STOP SWITCH

2.13.1 An emergency stop switch shall be provided in the elevator pit, designed to cut off current supply to motor and down direction valves and bring the car to rest independently of the regular operating devices.

2.14 WORK LIGHT

2.14.1 A work light and outlet receptacle shall be provided on the car crosshead.

3.1 PREPARATION

3.1.1 Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 ELEVATOR INSTALLATION

3.2.1 Elevator shall be installed in accordance with manufacturer's directions and applicable codes using experienced workmen.

3.3 GUIDES INSTALLATION

3.3.1 The guides shall be erected plumb within 3mm and be properly located and supported so as not to become distorted by eccentric loading. They shall be suitably bottomed in the pit and extend to the underside of the overhead slab or grating.

3.4 WIRING INSTALLATION

3.4.1 All wiring necessary shall be installed and terminated to connect operating buttons, switches and signals in the hoist way and all electrical equipment on the car to the elevator control panel.

3.5 HOIST WAY ENTRANCES ERECTION

- 3.5.1 The entrance structures shall be erected prior to the completion of the hoist way walls and shall be set in proper relation to the elevator car guides. The hoist way entrance frames and door panels complete with hangers shall be erected as building progress requires.

3.6 DEMONSTRATION

- 3.6.1 The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

3.7 MAINTENANCE SERVICE

- 3.7.1 The Work 1 include full maintenance of elevator equipment starting at the completion of installation and ending three months after the equipment is first used for public revenue service. This maintenance service shall consist of systematic monthly examinations of the equipment including necessary adjustments, lubrication, cleaning, supplies and parts except repairs made necessary by abuse, misuse, or other causes beyond the control of the Contractor. All maintenance shall be done by the Contractor with employees trained by the elevator manufacturer and during regular working hours of the trade as far as possible. The Contractor shall repair or replace electrical and mechanical parts of the elevator equipment whenever this is required and use only genuine standard parts produced by the manufacturer of the equipment concerned.
- 3.7.2 The maintenance service Work shall also include the following which shall be performed immediately prior to the end of the maintenance period and in the presence of the Owner's maintenance staff:
- 3.7.3 all equipment shall be maintained in a clean and correctly adjusted state through to the completion of the maintenance period, and copies of inspection and repair records, and any forms sent to the regulatory agency having jurisdiction, shall be provided to the Owner;
- 3.7.4 a full demonstration and inspection of the equipment with the Owner's maintenance staff in attendance shall be provided at a mutually agreed time on or just prior to the completion of the maintenance period to introduce the Owner's maintenance staff to the function and purpose of all devices;
- 3.7.5 a final turnover inspection at which all maintenance records, including monthly maintenance reports, for the maintenance period, shall be made available for the Owner's files.
- 3.7.6 Evidence shall be submitted to the Owner upon request to show successful experience in the complete maintenance of elevators, that competent personnel are available to handle this service, that an adequate stock of parts is available locally for replacement or emergency

purposes and that qualified personnel are available locally to ensure the fulfilment of this service without unreasonable loss of time in reaching the elevator.

- 3.7.7 The maintenance service shall be performed solely by the Contractor and shall not be assigned or transferred to any agent of Other Contractor.
- 3.7.8 Overtime call back service for minor adjustment of equipment shall be available at all times. Reimbursement for the overtime premium portion of such a call back will be provided by the Owner.
- 3.7.9 In the case of a breakdown, the Contractor shall perform repairs with the utmost diligence and promptness. The service shall be performed at any time with no reimbursement made for overtime premium.
- 3.7.10 Maintenance documentation shall be maintained and be available for review by the Owner at all times; preventive maintenance and servicing record, failure log which identifies failure occurrence at the elevator, failure records for each type of equipment item and corrective maintenance records.
- 3.7.11 Maintenance personnel shall be dressed in uniforms and shall register their presence with the Owner operating personnel prior to each inspection.

3.8 MAINTENANCE DATA REQUIREMENTS

- 3.8.1 Maintenance documentation shall be maintained at all times and copies made available for the Owner's files; preventive maintenance and servicing record, failure log which identifies failure occurrence at the elevator, failure records for each type of equipment item and corrective maintenance records.

3.9 INSTRUCTION MANUALS

- 3.9.1 The Contractor shall provide four complete and detailed copies of the "Operating and Maintenance Data": spare parts books; operating and maintenance manuals; approved Contractors' "AS WIRED" Drawings of wiring and circuit diagrams, including schematic diagram; and descriptive brochures on the controls, maintenance instruction manuals and test procedures for all safety devices.

3.10 SPECIAL TOOLS

- 3.10.1 If diagnostic tools are required, the Contractor shall provide 1 diagnostic tool and a complete diagnostic manual.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 GENERAL

- .1 This Section covers items common to Sections of Division 16. This section supplements requirements of Division 1.

1.2 CODES AND STANDARDS

- .1 Except where specified otherwise, do complete installation in accordance with CSA C22.1 Part I and as amended for use in the Province of British Columbia, henceforth alternatively referred to as the Rules and Regulations.
- .2 Do overhead and underground systems in accordance with CSA C22.3, No.1 and CSA C22.3 No. 7, except where specified otherwise.
- .3 Abbreviations for electrical terms: to CSA Z85.
- .4 In addition to the above, the requirements related to electrical installations that are not governed by the Rules and Regulations but are required by the B.C. Building Code, CNW Electric, Telus, and the Workers Compensation Board, shall be met.

1.3 CARE, OPERATION AND START-UP

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's qualified field service representative (FSR) to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.
- .4 Submit a service and commissioning report, by the FSR, for each applicable piece of equipment or system.

1.4 UTILITY COORDINATION

- .1 Submit all pertinent information to the electrical utility and when requested, to the BC Safety Authority.

1.5 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235.

- .2 Electric equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.6 PERMITS, FEES AND INSPECTION

- .1 Submit to B.C. Electrical Safety Authority and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Upon request of Contractor, Consultant will provide drawings and specifications to Contractor, as required by B.C. Electrical Safety Authority and Supply Authority at no cost.
- .4 Notify Consultant of changes required by B.C. Electrical Safety Authority prior to making changes.
- .5 Furnish Certificates of Acceptance from B.C. Electrical Safety Authority and authorities having jurisdiction on completion of work. The Contractor's Declaration of Completion, countersigned by the Electrical Inspector will be accepted as the Final Certificate.
- .6 Pay all fees and charges for FSR for testing, start-up, and commissioning of equipment.

1.7 MATERIALS AND EQUIPMENT

- .1 Equipment and material to be of manufacturer's current design and to be certified by CSA or an equivalent certification agency as identified in the Rules and Regulations. Where there is no alternative to supplying equipment which is thus certified, obtain special approval from B.C. Electrical Safety Authority.
- .2 Factory assemble control panels and component assemblies.
- .3 Listing of a company as an acceptable manufacturer or supplier of equipment and materials is conditional to compliance with the specified requirements.
- .4 Uniformity of equipment: Materials and equipment of similar or identical nature shall be of same manufacture and type.
- .5 Upgrades to existing equipment: materials and equipment required for modifications to existing electrical equipment to be supplied and installed by the manufacturer's service group.

1.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish air dry enamel.
 - .1 Paint outdoor electrical equipment "dark transformer green" finish to EEMAC Y1-2.
 - .2 Paint indoor switchgear and distribution enclosures and outdoor junction boxes light grey air dry enamel to EEMAC 2Y-1.
- .2 If acceptable to Consultant, clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .4 If acceptable to Consultant, apply Galvacon touch-up paint to damaged portions of galvanized threads and surfaces.

1.9 EQUIPMENT IDENTIFICATION

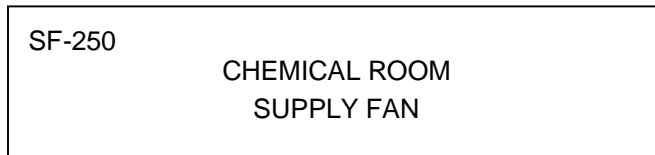
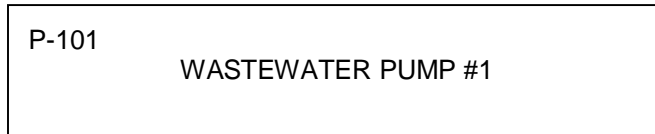
- .1 Identify electrical equipment, instruments, control devices and mechanical equipment which have an electrical component with nameplates and labels as follows.
- .2 Nameplates:
 - .1 Lamacoid 2-ply, 3 mm thick plastic engraving sheet, white face, black backing, attached with foam-tape 3M Scotch-Mount No. 4032 adhesive backing where used in controlled environment indoor areas and with self tapping screws (rivetting not acceptable) where used outdoors or in wet, damp or contaminated indoor areas. Epoxy glued where integrity of enclosure would be impeded by screwholes.

NAMEPLATE SIZES

Size 1	13 x 50 mm	1 line	4 mm high letters
Size 2	13 x 70 mm	1 line	4 mm high letters
Size 3	20 x 50 mm	2 lines	4 mm high letters
Size 4	20 x 70 mm	2 lines	4 mm high letters
Size 5	27 x 70 mm	3 lines	4 mm high letters
Size 6	27 x 90 mm	4 lines	3 mm high letters
Size 7	70 x 150 mm	as required	min. 10 mm high letters

- .3 Labels:
 - .1 Embossed plastic labels with 6 mm high letters unless specified otherwise, for use inside cabinets and panels only.

- .4 Nameplates shall include the device, loop number, and the description from the single line diagrams and schematics as typically shown below.



- .5 Nameplate sizes shall be verified as being adequate before they are fabricated.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

1.10 CONDUIT AND CABLE IDENTIFICATION

- .1 Identify conduits and cables which are numbered on the drawings or schedules using the alpha-numeric code as shown. Attach a tag at each point of termination or connection.
- .2 Identify conduits and cables installed in non-hazardous or non-corrosive indoor areas or within enclosures with white nylon marker plates, Panduit #MP xxx-C, fastened with locking-type black nylon ties. Use intermediate grade ties, Panduit #PLT xxI-CO. If tie also serves as cable strap, use heavier grade tie.
- .3 Identify conduits and cables installed outdoors or in hazardous or corrosive areas with stainless steel, embossed metal marker plate, Panduit #MMP, fastened with stainless steel, Panduit #MLT PANSTEEL ties. Use #304 or #316 stainless steel as appropriate.
- .4 Identify conduits and cables installed in areas where they are subjected to chemical attack with stainless steel marker plates as specified above and fastened with Panduit #PLT xx - x76 Pan-Ty TEFZEL ties.
- .5 Provide the required embossing and printing equipment, complete with software where applicable. Keep equipment on-site until plant commissioning is complete.
- .6 Catalogue numbers specified are for the purpose of illustrating features and quality of the conduit and cable identification system. Products from other manufacturer's are acceptable subject to meeting or exceeding the specified products.

1.11 WIRE IDENTIFICATION

- .1 Identify control and instrument wires with permanent, indelible numbered markings on both ends of wires, i.e. at all points of terminations and splices. Characters to be no less than 2 mm high. Numbering shall not be handwritten.
- .2 Unless otherwise specified or shown, wire numbers and terminal block numbers shall be the same.
- .3 Maintain phase sequence and colour coding of wires throughout.
- .4 Colour code wires to CSA C22.1 and as follows:
 - .1 Power wires: phase A-B-C from left to right or front to back, red-black-blue
 - .2 Neutral: white
 - .3 AC, control: red
 - .4 AC, ground: green
 - .5 DC + (ungrounded): yellow
 - .6 DC- (grounded): brown
 - .7 Instrument wires: shielded twisted pairs, white for higher potential, black for lower potential, grey overall jacket.
 - .8 Taping for the purpose of colour coding will not be accepted for conductors less than #2 AWG.

1.12 CONDUCTOR TERMINATIONS

- .1 Lugs, terminals, screws used for termination of conductors to be suitable for copper and aluminum conductors.

1.13 MANUFACTURERS AND APPROVAL LABELS

- .1 Visible and legible after equipment is installed.

1.14 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Safety Authority and Consultant.
- .2 Decal signs, minimum size 175 x 250 mm.

1.15 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit, and sleeves prior to pouring of concrete. Sleeves through concrete, unless otherwise shown: Schedule 40 PVC, sized for free passage of conduit and cable, and protruding 50 mm.
- .2 Install cables, conduits, and fittings to be plastered over, neatly and close to building structure so furring can be kept to minimum.

1.16 LOCATION OF WIRING, OUTLETS, AND EQUIPMENT

- .1 Wiring, outlets and equipment locations shown on the drawings are of a general nature.
- .2 Drawings do not show all conduits, cables and equipment. Those shown are in diagrammatic form only. Provide all wiring required to complete the systems.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 1000 mm, and information is given before installation.
- .4 Check the location of all items fed by conduit embedded in or below the floor slab. Ensure that the conduit is located correctly.

1.17 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor (AFF) to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at the following heights unless indicated otherwise:
 - .1 Switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Process areas: 1000 mm.
 - .3 Above top of continuous baseboard heater: 200 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Thermostats: 1520 mm.

1.18 LOAD BALANCE

- .1 Measure phase current with normal loads operating at time of acceptance. Adjust panelboard branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and, where applicable, adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, a report listing phase voltages, phase currents and if applicable, neutral currents on MCC, panelboard and motors, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.19 QUALITY CONTROL

- .1 Test, calibrate and, unless otherwise specified, program and configure the new works to ensure that they are operating in accordance with the intent of the drawings and specifications. Any clarification required as to the intent of the drawings and specifications must be obtained prior to bid closing.
- .2 Supply all necessary instruments, meters, equipment and qualified personnel to perform tests and calibrations.
- .3 Furnish manufacturer's certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions.
- .4 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument; use a 1000 V instrument for system voltages above 350 V. Note: Disconnect cables connected to instruments, controllers and similar devices.
 - .2 Check resistance to ground before energizing.
 - .3 Carry out tests in presence of Consultant.
 - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .5 Submit test results for Consultant's review.
- .5 Check electrical equipment and motor nameplates to ensure that the breakers, fuses, overload heaters and conductors are sized in accordance with the Rules and Regulations.
- .6 Ensure that circuit protective devices such as overcurrent trips, relays, fuses, and the like, are set to required values.
- .7 Provide Consultant with list of test results including, but not limited to, the following:
 - .1 Nameplate full load current of each motor.
 - .2 Measured operating current of each motor.
 - .3 Cat. No. and current range of installed O/L heater or settings, as applicable.
 - .4 Setting of circuit breakers.
 - .5 Settings of all protective relays.
 - .6 Thermostat settings.
 - .7 Calibration calculations.
 - .8 Analog and control setpoints.
 - .9 Parameter setting record sheets for devices and equipment which need programming, e.g. Booster Pump Control Panel, Cl₂ Analyzer, DMS and the like.

.10 All other relevant and similar data.

.8 Submit a completed Motor Data Sheet as shown appended to this Section.

1.20 GUARDING

.1 Guard exposed live equipment during construction for personnel safety.

.2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage.

1.21 PROTECTION

.1 Protect equipment and material from the weather, moisture, dust and physical damage.

.2 Cover equipment openings and open ends of conduit piping and pullboxes as work progresses. Failure to do so will result in the Contractor being required to adequately clean or replace materials and equipment at no extra cost to the Owner.

.3 Refinish damaged or marred factory finish to as-new condition.

.4 Protect all existing services encountered. Obtain instructions from the Consultant when existing services require relocation or modification, further to that defined in these contract documents.

1.22 CLEANING

.1 Do final cleaning.

1.23 WORKMANSHIP

.1 Workmanship shall be in accordance with well established practice and standards accepted by Consultant.

.2 The Consultant has the right to reject any item of work that does not conform to the contract documents and accepted standards of performance, quietness of operations, finish and appearance.

1.24 SEISMIC RESTRAINTS

.1 Provide seismic restraints for luminaires, transformers, control panels and the like.

1.25 DRAWINGS AND MEASUREMENTS

.1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of the work. Do not scale the drawings.

.2 Take field measurements where equipment and material dimensions are dependent upon buildings.

- .3 Ensure adequate clearance in front of all electrical panels and equipment.
- .4 Ensure that all suppliers of equipment and material have sufficient information to determine that their equipment and material is suitable for the intended use shown in these documents.

1.26 EXAMINATION

- .1 Locations shown on the Drawings must be verified and the responsibility for any error resulting from failure to exercise such precaution shall be the responsibility of this Contractor.
- .2 Examine the documents for details of work included. Obtain written clarification from the Consultant, in the event of conflict within the Specification, between the Specification and Drawings, or in the Drawings. Obtain written clarification from the Consultant if work affecting the installation is not clear.

1.27 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data as specified.
- .2 Shop drawings depicting schematic and single line diagrams, connection diagrams, panel layouts, and the like must be prepared by electronic drafting means.
- .3 Include information for the following:
 - .1 Elevator as specified in Section 14 21 23 – Electric Traction Passenger Elevators.
 - .2 Kiosk as specified in Section 26 16 02 – Electrical Kiosks.
 - .3 Electrical distribution equipment, such as transformers and panelboards.
 - .4 Lighting equipment including ballasts and applicable photometrics with coefficient of utilization tables.
 - .5 Fire alarm.
- .4 Information for the above listed items to include, but not be limited to, wiring diagrams, bills of materials, dimensional data and operating descriptions. Catalogue sheets may be submitted as shop drawings provided they are for actual piece of equipment supplied; literature which covers an entire family of equipment is only acceptable if the equipment proposed is clearly highlighted.

1.28 INSTALLATION INSTRUCTIONS

- .1 Obtain the manufacturer's instructions necessary for the correct installation, calibration and adjustment for all equipment well in advance of commencement of shop and site work.

1.29 RECORD DRAWINGS

- .1 Contractor to provide project record documents.
- .2 Record drawings and information is to include but is not limited to the following:
 - .1 Field Instrument Manufacturer calibration certification sheets.
 - .2 Shop drawings, revised to as constructed status; refer also to another clause in this Section entitled Shop Drawings.
 - .3 Design drawings, revised to as constructed status.
 - .4 Instrument and calibration record forms.
 - .5 Data sheets with listing of programming and configuration variables of such equipment as Transmitters, Metering Systems, and the like.

1.30 OPERATIONS AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manual.
- .2 The data must include all information listed under another item of this Section entitled Shop Drawings and Product Data, supplemented by illustrated parts lists, catalogue numbers and detailed instructions to permit effective operation, maintenance and repair of the equipment.
- .3 Include data for each type and style of device.
- .4 For each manual, provide 1 print of each shop drawing, revised to as-built status, including all final settings and sizes of circuit breakers, fuses, relays, and the like.
- .5 For control, instrumentation and other similar equipment, include information on calibration and programming.
- .6 Information must be for actual piece of equipment supplied; literature which covers an entire family of equipment is only acceptable if the equipment in use is clearly highlighted.

1.31 TERMINOLOGY

- .1 Unless further qualified, the following definitions apply:
 - .1 Wiring - refers to any or all of conduits, cables, wires, conductors and associated fittings and hardware.
 - .2 Conductor - refers to the current carrying portion of an insulated or non-insulated wire.
 - .3 Wire - refers to a single, insulated conductor.
 - .4 Cable - refers to an assembly of a single or multiple wires with shield, jacket, sheath or armour.

- .5 Field wiring - refers to wiring outside a control panel or kiosk.
- .2 Wherever the term 'duct' appears, it applies equally to conduit.

1.32 MEASUREMENT AND PAYMENT

- .1 Payment for Structure Type A Lighting System shall be made at the Lump Sum Price bid. Lump Sum Price shall include the cost to the supply and installation of this system as detailed in the Contract Drawings and shall include the cost of all submittals, materials and work required under this section and related sections.
- .2 Payment for Pole Mounted Type B Luminaire System shall be made at the Lump Sum Price bid. Lump Sum Price shall include the cost to the supply and installation of this system as detailed in the Contract Drawings and shall include the cost of all submittals, materials and work required under this section and related sections.
- .3 Payment for Curb Trench Type C Lighting System shall be made at the Lump Sum Price bid. Lump Sum Price shall include the cost to the supply and installation of this system as detailed in the Contract Drawings and shall include the cost of all submittals, materials and work required under this section and related sections.
- .4 Payment for Elevator Lighting and Power Supply System shall be made at the Lump Sum Price bid. Lump Sum Price shall include the cost to the supply and installation of this system as detailed in the Contract Drawings and shall include the cost of all submittals, materials and work required under this section and related sections.
- .5 Payment for Elevator Ancillary Systems shall be made at the Lump Sum Price bid. Lump Sum Price shall include the cost to supply and install the telephone outlet, smoke detectors, and fire alarm system as detailed in the Contract Drawings and shall include the cost of all submittals, materials and work required under this section and related sections.
- .6 Payment for Electrical Enclosure Cabinet shall be made at the Lump Sum Price bid. Lump Sum Price shall include the cost of all submittals, materials and work required under this section and related sections.
- .7 Payment for Tie-in of New Electrical systems to Existing Concession Building Electrical Room shall be made at the Lump Sum Price bid. Lump Sum Price shall include the cost to complete the work of trenching, protected conduit runs, passage through existing concrete pathway and walls, and restoration to match existing, as detailed in the Contract Drawings and shall include the cost of all submittals, materials and work required under this section and related sections.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

1 General

1.1 REQUIREMENTS

- .1 This section specifies the supply and installation of the electrical systems; refer also to other sections of this Division.

1.2 OWNER-SUPPLIED EQUIPMENT

- .1 No Owner-supplied equipment is provided.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 16010 – Electrical: General Requirements.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for inclusion into manual specified in Section 26 00 10 – Electrical: General Requirements.

1.5 RECORD DRAWINGS

- .1 Submit record drawings in accordance with Section 26 00 10 – Electrical: General Requirements.

1.6 CITY OF NEW WESTMINSTER ELECTRIC SERVICE

- .1 A new 600 V, 3 Ph, 4 W, 100 A service is required. Service location to be advised.
- .2 The Contractor is to do the following work at both sites:
 - .1 Supply and install a service conduit(s) from the CNW Electric pad-mounted transformer to the kiosk.
 - .2 Supply and install the meter cabinet and base for the revenue metering equipment in the kiosk.
 - .3 New pad and grounding for relocated service transformer.
 - .4 New primary duct system for relocated transformer and HV in-ground junction box.
- .3 CNW Electric will do the following work:
 - .1 Supply and install the service cables into the Contractor's conduit and make connections at the service breaker within the kiosk.
 - .2 Supply and install the revenue meter on the meter base in the new kiosk.
 - .3 Relocate existing service transformer and 3 phase HV junction box.

- .4 The Contractor is to make to CNW Electric for the service. Service charges of the utility will be paid by the Owner.
- .5 Coordinate work with CNW Electric and carry out the work in accordance with CNW Electric standards and requirements.

1.7 PAYMENT

- .1 No separate payment will be made for on this section. Include Electrical Installation costs in applicable lump sum prices of work items to which they are applied.

2 Products

2.1 CONDUITS

- .1 Conduit sizes, unless otherwise specified, are given in metric trade sizes as listed in the Rules and Regulations.
- .2 Minimum size 21 mm, except as otherwise specified.
- .3 Abbreviations shown in brackets correspond to type identification shown on drawings.
- .4 Rigid metal threaded conduit aluminum (RA) and galvanized steel (RS), to CSA C22.2 No. 45 and No. 18.
- .5 Rigid PVC conduit (RPVC) to CSA C22.2 No. 211.2.
- .6 Rigid DB2 PVC conduit, to CSA C22.2, No. 211.1.
- .7 Liquid-tight flexible metal conduit (FLC), to CSA C22.2, No. 56 from flat spiral-wound galvanized steel strip, smooth inside, Thomas and Betts Type CSA.
- .8 Liquid-tight flexible non-metallic conduit (FNC), to CSA C22.2, No. 227.2, Hubbell Polytuff Gray, Thomas and Betts Type LTC.

2.2 CONDUIT FASTENINGS AND SUPPORTS

- .1 One hole malleable iron straps to secure surface conduits 53 and smaller. Two hole steel straps for conduits larger than 53.
- .2 For outdoor and corrosive environment applications, two hole ultra-violet stabilized PVC straps to secure surface conduits 53 and smaller. Two hole PVC-coated steel straps for conduits larger than 53.
- .3 Beam clamps to secure conduits to exposed steel work.
- .4 Channel type supports for two or more conduits at spacing required by the Rules and Regulations.

- .5 6 mm diameter threaded rods to support suspended channels.

2.3 CONDUIT FITTINGS AND COUPLINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 27 and larger conduits.
- .3 Liquid tight connectors for flexible conduit; dry-type will not be accepted.
- .4 Non-metallic connectors for non-metallic conduits.
- .5 Threaded couplings for metal conduit. Solvent-weld couplings for PVC conduit.

2.4 WARNING TAPE

- .1 Red plastic tape, Brady No. 91295.

2.5 PULLSTRING

- .1 6 mm stranded nylon pull string, tensile strength 5 kN.

2.6 WIREWAYS

- .1 Sheet steel with hinged cover to give uninterrupted access, non-metallic (polyester or fibreglass) in outdoor and corrosive environments.
- .2 Cross section dimensions: minimum 50 x 50 mm.
- .3 Finish: baked grey enamel for metallic enclosures.
- .4 Elbows, tees, couplings and hanger fittings manufactured as accessories to wireway supplied.

2.7 BUILDING WIRES

- .1 Compliance: CSA C22.2, No. 38.
- .2 Conductors: stranded; solid conductors will not be accepted.
- .3 Copper conductors: size as specified, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.8 FLEXIBLE CABLES

- .1 Compliance: CSA C22.2, No. 49.
- .2 CSA Type SOW, size and number of conductors as shown.

- .3 Other flexible cable as factory-supplied with equipment.

2.9 SHIELDED CABLES

- .1 Compliance CSA C22.2 No. 239.
- .2 CSA Type CIC (unarmoured) for installation into conduit; referred to as "TPSH" on the drawings.
- .3 CSA Type ACIC (aluminum armoured) for surface or direct buried installation, or installation into non-magnetic conduit; referred to as "ATPSH" on the drawings.
- .4 Common features:
 - .1 Single or multiple twisted pair #18 AWG copper conductors, except for long run to reservoir.
 - .2 Number of pairs as shown on the drawings.
 - .3 300 V insulation, except 600 V insulation where required by the Rules and Regulations for installation on common raceway (tray) with other 600 V circuits.
 - .4 Shield with drain wire for each pair and overall shield with drain wire for multiple pair cables.
 - .5 PVC outer jacket, 90°C and -40°C, FT-4 rated.
- .5 Acceptable products, in alphabetical order:
 - .1 for "TPSH" - Belden Series 224XX
- Nexans Series 900 000
- Shawflex Series 66021M18XX
 - .2 For "ATPSH" - Belden Series 245XX (aluminum armour)
- Nexans Series 910 000 (aluminum armour)
- Shawflex Series 66222M18XX (aluminum armour)
 - .3 The above product numbers are for 300 V-rated cables; adjust as required for 600 V-rated cables.
- .6 Factory-supplied shielded cables where forming part of an instrument assembly.
- .7 Data communications cables: refer to Section 16710 – Data Communications Cabling and Devices.

2.10 JUNCTION, PULL AND TERMINAL BOXES

- .1 To CSA C22.2, No. 40.
- .2 Welded steel or aluminum construction with screw-on flat covers for surface mounting in dry indoor areas.

- .3 Non-metallic, PVC, Fibreglass, Polyester or similar materials, with screw-on covers for outdoor, wet and corrosive areas, or as shown on the drawings.
- .4 Aluminum EEMAC Type 4X construction for larger size boxes used for outdoor surface mounting. Provide a breather fitting where box serves as a protective enclosure for other enclosed equipment.
- .5 Copper free aluminum in areas classified as hazardous.
- .6 Complete with terminal block kit assembly, where applicable.
- .7 Provide appropriate termination and identification in control and instrumentation terminal boxes. Terminate each conductor on a terminal block and provide 15% spare terminals with a minimum of 4 spare terminals.

2.11 OUTLET AND CONDUIT BOXES GENERAL

- .1 Compliance: CSA C22.2, No. 18.
- .2 Size boxes in accordance with CSA C22.1.
- .3 102 mm square or larger outlet boxes as required for special devices.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where more than one system is present.
- .6 Boxes suitable for area classification shown or specified and where available or noted, made of same material or to have same finish as connecting conduit.
- .7 Gang boxes where wiring devices are grouped.
- .8 Cast FS or FD copper-free aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle. Pressed sheet steel boxes and sectional boxes not acceptable for surface-mounted devices.
- .9 Surface-type FS or FD style fibreglass or PVC boxes with hubs and mounting feet for corrosive and wet locations.

2.12 CABLE GRIPS

- .1 Sized to suit cable diameter.
- .2 With stainless-steel or non-metallic mesh.

2.13 FITTINGS

- .1 Bushing and connectors with nylon insulated throats.

- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes or enclosures.

2.14 SUPPORT CHANNELS

- .1 C-shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.
- .2 Aluminum for dry indoor location, fibreglass for outdoor and wet and corrosive locations.
- .3 Acceptable products: for fibreglass, Champion, available from Milham Industries, Delta, BC.

2.15 SPLITTERS

- .1 Compliance: CAN/CSA C22.2 - No. 76
- .2 Sheet metal enclosure, welded corner and formed hinged gasketed cover suitable for locking in closed position.
- .3 Main and branch lugs or connection bars to match required size and number of connecting conductors as indicated.
- .4 At least four branch terminals on each set of lugs in splitters.

2.16 UTILITY METER BOX

- .1 Meter bases for secondary services as indicated.
- .2 Meter base to be mounted on the exterior of the new electric distribution kiosk.
- .3 To CNW Electric requirements.

2.17 MOULDED CASE CIRCUIT BREAKERS FOR 600 V OR LESS CIRCUITS

- .1 Common-trip breakers: quick-make, quick-break type with single handle for multi-pole applications.
- .2 Temperature compensation for 40°C ambient. Thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for overload and short circuit protection.
- .3 Handle with door interlock, complete with interlock defeater mechanism.
- .4 On-off locking device for operating handle.

- .5 EEMAC Type 12 enclosure for process areas. EEMAC Type 1 in electrical room.

2.18 LIGHTING CONTACTORS

- .1 Permanent magnet latching type, operated from remote momentary contact ON and OFF pushbuttons.
- .2 Rated for fluorescent and HID lighting loads.
- .3 EEMAC Type 12 enclosure or open type for mounting in a control panel.
- .4 Minimum size: to match branch circuit breaker supplying power to the circuit.

2.19 LIGHTING TRANSFORMERS

- .1 To CSA C22.2, No. 47, CSA C9, and CSA C802.
- .2 Dry-type, enclosed core and coil design with Class 220 (150° rise) copper windings.
- .3 Vacuum pressure impregnated (VPI) polyester resin.
- .4 kVA rating, primary and secondary voltages as indicated.
- .5 Full capacity, primary taps: at least 1 above and 1 below.
- .6 Sound level not to exceed dB values listed in CSA C9.
- .7 Provide anti-vibration pads. Wall mount transformer on non-combustible surface.

2.20 PANELBOARDS

- .1 Panelboards to CSA C22.2, No. 29 and be Service Entrance rated.
- .2 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase. Buss bar arranged to permit installation of multi-pole branch breakers at any location.
- .3 Voltage, mains, number of phases and circuits, and number and size of branch circuit breakers as indicated.
- .4 Surface-mounted enclosure with hinged door.
- .5 Copper or aluminum bus with neutral of same ampere rating as mains.
- .6 Ground bar.
- .7 Mains: suitable for bolt-on breakers.

- .8 Trim and door finish: baked grey enamel.
- .9 "Full-width" circuit breakers moulded case with thermal and magnetic tripping; half-width type not acceptable.
- .10 Common-trip breakers with single handle for multi-pole applications.
- .11 Ground fault circuit interrupters (GFCI) breakers as indicated; Class A unless otherwise noted.
- .12 Lock-Off/Lock-On devices for breakers serving critical circuits such as alarm and control circuits.
- .13 Circuit schedule, typed on a removable cardboard for installation on inside of panel door.

2.21 LIGHTING EQUIPMENT

- .1 Provide energy efficient luminaires complete with lamps as shown on the drawings.
- .2 Stainless steel fixture chain, hangers or rigid steel conduit for suspended luminaires in dry locations; stainless steel chain or nylon covered stainless steel wire in wet, unheated or corrosive areas.
- .3 Use aligning channels approved as fixture raceway for mounting suspended continuous row luminaires in dry locations.
- .4 Lamps.
 - .1 Fluorescent Lamps.
 - .1 Standard imperial lengths, 48 inch rapid start (T8), 46 in. rapid start (T5).
 - .2 Medium, bi-pin, T8, (265 mA, 32 W).
 - .1 CRI not less than 60%.
 - .2 Colour temperature 3100 K for "warm", 4100 K for "cool" applications.
 - .3 Rated life minimum 20,000 hours.
 - .4 Mean lumen output at 40% rated life not less than 2850 Lm.
 - .3 Bi-pin, T5, high output (HO), 54 W, CR1-80+, colour temperature 4000 K, minimum rated life 30,000 hours.
 - .2 Compact Fluorescent Lamps.
 - .1 Supply voltage nominal 120 V, wattage as shown or specified.
 - .2 Ballast electronic, integral or in socket adaptor.
 - .3 Rated life minimum 10,000 hours.

- .4 CRI not less than 80%.
- .5 Colour temperature 2700 K.
- .3 HID Lamps.
 - .1 Metal Halide (MH) or High Pressure Sodium (HPS) as shown or specified.
 - .2 Lamp shape to suit requirements of specified luminaire.
 - .3 Designed for base-up or base-down mounting as dictated by luminaire design.
 - .4 MH lamps, phosphor-coated, deluxe white unless otherwise shown or specified.
 - .5 HPS lamps with clear envelope.
- .5 Ballasts.
 - .1 General
 - .1 Compatible with type of lamp installed.
 - .2 Voltage rating to correctly match system supply voltage.
 - .3 Fluorescent ballasts with sound rating A.
 - .4 For multiple lamp luminaires, do not exceed two lamps per ballasts or as dictated by circuit design.
 - .5 Generally, ballasts to be designed for integral mounting in the luminaire.
 - .6 Ballasts for unheated areas to be suitable for starting and operation at temperatures to -29°C.
 - .7 Capacitors non-PCB, where applicable.
 - .8 Thermally-protected non-resettable, where applicable.
 - .9 Magnetic ballasts are not acceptable.
 - .10 Fluorescent ballasts non-leaking type filled with thermosetting compound.
 - .11 Radio interference suppressor.
 - .6 Fluorescent Ballast.
 - .1 Except as otherwise specified, high-frequency, 20 kHz or higher, energy efficient, electronic type for rapid start lamps, UL-listed Class P.
 - .2 Suitable for operation with specified lamp.
 - .3 Total harmonic distortion not to exceed 15%.
 - .4 Capable to operate continuously at 90 - 110% of rated voltage, with parallel circuit allowing remaining lamp to maintain full light output if one or more lamps fail or are removed from circuit.
 - .5 Power factor not less than 95% lagging or leading.

- .6 Capable to tolerate sustained open circuit and short circuit output conditions without damage to the ballast.
 - .7 Soft start, with pre-heat time designed to suit lamp requirements, but not less than 0.4 seconds.
 - .8 Cathode heating circuits for rapid start lamps, designed to suit lamp requirements.
 - .9 Lamp current crest factor not to exceed 1.7.
 - .10 Surge protection to withstand line transients to ANSI C62.41.
 - .11 Provide dimmable ballasts where specified or shown. Ballast features to be compatible with dimming controls supplied.
 - .12 Manufacturer's warranty to be no less than 3 years from date of energization.
- .7 HID Ballasts.
- .1 Constant wattage auto transformer (CWA) or isolated secondary constant wattage (CWI).
 - .2 Pulse-start type for metal halide lamps.
 - .3 Regulated output, maintains light output over a range of $\pm 10\%$ of input voltage.
 - .4 Starting current less than operating current.
 - .5 95% or better power factor.
 - .6 Two lamp ballasts for parallel lamp operation.
- .8 Emergency Lights.
- .1 Compliance: CSA Standard C22.2, No. 141.
 - .2 Control Unit.
 - .1 Supply voltage: 120 V, ac.
 - .2 Output voltage: 12 V dc.
 - .3 Operating time: 30 min.
 - .4 Battery: sealed, maintenance free, 10-year life, with 50% spare capacity to allow for connection of future additional light heads.
 - .5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected. Capable of restoring battery to full charge within 12 hours after a discharge of not more than 30 minutes at rated load.
 - .6 Solid state transfer.
 - .7 Low voltage disconnect: solid state, modular, to operate at 80% battery output voltage.
 - .8 Signal lights: solid state, life expectancy 100,000 h minimum, for 'AC Power ON' and 'High Charge'.

- .9 Cabinet: EEMAC Type 12. Wall or shelf mounting as applicable, with provision for wiring entry.
- .10 Ready access to battery.
- .11 With integral lamp heads and provision for remote heads.
- .12 Auxiliary equipment:
 - .1 Lamp disconnect switch.
 - .2 Test switch.
 - .3 Time delay relay upon return of normal power.
 - .4 ac input and dc output terminal blocks inside cabinet.
 - .5 Shelf or bracket as required.
 - .6 Cord and single twist-lock plug connection for ac connection.
 - .7 RFI suppressors.
- .3 Lamp Heads
 - .1 Swivel-type integral on unit, 360° horizontal, 180° vertical adjustment.
 - .2 Remote-type for installation on surface-mounted box, with swivel-type adjustment.
 - .3 Remote, adjustable gimbal-type for installation in T-bar ceiling.
 - .4 Lamp type: Halogen, sealed-beam not less than 12 W or as shown.
- .9 Exit Lights
 - .1 To CSA C22.2 No. 141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.
 - .2 Housing: cast anodized extruded aluminum housing, brush aluminum finish.
 - .3 Face and back plates: extruded aluminum.
 - .4 Lamps: LED.
 - .5 Letters: red on white, reading EXIT.
 - .6 Third lamp socket for emergency lamp lighting circuit. Third lamp: 6 W, 12 VDC.
 - .7 Self-luminous signs requiring no power or wiring and are spark free and built to NFPA requirements, are acceptable.
- .10 LED lights: Refer to Drawings.

2.22 PHOTOELECTRIC LIGHTING CONTROL

- .1 Wall or fixture mounting, as applicable.

- .2 Capable of switching 1800 W of lighting at 120 V.
- .3 Voltage variation: plus or minus 10%.
- .4 Temperature range: -40°C to +40°C.
- .5 Switching on lights at dusk.
- .6 Switching off lights at dawn.
- .7 Rated for 5000 operations.
- .8 Switching time delay of minimum 30 s.
- .9 Wall mounting bracket.
- .10 Colour coded leads: size 10 AWG, 460 mm long.

2.23 LIGHT SWITCHES

- .1 15 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.
- .2 Manually-operated, general purpose, specification-grade, ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory or brown toggle for light or dark surrounding wall surfaces respectively.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Snap switch where used to switch a motor load.
- .5 For wet and corrosive locations use IPEX/SCEPTER #VSC 15/10 coverplates.

2.24 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, premium specification-grade, with following features:
 - .1 Urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.

- .4 Eight back wired entrances, four side wiring screws.
- .5 Double wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground, premium specification-grade, with following features:
 - .1 Urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Twistlock receptacles, specification grade, CSA type L5-15 R, 125 V, 15 A.
- .4 Other receptacles with ampacity and voltage as indicated.
- .5 Except as otherwise specified, ivory or brown coloured bodies for light or dark surrounding wall surfaces respectively.
- .6 For wet and corrosive locations, yellow melamine body Hubbell 52CM61/62.

2.25 WIRING DEVICE COVER PLATES

- .1 Cover plates for wiring devices from one manufacturer throughout project.
- .2 Brushed stainless steel coverplates for recessed locations.
- .3 Sheet metal cover plates with rounded edges for wiring devices mounted in surface-mounted metal boxes.
- .4 Lever-type Ipex/Sceptre, Type VSC 15/10, switchplates for weatherproof, wet or corrosive locations.
- .5 PVC coverplates for PVC boxes.
- .6 Cast aluminum with double lids "cover open" type, Hubbell Series 520*WO, receptacle plates for weatherproof, wet or corrosive locations.
- .7 Provide multi gang cover plates on multi gang boxes.

2.26 CONNECTORS

- .1 Pressure type wire connectors: with current carrying parts sized to fit copper/aluminum conductors.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, flexible conduit, as required.

2.27 GROUNDING

- .1 Unless specifically differentiated, the terms "grounding" applies equally to the system grounding and equipment bonding requirements.
- .2 Clamps for connection of conductor, size as required to electrically conductive underground water pipe or ground electrode.
- .3 Rod electrodes, copper clad steel 19 mm dia by 3 m long.
- .4 Grounding conductors, bare and insulated stranded copper, size as indicated.
- .5 Equipment bonding conductors, bare and insulated stranded soft annealed copper size as indicated or as required by the Rules and Regulations.
- .6 Insulated grounding conductors: green, insulation to match circuit conductors.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as required, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Compression type conductor to conductor connectors.
 - .4 Exothermic welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure type conductor to equipment connectors.
 - .7 Ground electrode box: Thomas & Betts #51629 or Slacan #22109.

3 Execution

3.1 WIRING

- .1 Except for "finished" areas, generally defined as areas with T-bar ceilings, or where otherwise specified, interior wiring may be surface-installed, except where it services equipment located away from walls in which case wiring shall be installed in or below slabs. Wiring in finished areas shall be concealed.
- .2 Where wiring is subject to mechanical injury, provide additional mechanical protection.
- .3 Unless otherwise specified, do not install wiring on exterior building surfaces; instead, run conduit on inside wall and enter boxes and equipment from the back.

- .4 Unless otherwise specified, minimum conductor size is #12 AWG, except for control and instrumentation wiring which may be done with #14 AWG and #18 AWG respectively.
- .5 Line voltage wiring for the HVAC system shall be done to the same standards as specified in this Section. Low voltage wiring method must provide protection against physical damage. Coordinate with HVAC contractor for wiring requirements.
- .6 Run surface wiring parallel or perpendicular to building lines; where applicable, run wiring in flanged portion of structural steel. Wherever possible, group wiring on profile channels. Do not pass wiring through structural members except as indicated.
- .7 Install wiring to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .8 Use rigid PVC conduit or Teck cable, except where specified otherwise. If metallic conduit is required use rigid aluminum in process areas.
- .9 Where permitted by the Rules and Regulations, Teck and Teck-style cable or liquid-tight non-metallic conduit may be used for motors, control and instrumentation wiring respectively. Type SOW cable may be used for extra flexible connections; maximum length 450 mm or as shown.
- .10 In corrosive areas, and as permitted by the Rules and Regulations, liquid-tight conduit shall be non-metallic.
- .11 Use DB2 conduit, rigid PVC conduit, Teck cable or a combination thereof for wiring buried below grade or in wet and damp areas.
- .12 CSA Type AC cable ("BX" cable) is not acceptable.
- .13 Install plastic warning tape over underground wiring, placed 300 mm below finished grade. Minimum burial depth of conduit is 900 mm or as shown.
- .14 Place U/G wiring in a sand envelope of not less than 100 mm. Do trenching and backfilling in accordance with Section 31 23 10 – Trench Excavation and Backfill. Keep an accurate record of any buried services.
- .15 Slightly snake direct-buried U/G cable when laying into trench, to allow for some take-up during settlement of ground.
- .16 Underground cabling from Colonial Drive to the Arbutus WTP to be single continuous runs; no splicing for entire length. Pull the cable through the existing conduits routed under Holland Creek. After installation of cables, seal conduit ends with approved compound such as Duxseal or expandable foam material to provide a waterproof barrier.

- .17 After installation of conduits, seal voids around conduits to provide a waterproof finish. Trim any excess material to obtain a neat appearance.
- .18 Except as otherwise shown, maintain a separation of not less than 300 mm between analog instrumentation and power wiring where they run parallel to each other.
- .19 Bend metal conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .20 Mechanically bend metal conduit over 19 mm diameter.
- .21 Sleeves through concrete: Schedule 40 plastic pipe, sized for free passage of conduit or cable, and protruding 50 mm. After installation of conduit or cable, seal voids with approved compounds such as Duxseal or expandable foam material. Seal larger-sized openings, provided for passage of cables from one area to another, in a similar fashion. Seal all openings around wiring and/or cables within conduits entering or leaving the building and where water can potentially enter the conduit system.
- .22 Where it is essential that the integrity of a room or space is preserved, seal voids around sleeves, cables and conduits with fire-rated material approved for that purpose.
- .23 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .24 U/G conduit joints for PVC conduits to be done with adhesive prescribed by the manufacturer, such as solvent cements; push-fit couplings not acceptable unless conduit is concrete encased.
- .25 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .26 Dry conduits out before installing wire.
- .27 Install pullstring in empty conduit.
- .28 Use non-metallic boxes, fittings and straps in wet, damp and corrosive environments.
- .29 Unless otherwise specified, terminate conduit sleeves and spare conduits in a coupling or end bell.

3.2 INSPECTION FOR BURIED WIRING

- .1 Advise Consultant a minimum of 2 working days in advance of placing conduit and cables so that he may be present during installation, including cleanout and backfilling.

3.3 FIRE AND WATERSTOPS

- .1 At penetration of fire-rated walls, ceilings, or floor construction, seal voids around cables and conduits with an approved re-enterable fire stop compound, full thickness of the construction material. Trim any excess material to obtain a neat appearance; do not damage outer jacket of armoured cable. Strictly follow the fire stop manufacturer's instructions.
- .2 After installation of conduits, seal voids around conduits to provide a waterproof finish. Trim any excess material to obtain a neat appearance.

3.4 WIREWAYS

- .1 Wireways and auxiliary gutters may be used to facilitate multiple conduit or cable entries into an enclosure.
- .2 Keep number of elbows, offsets, connections to minimum.
- .3 Install supports, elbows, tees, connectors, fittings.
- .4 Install barriers where required.
- .5 Install gutter to full length of equipment.

3.5 BUILDING WIRES AND CABLES

- .1 Do not pull spliced wires and cables inside conduits.
- .2 Install multiple wires and cables into conduit simultaneously.
- .3 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .4 Wherever possible, group cables on channels.
- .5 Terminate cables in strict conformance with manufacturer's instructions.

3.6 SHIELDED CABLES

- .1 Unless cable has its own magnetic armour, install shielded cables for instrumentation wiring into magnetic, i.e. steel, conduit.
- .2 Ground cable shield.
- .3 Maintain a separation of not less than 300 mm between analog instrumentation and power wiring where they run parallel to each other.

3.7 JUNCTION AND PULL BOXES

- .1 Install pull boxes in accessible locations.
- .2 Only main junction boxes are indicated. Install pull boxes as required.

3.8 CABLE TRAYS AND SUPPORTS

- .1 Install a complete tray system as shown and specified. Cut to length section of tray as required to fit into the available space.
- .2 Install cable tray on wall brackets where tray runs along structural columns or walls.
- .3 Space supports as required by classification rating and weight of cables to be installed. Allow for 50% additional cable weight in determining tray support spacing. Secure tray to supports by suitable brackets and bolts.
- .4 At corners provide a support installed as close as possible to the corner.
- .5 Provide vertical clearance of 300 mm above the trays. This clearance can be reduced at piping or duct crossovers, but shall not be less than 150 mm.
- .6 Maintain minimum 20 mm clearance between tray and concrete surfaces.
- .7 All trays are shown diagrammatically on the drawings. The exact location is to be determined in the field. Determine the exact location of tray supports and runs in the field to prevent interferences with other structures and to maintain clearance for tray access.
- .8 Use manufactured links to bolt individual tray lengths together or, where there is a separation between metallic tray sections, use a #6 copper bonding conductor between two sections.
- .9 Install a #6 copper bonding conductor along the full length of the metallic tray system. Solidly bond the tray to the building steel and grounding system at the intervals required by the Rules and Regulations.
- .10 Run trays parallel to building lines unless otherwise shown on the drawings.
- .11 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .12 Use beam clamps to fasten support systems to structural steel. Welding, drilling and cutting of structural steel is not permitted without approval by the Consultant.

3.9 CONDUIT AND OUTLET BOXES

- .1 Use FS-style boxes for surface installations; sheet steel utility boxes not acceptable.

- .2 Use non-metallic boxes in wet, damp or corrosive areas.
- .3 Support boxes independently of connecting conduits and cables.
- .4 Provide correct size of openings in boxes for conduit and cable connections.
Reducing washers not allowed.

3.10 WIRING DEVICES

- .1 Install wiring devices as indicated.
- .2 Do not use coverplates meant for flush outlet boxes on surface-mounted boxes.

3.11 CONNECTORS

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2, No. 65.
 - .2 Install fixture type connectors and tighten. Replace insulating cap.

3.12 FASTENING AND SUPPORTS

- .1 Secure equipment to metal members by clamping or by drilling and tapping. Welding will not be acceptable.
- .2 Secure equipment to poured concrete with non-corroding expandable inserts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members. In outdoor or corrosive areas use non-metallic, stainless steel or brass materials and brass or stainless steel screws and bolts.
- .4 Fasten exposed conduit or cables to structures or support system using PVC straps or other non-metallic straps. Straps exposed to daylight must be of ultra-violet stabilized materials.
- .5 Suspended support systems:
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 3 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of 3 or more conduits or cables use channels at spacing in accordance with the Rules and Regulations.

- .7 Provide brackets, frames, hangers, clamps and related types of support structures as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .11 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.

3.13 LIGHTING EQUIPMENT

- .1 Locate and install luminaires as required and in accordance with manufacturer's instructions.
- .2 Support luminaires level and plumb and true with structure and other equipment in horizontal or vertical position as intended. Install wall or side bracket mounted luminaire housings rigidly and adjust to a neat flush fit with mounting surface.
- .3 Hang and mount luminaires to prevent distorting frame, housing, sides or lens.
- .4 Connect suspended fluorescent luminaires to splice box through a length of flexible conduit.
- .5 Use stainless steel fixture chain, hangers or rigid steel conduit for suspended luminaires in dry locations; stainless steel chain or nylon covered stainless steel wire in wet, unheated or corrosive areas. EMT is not acceptable for hanging luminaries.
- .6 Use aligning channels approved as raceway for mounting suspended continuous row luminaires in dry locations.
- .7 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .8 Align luminaires mounted individually parallel or perpendicular to building grid lines.
- .9 Remove any noisy ballasts from the luminaires and replace at no additional cost to the Owner prior to completion and final acceptance of the installation.
- .10 Emergency lights:
 - .1 Fill batteries delivered in dry state with electrolyte.
 - .2 Install unit equipment and remote mounted fixtures as indicated.
 - .3 Direct heads as required to obtain optimum illumination.

- .11 Exit lights:
 - .1 Install exit lights and connect to exit light circuit and emergency lamp to emergency circuit.
 - .2 Ensure exit light circuit breaker is locked in "ON" position.
- .12 Completely clean all luminaires, including lenses, lamps, hangers and interiors at completion of project and before final acceptance of project.
- .13 Perform tests in accordance with another Section in this Division entitled "Electrical, General Requirements. Do not megger the luminaires.

3.14 GROUNDING SYSTEM

- .1 Install complete system grounding and equipment bonding systems including number of electrodes, conductors, connectors and accessories to conform to requirements of Consultant, and local authority having jurisdiction over installation.
- .2 Install a grounding conductor in each conduit run unless otherwise indicated.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections to electrodes using copper welding by exothermic process or high pressure compression connectors. Bolt-type connectors are not acceptable.
- .6 Install an electrode box, placed flush with finished grade, high pressure compression connectors. Bolt-type connectors are not acceptable for access to top of ground rods.
- .7 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .8 Use Penetrox "E" joint compound on all connections.
- .9 Soldered joints not permitted.

3.15 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 00 10 – Electrical: General Requirements.
- .2 Identify each phase conductor of feeders and check phase rotation for 3-phase systems.
- .3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

- .4 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant, to ensure compliance with the Canadian Electrical Code, but not to be less than 5 ohms. The test to include the complete grounding system.
- .5 Provide Consultant with the test results.
- .6 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1 General

1.1 REQUIREMENTS

- .1 This section specifies the supply and installation of sheet metal kiosks and ancillary equipment.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 00 10 – Electrical: General Requirements.
- .2 Indicate:
 - .1 Details of sheet metal construction.
 - .2 Compartment sizes and overall dimensions, including equipment layout.
 - .3 Anchor bolt details.
 - .4 Scaled equipment layout.
 - .5 Hardware details.
 - .6 Details of ventilation provisions.
 - .7 Support and connection at antenna mast.

1.3 PAYMENT

- .1 No separate payment will be made for on this section. Include Electrical Kiosk costs in applicable lump sum prices of work items to which they are applied.

2 Products

2.1 CONSTRUCTION

- .1 Single-sided enclosure constructed of minimum 2.7 mm (12 Ga) thick sheet steel, to provide a rigid, free standing, weatherproof structure with weather and corrosion resistant finish. Provide permanent or detachable provisions for lifting of the assembly. Provide stiffeners and bracing as required to prevent “oil canning”.
- .2 Entire enclosure capable of withstanding snow and ice loads and a windforce of 100 km/h.
- .3 Doors and jambs arranged to give unobstructed access to the electrical equipment mounted within.
- .4 Maximum individual door width not to exceed 1100 mm for each door without Consultant's approval.

- .5 Kiosk interior to be lined with faced batt insulation, 38 mm (1.5 in.) polyisocyanurate. All insulated joints and exposed edges to be covered with foil tape.
- .6 Roof to be sloped and roof interior to be insulated with minimum 25 mm styrofoam material. Minimum 100 mm overhang all around. Provide rain gutter over doors.
- .7 Door to be heavy-duty, tamper-proof pan-type construction with heavy duty hinges and stainless-steel lockable handles with 3-point catch. Hinges to have weather caps and grease nipples. Minimum 12.7 mm diameter hole to be drilled in each door latch for installation of standard Owner-supplied padlock(s).
- .8 Handles, latches and padlocks must be recessed such that they cannot be struck off or cut with a hacksaw.
- .9 Metal pouch for drawings and O&M literature on inside of panel.
- .10 Air louvres with insect screens in or above each door, sized to provide adequate ventilation for type of equipment mounted within or for supply fan requirements where applicable.
- .11 All mounting hardware which is accessible from the exterior to be stainless steel. Bolts, where required, to be cap-type.
- .12 Provide a solidly bolted ground strap from the kiosk body to each door.
- .13 Overall dimensions, where indicated, are tentative minimum dimensions. Determine final dimensions based on the type and manufacture of the equipment mounted in the kiosk.
- .14 Apply in shop, heavy-duty, high-quality coating inside and out. Use dark transformer green for exterior and light grey for interior colour. Prepare kiosk for paint with a three-stage wash process and finish with polyester dry powdered coat with a minimum thickness of 3.0 mils.

2.2 MISCELLANEOUS

- .1 For kiosk mounted equipment and devices as shown on the drawings, refer to specification Sections 26 00 50 – Electrical Installation.

2.3 CONCRETE PAD

- .1 Precast as manufactured by AE Concrete Precast Products, or cast-in-place as specified on structural drawings.

3 Execution

3.1 INSTALLATION

- .1 Mount and secure on concrete pad as indicated.
- .2 Use shims as required to level properly.
- .3 Concrete pad placed on granular base as shown on drawings.
- .4 Concrete pad to be formed such that exposed sill slopes away from kiosk on all sides.
- .5 Use foam tape or a heavy silicon bead under and around kiosk base to provide a watertight seal.

3.2 EQUIPMENT MOUNTING

- .1 Provide a metal back pan and mounting panel in the kiosk with provision for mounting of equipment as indicated. Unless otherwise indicated, no equipment is to be mounted directly on walls and roof.
- .2 If required, use mounting brackets or supports, securely anchored to concrete pad, for mounting of equipment which cannot be readily mounted on plywood panel.
- .3 Locate equipment such that hinged doors can be opened at least 120° without being obstructed by kiosk door jambs.
- .4 Provide insulated restraining chain for individual enclosure doors if required to protect door-mounted devices.

3.3 WIRING METHODS

- .1 Inside the kiosk, acceptable wiring methods are RA and/or RPVC conduit.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

PART 1 General

1.1 REFERENCES

- .1 Conform to the BC Landscape Standard (BCSLA and BCLNA), 7th Edition: Section 4 – Grading and Drainage.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM D69891(1998), Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kNm/m ;).

1.2 EXISTING CONDITIONS

- .1 Refer to Geotechnical Report.
- .2 Verify locations of all existing utilities and buried structures prior to work.

1.3 PROTECTION

- .1 Protect all existing items to remain. If damaged, restore to original condition unless specified otherwise. Notify the Consultant immediately if any damage occurs.
- .2 Maintain access routes to prevent accumulation of mud on roads.

1.4 MEASUREMENT PROCEDURES

- .1 No measurement will be made under this Section. Include Rough Grading costs in applicable lump sum prices of related landscaping work to which they are applied.

PART 2 Products

2.1 MATERIALS

- .1 Fill material as specified under Section 31 23 10 – Excavating, Trenching and Backfilling.
- .2 Excavated or graded material existing on site may be suitable to use as fill for grading work if approved by Consultant.
- .3 Refer to Appendix A – Geotechnical Report.

PART 3 Execution

3.1 PREPARATION

- .1 Remove trees within site boundaries unless designated to remain.
- .2 Stake location of existing utilities.

3.2 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Consultant.
- .2 Commence topsoil stripping of areas as indicated as directed by Consultant or Consultant after area has been cleared of brush, weeds and grasses.
- .3 Avoid mixing topsoil with subsoil. Screen topsoil to remove roots and other large pieces of organic material.
- .4 Where possible re-use topsoil as fill in areas for planting. Rough grade to levels that allow sufficient depth of growing medium to be placed above as approved by Consultant. Growing medium depths range from 18" to 24".
- .5 Dispose of unused topsoil off site.

3.3 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade to depths corresponding to the depth of surface treatments as indicated.
- .3 Ensure positive drainage. Slope rough grade away from building min 1:50 minimum, or as indicated.
- .4 Grade ditches to depth as indicated.
- .5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .6 Compact filled and disturbed areas to corrected maximum dry density to ASTM D698, as follows:
 - 85% under landscaped areas.
 - 95 % under paved and walk areas.

- .7 Do not disturb soil within branch spread of trees or shrubs to remain. Grade ditches to depth as indicated.

3.4 SURPLUS MATERIAL

- .1 Remove all surplus material not required for backfill, grading or landscaping from the site as directed by the Consultant.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 DESCRIPTION

- .1 Furnish all labour, materials, equipment, and services necessary to excavation and backfill of all landscape paved areas, footings, walls, etc. indicated on Contract Drawings.
- .2 The Work shall include but is not limited to the following areas:
 - .1 Excavation of subgrade.
 - .2 Grading operations to attain subgrade design grades.
 - .3 Import and placement and compaction of granular fill materials.
 - .4 Compaction testing.
 - .5 Removal and disposal of excess material off Site.

1.2 CODES AND STANDARDS

- .1 Contractor is responsible for complying with all current WorkSafe BC requirements for Site safety related to the scope of Work in this section. This includes but is not limited to protection of personnel and Site safety procedures related to open excavation.

1.3 ON AND OFF SITE CONSTRUCTION MANAGEMENT

- .1 Contractor shall be responsible for implementation, maintenance, and decommissioning of vehicle wheel wash facility. Decommissioning of wheel wash facility includes but is not limited to fill with certified fill material and re-grading of affected area to the satisfaction of the Consultant.
- .2 Contractor shall be responsible for cleaning of adjacent municipal streets, private streets, railway lines, and driveways affected by vehicle movements on Site or to and from the Site.
- .3 Contractor shall be responsible for implementing and maintaining dust control measures for all on Site activities of this section. Dust control measures shall meet all local bylaws and regulations.

1.4 ON AND OFF SITE CONSTRUCTION MANAGEMENT

- .1 The Contractor shall be responsible for ensuring that there is minimal disruption of vehicle and pedestrian traffic flow on adjacent existing roads during Work of this section.
- .2 The Contractor shall be responsible for providing warning signs, flashing lights, flag people, barricades, etc. to ensure vehicle, train, and pedestrian movement associated with the Site or adjacent to the Site meets all applicable municipal, provincial, or federal requirements.

1.5 PROTECTION AND INTERRUPTION OF EXISTING SERVICES AND UTILITIES

- .1 Prior to commencing any excavation Work, the Contractor shall establish the location of any existing active buried utility or service lines, including service entry points, and retaining wall tie-rods and anchors. Mark these locations clearly on Site to prevent accidental disturbance during the Work.
- .2 Any utility or service which is presently in use, or not established as abandoned but which must be moved or otherwise disturbed, shall be referred to the utility or service company concerned so that they may advise on, coordinate, inspect necessary operation for relocation.
- .3 Costs incurred by any disturbance of existing active utilities and service lines, not called for under the Contract Documents, shall be borne by the Contractor.
- .4 Any damage done including settlement or collapse to existing active services caused by inadequate measures taken by the Contractor to prevent such disturbances shall be rectified immediately by the Contractor at no cost to the Owner.

1.6 PROTECTION OF ADJACENT STRUCTURES AND SURFACES

- .1 The Contractor shall protect all adjacent structures and surfaces including but not limited to roadways and sidewalks from damage, direct, or incidental as a result of Work of this section.
- .2 The Contractor shall make good all damages to adjacent structures and surfaces including but not limited to roadways and sidewalks as a result of Work of this section to the satisfaction of the Consultant.

1.7 PERMITS AND DEPOSITS

- .1 The Contractor shall at no cost to the Owner obtain all damage and/or crossing deposits required by the municipal, provincial, federal, or utility to carry out the Work of this section.

1.8 TESTS AND INSPECTIONS

- .1 The Contractor shall at no cost to the Owner and as part of the Work of this section perform, or cause to be performed, all tests, inspections, and approvals.
- .2 Should the test, inspection, or approval require a representative sample of the material or workmanship, the Contractor shall at no cost to the Owner supply the labour and materials necessary to provide the sample or test.
- .3 Should the test or inspection indicate that the material or Work completed does not conform to the Specifications, the Contractor shall at no cost to the Owner promptly remove this Work, dispose of it off Site and re-execute it in accordance with the Contract Documents. The remedial Work shall include retesting as required to establish conformance with the Contract Documents.

1.9 SUBMITTALS

- .1 Prior to the start of Work for this section, the Contractor shall submit the following to the Consultant for review:
- .2 Sieve analysis of granular material.
- .3 Chemical analysis of granular material that meets the requirements of the Consultant.
- .4 Source for supply of all materials (source shall be used throughout duration of Project). Should a change of material source be proposed during Work; provide samples and sieve analysis from proposed source.
- .5 Company name, address, and contact information for material testing company.

1.10 MEASUREMENT PROCEDURES

- .1 No measurement will be made under this Section. Include Excavating, Trenching, and Backfilling costs in applicable lump sum prices of related landscaping work to which they are applied.

2 Products

2.1 MATERIALS

- .1 Granular Sub-Base: shall be 75 mm (3 in.) minus, clean, granular material free of organic material conforming to following gradation limits:

Sieve Size (mm)	Percent Passing
100	100
75	55 to 100
4.8	30 to 100
0.55	15 to 80
0.25	10 to 50
0.075	0 to 5

- .2 Crushed Granular Base Course: the 19 mm (3/4 in.) crushed granular base course shall consist of sound, durable particles, free from clay, organic material, or other deleterious matter, evenly graded, to meet the following gradation requirements:

Sieve Size (mm)	Sieve Size (imperial)	Percent Passing
19	3/4 in.	100
12.5	1/2 in.	75 to 100
9.5	3/8 in.	60 to 90

Sieve Size (mm)	Sieve Size (imperial)	Percent Passing
4.75	#4	40 to 70
2.36	#8	27 to 55
1.18	#16	16 to 42
0.60	#30	8 to 30
0.30	#50	5 to 20
0.15	#100	5 to 15
0.074	#200	2 to 8

- .3 Native Material Fill: will be considered but must be reviewed and approved by the Environmental Engineer and either the Project geotechnical Engineer or should a geotechnical Engineer not be part of the Project team, a geotechnical Engineer engaged by the Contractor at no cost to the Owner:
- .4 Review and approvals by a geotechnical Engineer engaged by the Contractor shall be signed and sealed and submitted to the Consultant prior to use of this material.

3 Execution

3.1 EXCAVATION

- .1 Prior to commencing excavation, the Contractor shall:
 - .1 Confirm in writing to the Consultant that he has verified the locations of all underground services.
 - .2 Obtain in writing and submitted to the Consultant at no Cost to the Owner permission from adjacent property Owners and/or municipality to carry out Work beyond the property limits of this Contract if required to carry out the Work of this section.
 - .3 Notify the Consultant for on Site review of subgrade preparation Work 24 hours prior to commencement of import, placement, and grading operations.
 - .4 Grade to elevations and dimensions indicated on Contract Documents or required by the Work of this section or related sections.
 - .5 Ensure that Work of this section provides sufficient space to permit erection of forms, Site elements, and miscellaneous elements of related sections.
- .2 Excavation shall be carried out to ensure that the placement of fill materials are minimized.
- .3 Contractor shall phase his operation so that a stable slope at the edge of excavation is maintained at all times. Where sloping of the sides of excavations is not possible, the Contractor shall implement appropriate safety measures in accordance with current WorkSafe BC requirements.

- .4 All exposed excavation faces shall be protected from weather with appropriate tarps or plastic sheeting as soon as possible after being cut.
- .5 Remove all boulders, rock, and stones larger than 150 mm (6 in.) in diameter from excavated surfaces encountered during excavation. Fill cavities created with Consultant approved crushed granular base course material compacted to 95% Modified Proctor Density.
- .6 Bottom of excavation to be level, free from loose material, and debris.
- .7 Protect excavations against freezing. Frozen areas shall be thawed and protected from further frost until subsequent Work has been completed.
- .8 All necessary precautions shall be taken to preserve all materials outside the required excavations in an undisturbed condition.
- .9 Costs incurred as a result of deterioration caused by activities or neglect of the Contractor, and fill required for over excavation as a result of action by the Contractor, are the responsibility of the Contractor.

3.2 PLACEMENT OF GRANULAR FILL

- .1 Prior to the backfill operation of Site excavation, ensure the following actions have been completed:
 - .1 Concrete foundation walls and footings shall have reached specified strength unless otherwise approved by the Consultant.
 - .2 All backfill materials shall have been inspected and approved by the Environmental Engineer and the Geotechnical Engineer.
 - .3 Each component of the backfill operation shall have been inspected and approved to by the Environmental Engineer and Geotechnical Engineer at the time of placement.
 - .4 Compaction density tests shall have been completed and tests results reviewed and approved by the geotechnical Engineer.
 - .5 Place granular sub-base in maximum 300 mm (1 ft.) lifts to depths indicated on Drawings. Compact each lift to 95% Modified Proctor Density.
 - .6 Place crushed granular base course in maximum 150 mm (6 in.) lifts to depths shown on the Drawings. Compact each lift to 95% Modified Proctor Maximum Density.
 - .7 Place all native material fill in uniform 300 mm (1 ft.) compacted lifts to depths indicated on Drawings. Compact each lift to 95% Modified Proctor Density.
 - .8 Ensure that granular fill material is placed to the full width of the excavation, in uniform lifts, shaping each lift to smooth, even contours.
 - .9 Ensure the placement and compaction of granular sub-base and crushed granular base course does not segregate or degrade the aggregate.
 - .10 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.

.11 Mechanical compaction equipment shall be used with extreme caution to prevent any undue pressure on foundation Work. Do not use motorized compaction equipment directly adjacent to foundation or retaining walls.

.12 Where backfill is required on both sides of foundation walls, it shall be placed and compacted simultaneously on both sides of the wall.

.13 All subgrade, whether disturbed or undisturbed, shall be compacted to 95% Modified Proctor Density:

.14 Soft areas or areas that do not meet specified compacted densities shall be over excavated and filled with compacted crushed granular base course as required to obtain the specified compaction density.

3.3 GRADING SUBGRADE AND GRANULAR FILL

- .1 Site subgrade shall be shaped to lines and elevations indicated on Contract Drawings.
- .2 Finished surface of subgrade and granular fill material shall have no irregularities exceeding 10 mm (3/8 in.) when checked with a 3 m straight edge placed in any direction. Correct all subgrade and granular fill surface irregularities by loosening and adding or removing subgrade or granular fill material until surface is within specified tolerance. Correcting subgrade deficiencies by manipulating granular fill material is not acceptable.
- .3 Shaping of subgrade shall ensure uniform slope transitions with rounded, smooth profiles between changes in elevations.
- .4 Ensure that subgrade preparation allows for depth of granular fill and finished materials as indicated on Contract Drawings.

3.4 DEWATERING

- .1 Pump or otherwise continuously remove all water that has accumulated in excavation during the progress of the Work.
- .2 Do not divert water onto adjacent property.
- .3 Ensure that sediment control devices are in place as per municipal or provincial regulations prior to the start of dewatering operations. Do not divert dewatering effluent to natural water bodies.
- .4 Collect water samples to confirm water quality prior to placement in the municipal sanitary and/or storm sewer..

3.5 CLEAN UP

- .1 Clean up and remove from the Site, as the Work proceeds, any debris and waste material or rubbish resulting from the Work of this section.
- .2 Transport all surplus excavated materials, fill materials, and debris off Site to an approved disposal area.

END OF SECTION

PART 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM D175104, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB19.24M90, Multicomponent, ChemicalCuring Sealing Compound.
- .3 CSA International
 - .1 CSAA23.1/A23.22004, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSAG30.18M92(R2002), BilletSteel Bars for Concrete Reinforcement.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: Convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure key personnel attend.
- .2 Verify project requirements.

1.3 TRIAL MIXES

Trial mixes including on-site trial pour of a concrete section (including finishing, curing and jointing methods) shall be conducted. If appropriate, the following properties shall be evaluated in the trial: workability, air content, finishability, setting time, temperature development, hardened air-void parameters, strength and durability.

1.5 SAMPLES AND PROTOTYPES

- .1 Materials Samples: submit the following samples of materials for approval to the Consultant. Approved samples shall be used as the acceptable standard for all materials used on the project.
 - .1 Forming materials, including Board Form finish materials.

- .2 Gaskets, sealing materials, and form jointing system (as applicable).
- .3 Ties where specified.
- .4 Form release agent.
- .5 Expansion and isolation joints.

1.6 SAMPLE PANELS

- .1 At least fourteen (14) days before beginning work, construct on-site samples of the following items:
 - .1 Proposed sandblast finishes.
 - .2 Proposed float finishes.
 - .3 Proposed trowel control joints.

Each sample must be at least 500mm x 500mm.

Construct additional samples as necessary until a sample is approved by the Consultant.

- .2 Samples shall be reviewed and approved by the Consultant prior to commencing concrete work. Any concrete placed prior to sample approvals may be rejected. Construct additional samples when required by the Consultant until acceptable finish is achieved.

- .3 The samples SHALL NOT be part of the exposed Architectural concrete or finished slabs.

- .4 All finishes shall be compared to the approved samples on site for compliance.

1.7 TEST SECTION

The test section must be produced by the same workers who will complete the work.

1.8 TEST SECTION APPROVAL

- .1 Obtain approval of the Engineer/Designer for test sections. The approved test sections will become the standard.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by the Consultant.

- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.10 MEASUREMENT PROCEDURES

- .1 Payment for Modify and Construct New Integrated Concrete Paving shall be made at the Lump Sum Price bid. All materials and work required under this section, Section 31 22 13, Section 31 23 10 and other related sections to be included in Lump Sum Price bid. In relation to these specification sections, the Lump Sum Price shall include the cost of the following landscaping Work Items:
- .1 Removal and disposal off-site of existing concrete paving affected by overpass construction
 - .2 Construct new integral coloured concrete paving to match existing, including grade preparation as required, and including saw-cut pattern as indicated in drawings and specifications

PART 2 Products

2.1 CAST-IN-PLACE CONCRETE

- .1 Concrete Mix: cast-in-place concrete specific to this section shall meet the following criteria:

Property	Criteria
Minimum 28 Day Strength	35 MPa
Slump	75 mm (3 in.), ±20 mm (3/4 in.)
Maximum Aggregate Size	19 mm (3/4 in.)
Exposure Classification	C-2
Water Cement Ratio	0.45
Air Content	5% to 8%

- .2 Water: potable in accordance with CSA-A23.1.
- .3 Air Entraining Add Mixtures: in accordance with ASTM C260.
- .4 Water Reducing Admixtures: in accordance with CSA-A23.2.

2.2 INTEGRAL COLOUR CAST-IN-PLACE CONCRETE

- .1 Integral Liquid Colour Additive: iron oxide pigment suitable for sandblasted concrete that will produce a uniform, consistent colour. Colour pigment shall be permanent, inert, stable in atmospheric conditions, sunfast, weather resistant,

alkali resistant, lime proof, and non-bleeding. Particle size shall be 95% to 99% minus 325 mesh.

.2 Acceptable Products include SGS Color-Flo Liquid Colors, by Solomon Colors, Springfield, Illinois, sgs@solomoncolor.com or pre-approved equal.

.3 Colour as indicated on Contract Drawings.

.4 Concrete Mix: integral coloured cast-in-place concrete specific to this section shall meet the following criteria:

Property	Criteria
Minimum 28 Day Strength	35 MPa
Slump	75 mm (3 in.), ± 20 mm (3/4 in.)
Maximum Aggregate Size	19 mm (3/4 in.)
Exposure Classification	C-2
Water Cement Ratio	0.50
Air Content	5% to 8%
Colour Pigment Weight	Maximum 10% of Cement Weight

.3 Ensure that the same concrete mix design, Supplier, and batch plant is used throughout the duration of this Project.

.4 Water: potable in accordance with CSA-A23.1.

.5 Air Entraining Add Mixtures: in accordance with ASTM C260.

.6 Water Reducing Admixtures: in accordance with CSA-A23.2.

.7 Calcium chloride shall not be used.

2.3 CAST-IN-PLACE CONCRETE ACCESSORIES

.1 Formwork: as specified under PART 3 - EXECUTION

.2 Curing Compound: to conform to ASTM C309. Vocomp - 20 water based curing and sealing compound by W.R. Meadows; or other pre-approved equal. Seal tight fibre expansion joint.

.3 Reinforcing Steel: as indicated on Drawings.

- .4 Expansion Joint Material: unless otherwise indicated in Contract Documents, 13 mm (1/2 in.) resilient, flexible, non-extruding, expansion-contraction joint filler. Cellular fibres securely bonded together, uniformly saturated with asphalt:
- .1 To ASTM D1751.
 - .2 Resilience: when compressed to half of original thickness, recover to a minimum of 70% of original thickness.
 - .3 027 Fibre Expansion Joint, W.R. Meadows, or other pre-approved equal.
- .5 Caulk Joint Materials:
- .1 Pre-Moulded Joint Fillers: closed cell low density polyethylene foam backer rod.
Acceptable Products include:
 - .1 Sonneborn, polyethylene expansion joint filler.
 - .2 Sternson, Rodofoam PVC expansion joint filler GR grade.
 - .3 Industrial Thermal Polymers, 101 standard backer rod. Thickness and depth of application as recommended by the manufacturer to suit joint thickness.
 - .6 Joint Sealant: shall be self-levelling, non sag, two part polyurethane type, conforming to CGSB 19.24-M80, Type 1, Class B. Acceptable Products include:
 - .1 Sika; Sikaflex-2C NS Mix TG
 - .2 Iso-Flex 880 GC
 - .3 Sonneborn SL2Colour from standard range as indicated on the Contract Drawings.
 - .7 Bond Break Tape: pressure sensitive plastic tape which will not bond to sealants.
 - .8 Joint Cleaner: xylol, methyl ethyl ketone or non-corrosive type recommended by the sealant manufacturer and compatible with the joint forming material.
 - .9 Non-Staining Type Form Release Agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap:
 - .1 Acceptable Products include Eco-Coat by W.R. Meadows or other pre-approved equal.

2.2 TESTING

- .1 The Owner may retain an independent material testing firm to carry out the following test:
 - .1 Poured Concrete: test: slump, air content and compressive strength and evaluate the properties identified in 1.3 for trial mixes.
 - .2 Such other testing as may be requested by the Designated Inspecting Authority. The materials testing firm may be requested to submit one set of test results directly to the Contractor.

- .2 The cost of initial testing shall be paid by the Owner, additional re-testing shall be paid by the Contractor.
- .3 The Contractor shall maintain records of concrete items: date, location of pour/application, quality (rated strengths of shipments and any additives such as retarders), air temperature, and any tests taken.

PART 3 Execution

3.1 GENERAL

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1-00.

3.2 PREPARATION

- .1 Provide Consultant 24 hours notice before each concrete pour.
- .2 Place concrete reinforcing in accordance with CAN/CSA-A23.1-00.
- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of rehandling, and without damage to existing structure or Work.
- .4 Protect previous Work from staining.
- .5 Clean and remove stains prior to application of concrete finishes.

3.3 WORKMANSHIP

- .1 Obtain Consultant's approval before placing concrete. Provide 24 hours notice, minimum, prior to placing concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix design.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of existing concrete during placing and curing new concrete areas.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or plains of weakness. If a section cannot be placed continuously, construction joints shall be located as permitted by the Consultant.

All pour and construction joints shall be formed with a straight-edge fixed to formwork or other methods submitted by Contractor and approved by Consultant. Placing shall be carried out at such a rate that concrete which is being integrated with fresh concrete is still plastic.

.7 Compact concrete with high-frequency vibrators applied directly to concrete by experienced personnel. Do not over-vibrate. Tap outside of forms with a hammer to ensure joints and exposed areas are well cast.

.8 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Attach steel dowels of deformed steel reinforcing bars with epoxy adhesive to the depths shown on the drawings or specified by the manufacturer.

.9 Take every precaution to protect finished surfaces from stains and abrasions. Surfaces and edges likely to be damaged during the construction period shall be especially protected. Any chipped, abraded or cracked edges, slabs shall be repaired by Contractor at no cost to Owner.

.10 Do not place load upon new concrete until authorized by Consultant.

.11 Place slabs-on-grade in alternate panels, complete with maximum size of 16m². Where specified on drawings, construction joints shall be keyway type at spacing as noted on the Contract Documents. Infill panels to be placed a minimum of seven (7) days after placing adjacent panels. Seal joints where specified.

.12 Unless otherwise specified by the Contractor's curing plan approved by Consultant, wet cure all concrete slabs for a minimum of seven (7) days using wet burlap covered with polyethylene sheets. Wet the burlap at regular intervals.

3.4 INSERTS

.1 NO sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where expressly detailed on structural drawings or approved by the Consultant.

.2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from the Consultant before placing of concrete.

3.5 TOLERANCES

.1 Concrete tolerances to be in accordance with CAN/CSA-A23.1-00, or as noted in Sub-section 3.1.5 of Section Concrete Formwork.

3.6 GRADE PREPARATION

- .1 Inspect sub-grade for adequate and uniform compaction. Remove any debris. Assure positive drainage. Check for 'soft' spots with probe rod.
- .2 Excavate soft spots to sound material and fill with suitable granular material to prepare a smooth and even sub-grade allowing for specified depths of granular base and concrete to meet design grades.
- .3 Compact to requirements called for on the drawings.
- .4 Place fill, to requirements of the drawings. Compact to sub-grade requirement allowing for specified structural fill material.
- .5 Dispose of surplus and unsuitable excavated material in an approved location.
- .6 Provide containment and drainage for curing water, ensuring water does not fall on adjacent roadways or shoulders or impede traffic movement in any way.

3.7 GRANULAR BASE

- .1 Obtain Consultant's approval of sub-grade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated.
- .3 Place granular base to achieve minimum 150 mm thickness to within 50mm of lines. Then grade the final 50mm with finer mulch suitable for wet compacting; compact layers to minimum 95% Proctor requirements.

3.8 PREPARATION

- .1 Prior to placing of any concrete, the work shall be cleared, cleaned or otherwise prepared in accordance with the design drawings, details and specifications in order that the work may proceed in an orderly fashion in accordance with the intended schedule of development. All existing services, structures, already completed works, etc., shall be protected and preserved as necessary.

3.9 FORM CONSTRUCTION AND STEEL REINFORCING

- .1 Forms shall be so constructed that the finished concrete will conform with the shapes, lines, grades and dimensions indicated on the plan.
- .2 Plug, tape and seal all cracks and holes in forms to withstand pressure and remain watertight.
- .3 Design forms to permit removal without damage to finish.
- .4 Clean and condition formwork before each use. Repair or replace any damaged form that may effect the concrete finish.

- .5 Lumber used in forms shall be free from warp. For any exposed surfaces, it shall be dressed to a uniform width and thickness and be free from loose knots, decay or other defects. For unexposed surfaces and rough work, undressed lumber may be used if means be taken to prevent leakage of mortar.
- .6 Unless otherwise specified, all corners shall be formed square on the concrete as shown on details.
- .7 The inside of forms shall be coated with non-staining mineral oil or other approved liquid or thoroughly wetted, (except in freezing weather). Where oil is used, it shall be applied before the reinforcement is placed.
- .8 Care shall be taken to ensure that forms do not become dried and warped before concrete is deposited. Before concrete is placed, forms and reinforcement shall be checked and approved by the Consultant's site representative.
- .9 Forms shall not be disturbed until the concrete has adequately hardened. Forms are to be removed in a regular sequence of elapsed time between pour and removal so as to maintain colour consistency. The proper time for removal of forms shall be determined by the Consultant.
- .10 Whenever forms are removed from showing faces before the concrete has become hard and dry, the surface of the concrete shall be immediately wetted and kept wet for at least 7 days. Defects in showing faces shall be rectified to the satisfaction of the Consultant.

3.10 FORMWORK

- .1 Do formwork to WCB Occupational Health and Safety Regulation 20.17 and as follows:
 - .1 Form materials for concrete surfaces which will be exposed to view, or which require smooth and uniform surfaces for applied finishes or other purposes, shall consist of square edged smooth panels of paper finish plywood. Panels shall be made in a true plane, clean, free of holes, surface markings, and defects.
 - .2 Form release agents and curing agents shall be compatible with applied finishes where applicable. Do not use release agents containing wax or oil in connection with concrete to receive applied coatings.
 - .3 Ties in exposed work shall generally be placed symmetrically about any section with plywood sheets and from each wall section.
- .2 Set to proper grade and alignment. Assure positive drainage.

- .3 Construct straight and warp free with no bulging when concrete placed. Fit tightly at joints and corners.

3.11 ADDITION OF MIX WATER

.1 Mix water addition shall be in strict accordance with CSA A-A23.1, Clause 5.2.4.3.2. No water from the truck system or elsewhere shall be added after the initial introduction of the mixing water for the batch except when, at the start of discharge, the measured slump of the concrete is less than that specified and no more than 60 minutes have elapsed from the time of batching to the start of the discharge. In this case, water may be added by the producer up to an amount not exceeding 12 ℓ per cubic metre (2 gallons per cubic yard). The resulting concrete must satisfy the specified requirements.

3.12 ADDITION OF COLOUR ADDITIVE

.1 Addition of liquid colour additive to concrete to follow manufacturers written instructions. Contractor to note the following key points.

- .1 Mixer to be loaded to 40% capacity to ensure good colour dispersion.
- .2 Mix design, ready-mix plant, water to cement ratio shall be consistent for the extent of the Project.
- .3 Prior to adding colour, reverse drum bringing the concrete to the back of the truck. Pour colour onto concrete thereby reducing direct contact of colour with sides of drum.
- .4 Mix at high speed for five minutes prior to placing concrete.
- .5 Do not add water to the batch once colour has been added.

3.13 PATCHING

- .1 **No patching of horizontal surfaces will be accepted.**
- .2 Areas to be repaired shall be determined by the Consultant and shall not exceed 0.2 square metres for each 93 square metres of surface area, and shall be widely dispersed. Repairs shall match the surrounding area. Architectural concrete requiring repair in excess of above standard is subject to rejection by the Consultant and shall be removed and replaced. Removal and replacement of work shall be at no additional cost to the Owner.
- .3 Before commencing any repair work, the Contractor shall confirm repair procedures with the Consultant and establish by trial mix the formula required. The Contractor shall demonstrate his repair techniques on a prototype sample panel.

- .4 The following are key steps to making a repair to architectural concrete:
 - .1 Prepare the area to be repaired. This should include achieving the desired finish in the surrounding area. Remove loose particles and chip out part of the sound concrete to avoid feather edge repairs.
 - .2 Proportion the repair mix by weight according to the same proportions as used in the concrete mix but substituting a portion of white cement for grey cement. This should be based on tests to determine what is required to match the finished surface.
 - .3 Apply a coat of bonding material to the root of the areas to be repaired, being careful to avoid dripping on any surface to be exposed.
 - .4 Fill in the area to be repaired with mortar of the stiffest consistency that will permit placing. Consolidate in place and strike off so as to leave the repaired area slightly higher than the surrounding surface to permit initial shrinkage. The repair shall be left undisturbed for at least one hour before being textured.
 - .5 Cure the repaired area by keeping continuously damp for 7 days.
 - .6 Clean the repaired area to remove laitance and match the surrounding area.
 - .7 Repair of cracks in concrete slabs and slabs-on-grade shall be the sole responsibility of the Contractor at no expense to the Owner to satisfy the requirements of the intended final use.

3.14 TOLERANCES

- .1 Finish surfaces to within 3mm in 3m as measured with straight edge placed anywhere on the surface. Slope to drain away wherever adjacent to building. Local depressions greater than 1mm under straight edge are not permitted.
- .2 Match surrounding grades smoothly and evenly.

3.15 EXPANSION JOINTS

- .1 Unless otherwise indicated on Contract Drawings, expansion joints shall be located at 10.0 m (30 ft.) on centre, at each end of driveway crossings, at face of buildings and curbs and at tangent points on circular walk.
- .2 Extend through full depth of concrete. Terminate joint 12 mm (1/2 in.) below finished surface to allow for approved sealant.
- .3 Caulking material shall be applied to locations noted on Drawings after a minimum of 14 day concrete cure or as specified by manufacturer. Ensure all

surfaces of the joint to be caulked are dry and have been cleaned in accordance with manufacturer's instructions. Ensure that the face of all joints is primed prior to caulking. Use bond break tape or closed cell backer rod at bottom face of joint in accordance with the manufacturer's instruction.

3.16 CONTROL JOINTS

- .1 Unless otherwise noted on Construction Drawings, control joints are to be set at a maximum of 1.5 m (5 ft.) on centre.
- .2 Control joints to be a minimum 1/4 depth of concrete section at point of cut or as otherwise shown on Project details. Saw cut joints to be sawn as soon as the concrete can be cut without ravelling or no later than 16 hours after placement.

3.17 COMPOUND SURFACES

- .1 Typically the concrete is placed in individual panels and segments to suit designed, compound surfaces. These are placed in 'leap-frog' fashion, allowing maximum amount of shrinkage to take place before placing intermediate panels.
- .2 The construction joint between panels, segments and flat slabs is to be key way type joint (no dowels), unless called for on drawings. Use styrene or wood block outs. Use form release on all edges prior to pour.
- .3 Drainage slopes must be planned with care from slab section edges to drain path shown on drawings or direct to drain. Ensure that drains are not plugged from surface material from unpoured sections.
- .4 When placing, ensure good vibration and rapping with hammer along joints and edges.

3.18 FINISHES

- .1 Finish surfaces to produce smooth, uniform surfaces free of open texturing and exposed aggregate. Do not work more mortar into surface than required; do not use neat cement as drier to facilitate finishing.
- .2 Schedule of Finishes:
 - .1 Sand Blast Finish – Where Specified
 - .1 Sandblast all stair treads (not risers) and paved concrete surfaces as indicated on the drawings or as instructed by the Consultant.
 - .2 Provide light sand blast finish concrete as approved sample provided.
 - .3 The surface, in general, shall not require any treatment after form removal, other than repair of defective concrete, snap-tie holes, and the removal of ridges and surface irregularities.

3.19 UNFORMED SURFACE

The finish to be provided for the various unformed surfaces shall be:

- .1 Plastic Concrete Surfaces:
 - .1 Working of the concrete surface shall take place while it is sufficiently plastic to achieve the desired shape, plane, and texture. Screeding shall be followed by one or more of the operations of darbying, floating, trowelling, and tooling of edges and joints, in that order, to provide the surface finish specified in the drawings or by the Consultant.
 - .2 Initial finishing shall be accomplished by screeding, darbying, or bull floating and shall be performed in accordance with the requirements of CAN/CSA-A23.1-00, Clause 22.2.
 - .3 Initial finishing operations shall be completed before any bleed or free water appears on the concrete surface. Overworking, which can bring excessive fines to the concrete surface, shall not be permitted.
 - .4 Final finishing shall be accomplished by mechanical floating, mechanical trowelling, creation of the specified surface finish, and tooling of edges and joints, in that order. Exposed edges and corners shall be detailed. Surfaces at tooled edges and corners shall be trowelled and sand-blasted to remove tool edge marks. Hand floating and trowelling shall only be permitted in small areas of restricted access. All final finishing procedures shall conform to the requirements of CAN/CSA-A23.1-00, Clause 22.5.
 - .5 Final finishing shall commence after bleed water has disappeared from the surface and when the concrete has stiffened sufficiently to prevent the working of excess water to the surface. Concrete with higher proportions of fly ash can be expected to exhibit reduced bleeding, and trial mixes in 1.3 should be used to determine the appropriate time for commencing final finish. No additional dry cement or water shall be used to facilitate finishing.
 - .6 The final finish to be provided shall be as specified herein and as noted on the drawings:
 - .1 Float Finish – for slab surfaces as noted.
Provide sample panels for the Consultant's approval in accordance with subsection 1.6.2 above. This finish is typically applied to slabs or unless noted otherwise on the drawings.
 - .2 Sandblast Finish in accordance with Section 03 35 00 – Concrete Finishing.
Types:

1. Light Sandblasted finish
2. Medium Sandblasted Finish

Provide a sample section of each sandblast that is approved by the Consultant in accordance with subsection 1.6.2 above.

3.20 CURING - CHEMICAL CURE

- .1 Apply approved curing compound to all exposed concrete surfaces at rate recommended by manufacturer or alternatively, use moist curing procedures for a minimum of seven days.
- .2 When temperature is below 5 deg. Celsius (41 deg. Fahrenheit) maintain all concrete at temperatures not less than 10 deg. Celsius (50 degrees Fahrenheit) for at least 72 hours.
- .3 Protect from freezing for at least another 72 hours or such time as required to ensure proper curing of concrete. Admixtures are not be used for prevention of freezing.

3.21 BACKFILL

- .1 Allow concrete to cure for 7 days prior to backfilling. Comply with all structural requirements. Curing time is longer for retaining walls over 3'-0". Backfill height as specified on the drawings, approved by Consultant.

3.22 DEFECTIVE CONCRETE

- .1 Remove defective concrete, blemishes and embedded debris; repair as required and directed by Consultant.

3.23 DEPOSITING CONCRETE

- .1 Concrete shall be deposited in forms as nearly as practical in its final position, to avoid re-handling and in approximately uniform horizontal layers. Depositing shall be continuous until the unit of operation is complete and as rapid as practicable to ensure bonding of the successive layers.
- .2 Concrete shall be thoroughly worked around reinforcement and embedded fixtures and in to all parts of the forms. Coarser particles shall be worked back from the face of the forms. Vibrate and rap concrete mass in forms, especially around embeds and against keyways and lockouts, in accordance with good industry practice.

3.24 PROTECTION

- .1 All areas of the work shall be protected from damage including that caused by vandalism, security against all risk to public, security guards until acceptance, temporary barriers, warning devices and other such equipment or material as

required to protect the completed work and work site shall be the responsibility of the Contractor.

- .2 Grind and round off corners where required.

3.25 CLEANUP

- .1 The work area shall be thoroughly cleared of all debris, excess material and litter accumulated during the course of the work or associated with the work and such material shall be disposed to an approved site.

3.26 RESTORATION OF IMPROVEMENTS

- .1 All damage to areas incidental to this work shall be repaired by the Contractor to the satisfaction of the Owner.

3.27 FINAL DRESSING

- .1 After concrete is fully set, prior to handover, dress all areas with dressing stone and grinder as directed by Consultant. This will include slab surfaces, edges, control and construction joints, coping/slab joints and walls.

3.28 QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by the Owner in accordance with CAN/CSA-A23.2-00.
- .2 Owner will pay for costs of tests.
- .3 Testing Laboratory will take additional test cylinders during cold weather concreting. Cure cylinders on job site under the same conditions as concrete which they represent.
- .4 If results of test show concrete to be less than specified in quality or strength, the Consultant shall have the right to have the mix designs altered for the remainder of the work at no cost to the Owner. Further testing and remedial measures required by CAN/CSA-A23.1-00 shall be done, the costs of this work paid for by the Contractor.
- .5 Inspection or testing by Owner will not augment or replace Contractor quality control nor relieve him of his contractual responsibilities.

3.29 ALTERNATIVE METHODS OF CONSTRUCTION

- .1 Alternative methods must be approved prior to close of tender. Submissions after tender will not be accepted.

- .2 Alternative methods must be pre-approved by a structural Consultant registered in the Province of British Columbia and retained by the Contractor.
- .3 The Consultant has no obligation to accept alternative methods.

END OF SECTION

PART 1 General

1.1 REFERENCES

- .1 ASTM International
 - .1 ASTM C13606, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM C11704, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM D431805, Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - .4 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB8.188, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB8.2M88, Sieves, Testing, Woven Wire, Metric.

1.2 ACTION AND INFORMATION SUBMITTALS

- .1 Furnish all labour, materials, equipment, and services necessary to excavation and backfill of all landscape paved areas, footings, walls, etc. indicated on Contract Drawings.
- .2 The Work shall include but is not limited to the following areas:
 - .1 Excavation of subgrade.
 - .2 Grading operations to attain subgrade design grades.
 - .3 Import and placement and compaction of granular fill materials.
 - .4 Compaction testing.
 - .5 Removal and disposal of excess material off Site.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Submittals in accordance with Division 02.
- .2 Prior to the start of Work for this section, the Contractor shall submit the following to the Consultant for review.
 - .1 Sieve analysis of granular material.

- .2 Chemical analysis of granular material that meets the requirements of the Consultant.
- .3 Source for supply of all materials (source shall be used throughout duration of Project). Should a change of material source be proposed during Work; provide samples and sieve analysis from proposed source.
- .4 Company name, address, and contact information for material testing company.
- .3 Scheduling: co-ordinate paving schedule to minimize interference with normal use of premises.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 02, and with manufacturer's written instructions.
- .2 Store crushed stone as and where directed by Consultant.

1.5 QUALITY ASSURANCE

- .1 The Owner shall retain a testing firm to carry out tests on material and workmanship used in construction, to verify they are in accordance with the specifications. Materials shall be the best of their respective kinds within the terms of this specification, and substitutes or deviation from those specifications can only be made by obtaining prior to approval and written permission from the Consultant.
- .2 Where required by the Consultant, supply certified copies of tests upon materials to be used in the construction of the work, indicating that the materials comply with the specifications.
- .3 Contractor to supply certificate of compaction test to Consultant for approvals and acceptance.

1.6 ALIGNMENT AND GRADE

- .1 Crown or crossfall shall be incorporated in the finished pathway surface to ensure positive drainage. Pathway finish grade shall blend into existing topography.
- .2 The Consultant will establish horizontal pathway centre line alignment. Use pathway layout on drawings as an indication of scope only.
- .3 Offset centre line stakes prior to construction and ensure that the offset stakes are protected during the construction process.

1.7 SAMPLES

- .1 A sample of the gravel surfacing shall be supplied for approval by Consultant prior to delivery to site. The approved sample shall be the standard throughout the work.

1.8 PROTECTION FROM DAMAGE

- .1 Protect trees, shrubs, lawns, planted areas and other features remaining as part of final landscaping.
- .2 Protect buildings, sidewalks, curbs, paved and gravelled areas against damage.
- .3 Restore bench marks and reference lines from damage.
- .4 Maintain adequate barriers and construction signs to prevent injury to the public.
- .5 Prior to commencement of work, confirm and establish from drawings and utility plans, the location and extent of underground utilities occurring in the areas.
- .6 Protect active utility lines exposed by excavation from damage. Final excavation to be done by hand.

1.9 MEASUREMENT PROCEDURES

- .1 Payment for Modify, Supply and Install Hard Landscaping shall be made at the Lump Sum Price bid. All materials and work required under this section, Section 31 22 13, Section 31 23 10, Section 32 31 13, Section 32 32 34 and other related sections to be included in Lump Sum Price bid. In relation to these specification sections, the Lump Sum Price shall include the cost of the following landscaping Work Items:
 - .1 Relocation of bolder, trees, and other hard landscaping items, as indicated in drawings
 - .2 Re-instate Deltalok wall and provide crushed stone paving as indicated in drawings
 - .3 Supply and install new chain link fence and associated footings, as indicated in drawings and specifications

PART 2 Products

2.1 MATERIALS

- .1 Granular Sub-Base: shall be 75 mm (3 in.) minus, clean, granular material free of organic material conforming to following gradation limits:

Sieve Size (mm)	Percent Passing
100	100

Sieve Size (mm)	Percent Passing
75	55 to 100
4.8	30 to 100
0.55	15 to 80
0.25	10 to 50
0.075	0 to 5

.2 Crushed Granular Base Course: the 19 mm (3/4 in.) crushed granular base course shall consist of sound, durable particles, free from clay, organic material, or other deleterious matter, evenly graded, to meet the following gradation requirements:

Sieve Size (mm)	Sieve Size (imperial)	Percent Passing
19	3/4 in	100
12.5	1/2 in.	75 to 100
9.5	3/8 in.	60 to 90
4.75	#4	40 to 70
2.36	#8	27 to 55
1.18	#16	16 to 42
0.60	#30	8 to 30
0.30	#50	5 to 20
0.15	#100	5 to 15
0.074	#200	2 to 8

.3 Native Material Fill: will be considered but must be reviewed and approved by the Environmental Consultant and either the Project geotechnical Consultant or should a geotechnical Consultant not be part of the Project team, a geotechnical Consultant engaged by the Contractor at no cost to the Owner:

.1 Review and approvals by a geotechnical Consultant engaged by the Contractor shall

PART 3 Execution

3.1 EXCAVATION

- .1 Prior to commencing excavation, the Contractor shall:
 - .1 Confirm in writing to the Consultant that he has verified the locations of all underground services.
 - .2 Obtain in writing and submitted to the Consultant at no Cost to the Owner permission from adjacent property Owners and/or municipality to carry out Work beyond the property limits of this Contract if required to carry out the Work of this section.
 - .3 Notify the Consultant for on Site review of subgrade preparation Work 24 hours prior to commencement of import, placement, and grading operations.
- .2 Grade to elevations and dimensions indicated on Contract Documents or required by the Work of this section or related sections.
- .3 Ensure that Work of this section provides sufficient space to permit erection of forms, Site elements, and miscellaneous elements of related sections.
- .4 Excavation shall be carried out to ensure that the placement of fill materials are minimized.
- .5 Contractor shall phase his operation so that a stable slope at the edge of excavation is maintained at all times. Where sloping of the sides of excavations is not possible, the Contractor shall implement appropriate safety measures in accordance with current WorkSafe BC requirements.
- .6 All exposed excavation faces shall be protected from weather with appropriate tarps or plastic sheeting as soon as possible after being cut.
- .7 Remove all boulders, rock, and stones larger than 150 mm (6 in.) in diameter from excavated surfaces encountered during excavation. Fill cavities created with Consultant approved crushed granular base course material compacted to 95% Modified Proctor Density.
- .8 Bottom of excavation to be level, free from loose material, and debris.
- .9 Protect excavations against freezing. Frozen areas shall be thawed and protected from further frost until subsequent Work has been completed.
- .10 All necessary precautions shall be taken to preserve all materials outside the required excavations in an undisturbed condition.

.11 Costs incurred as a result of deterioration caused by activities or neglect of the Contractor, and fill required for over excavation as a result of action by the Contractor, are the responsibility of the Contractor.

3.2 PLACEMENT OF GRANULAR FILL MATERIAL

.1 Prior to the backfill operation of Site excavation, ensure the following actions have been completed:

.1 Concrete foundation walls and footings shall have reached specified strength unless otherwise approved by the Consultant.

.2 All backfill materials shall have been inspected and approved by the Environmental Consultant and the Geotechnical Consultant.

.3 Each component of the backfill operation shall have been inspected and approved to by the Environmental Consultant and Geotechnical Consultant at the time of placement.

.4 Compaction density tests shall have been completed and tests results reviewed and approved by the geotechnical Consultant.

.2 Place granular sub-base in maximum 300 mm (1 ft.) lifts to depths indicated on Drawings. Compact each lift to 95% Modified Proctor Density.

.3 Place crushed granular base course in maximum 150 mm (6 in.) lifts to depths shown on the Drawings. Compact each lift to 95% Modified Proctor Maximum Density.

.4 Place all native material fill in uniform 300 mm (1 ft.) compacted lifts to depths indicated on Drawings. Compact each lift to 95% Modified Proctor Density.

.5 Ensure that granular fill material is placed to the full width of the excavation, in uniform lifts, shaping each lift to smooth, even contours.

.6 Ensure the placement and compaction of granular sub-base and crushed granular base course does not segregate or degrade the aggregate.

.7 Apply water as necessary during compaction to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is suitable for compaction.

.8 Mechanical compaction equipment shall be used with extreme caution to prevent any undue pressure on foundation Work. Do not use motorized compaction equipment directly adjacent to foundation or retaining walls.

- .9 Where backfill is required on both sides of foundation walls, it shall be placed and compacted simultaneously on both sides of the wall.
- .10 All subgrade, whether disturbed or undisturbed, shall be compacted to 95% Modified Proctor Density:
- .1 Soft areas or areas that do not meet specified compacted densities shall be over excavated and filled with compacted crushed granular base course as required to obtain the specified compaction density.

3.3 GRADING SUBGRADE AND GRANULAR FILL

- .1 Site subgrade shall be shaped to lines and elevations indicated on Contract Drawings.
- .2 Finished surface of subgrade and granular fill material shall have no irregularities exceeding 10 mm (3/8 in.) when checked with a 3 m straight edge placed in any direction. Correct all subgrade and granular fill surface irregularities by loosening and adding or removing subgrade or granular fill material until surface is within specified tolerance. Correcting subgrade deficiencies by manipulating granular fill material is not acceptable.
- .3 Shaping of subgrade shall ensure uniform slope transitions with rounded, smooth profiles between changes in elevations.
- .4 Ensure that subgrade preparation allows for depth of granular fill and finished materials as indicated on Contract Drawings.

3.4 DEWATERING

- .1 Pump or otherwise continuously remove all water that has accumulated in excavation during the progress of the Work.
- .2 Do not divert water onto adjacent property.
- .3 Ensure that sediment control devices are in place as per municipal or provincial regulations prior to the start of dewatering operations. Do not divert dewatering effluent to natural water bodies.
- .4 Collect water samples to confirm water quality prior to placement in the municipal sanitary and/or storm sewer.

3.5 CLEAN UP

- .1 Clean up and remove from the Site, as the Work proceeds, any debris and waste material or rubbish resulting from the Work of this section.

-
- .2 Transport all surplus excavated materials, fill materials, and debris off Site to an approved disposal area.

3.3 PROTECTION

- .1 Prevent damage to buildings, landscaping (refer to 3.5), curbs, sidewalks, trees, roads, fences, and adjacent property.
 - .1 Repair damages incurred.
- .2 Provide access to building at all times. Co-ordinate paving schedule to minimize interference with normal use of premises.

3.4 LANDSCAPE REHABILITATION

- .1 Path edges and where finished landscape has been disturbed will be raked smooth and blended to existing grades.
- .2 Where indicated on the Contract Documents, specified growing medium is to be spread to abut the path edge.

END OF SECTION

PART 1 GENERAL

1 General

1.1 DESCRIPTION

- .1 Furnish all labour, materials, equipment, and services necessary for the complete installation of all weld construction galvanized chain-link fence system to City of New Westminster Parks standards as indicated in the Contract Documents. The Work includes but is not limited to supply and installation of:
 - .1 Fusion bonded vinyl woven metal mesh fabric.
 - .2 Field welding of post, rail connection.
 - .3 Priming and painting of all exposed, uncoated galvanized metal components.
 - .4 Excavation and placement of concrete footings for all posts.

1.2 SUBMITTALS

- .1 Provide Shop Drawings of all fence and gate components illustrating post spacing, footing design, gate locations, assembly details, and general arrangement of all components for complete installation. Provide Product data that includes gauge of metal wire and mesh, post wall thickness, conformation of fusion bonded vinyl mesh.
- .2 Samples:
 - .1 300 mm by 300 mm (12 in. by 12 in.) sample of the fusion bonded vinyl chain-link fabric.
 - .2 Paint colour chip and manufacturers colour code number matching mesh colour.
 - .3 Product datasheets confirming galvanized metal Specifications.

1.3 REFERENCE STANDARDS

- .1 CAN-138.1 Fence, Chain-Link, Fabric
- .2 ASTM-F668 Class 2B Thermally Fused Vinly Coated Steel Fabric
- .3 CAN/CGSB-138.2 Fence, Chain-Link, Fabric, Framework, Zinc-Coated, Steel
- .4 CAN/CGSB-138.3 Fence, Chain-Link, Fabric - Installation
- .5 CAN/CGSB-138.4 Fence, Chain-Link, Gates
- .6 CAN/CGSB-1.1812 Ready-Mixed Organic Zinc-Rich Coating

- .7 CAN/CSA-G164 Hot-Dipped Galvanizing of Irregularly Shaped Articles
- .8 CSA-A23.1 Concrete Materials and Methods of Concrete Construction
- .9 CSA-A23.2 Methods of Test for Concrete

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- .1 Store packaged material in original containers with all manufacturer's seals and labeling intact.
- .2 Prevent damage to materials during handling and storage. Keep materials under cover and free from moisture.

1.5 APPROVED EQUALS

- .1 All items as specified or pre-approved equals.

1.6 MEASUREMENT PROCEDURES

- .1 No measurement will be made under this Section. Include Chain Link Fences and Gates costs in applicable lump sum prices of related landscaping work to which they are applied.

2 Products

2.1 MATERIALS

- .1 All pipe, woven mesh, tie wires, tension wires and bands, connectors, fittings and hardware to be hot-dipped galvanized.
- .2 Pipe: to CAN2-138.2, Table 1 Medium Duty, Schedule 40 (wall thicknesses as shown below), standard continuous weld, modulus of elasticity 30,000:

Outside Pipe Diameter Schedule	40 Wall Thickness
15/8 in.	0.140 in. (9/64 in.)
17/8 in.	0.145 in. (19/128 in.)
23/8 in.	0.154 in. (5/32 in.)
27/8 in.	0.203 in. (13/64 in.)
31/2 in.	0.216 in. (7/32 in.)
41/2 in.	0.237 in. (15/64 in.)

- .3 Fusion Bonded Vinyl Woven Metal Mesh Fabric:

- .1 To CAN2-138.1, 6-gauge, 4.88 mm (0.1920 in.) with 45 mm (13/4 in.) openings. Top and bottom selvages to have knuckled finish.
- .2 Fusion bonded vinyl coating to ASTM-F668 Class 2B, 7 mL to 10 mL coating thickness. Vinyl coating shall have specific gravity of minimum 1.30, ASTM D792. Hardness of vinyl coating A-93-3, ASTM D2240.
- .3 Colour: Black.

.4 Fence Component Sizes (note: pipe sizes shown are outside diameter):

Fence Component	Size (1.2 m Height)	Size (1.5 m and Taller Height)
Bottom Rail	50 mm (1 7/8 in.)	63 mm (2 1/2 in.)
Mid Rails	63 mm (2 1/2 in.)	63 mm (2 1/2 in.)
Top Rail	50 mm (1 7/8 in.)	75 mm (2 7/8 in.)
Line Posts	75 mm (2 7/8 in.)	75 mm (2 7/8 in.)
End/Man Gate Posts	75 mm (2 7/8 in.)	75 mm (2 7/8 in.)
Vehicular Gate Posts	89 mm (3 1/2 in.)	89 mm (3 1/2 in.)
Mid Brace	50 mm (1 7/8 in.)	63 mm (2 1/2 in.)
Tie Wire Spacing	150 mm (6 in.) o.c	150 mm (6 in.) o.c
Hog Ring Spacing	100 mm (4 in.) o.c.	100 mm (4 in.) o.c.
Tack Welds Where Specified	All Tension Bands and Frame Members	All Tension Bands and Frame Members

- .5 Tension Bar: 16 mm by 5 mm (3/4 in. by 3/16 in.), length to match entire height of fabric section.
- .6 Tie Wire: 3.55 mm (9-gauge) galvanized.
- .7 Bottom Tension Wire: tension wire is not acceptable, provide pipe rail as per 'Fence Component Size' chart.
- .8 Concrete: to CSA CAN3-A 23.1 and A23.3:
 - .1 Type 10 cement.
 - .2 Compressive strength 32 MPa minimum at 28 days.
 - .3 Coarse aggregate nominal size 19 mm (3/4 in.).

- .4 Admixture for Air Entrainment: 5% \pm 1%.
- .5 Slump at time and point of discharge (19 mm to 75 mm) (3/4 in. to 3 in.).
- .9 Touch-Up Paint: zinc rich organic ready-mixed coating to CGSB-1-GP-181M.
- .10 Post Caps: cone type galvanized steel or cast aluminum alloy designed to fit snugly over posts and exclude moisture.

3 Execution

3.1 POST SPACING

- .1 Maximum post spacing 3 m (10 ft.) on centre. Unless otherwise indicated in Contract Documents, set end posts in straight and true alignments. Line posts spacing shall be field adjusted to ensure equal spacing between end posts. Set all end, line, and gate posts vertical and plumb in concrete footings.

3.2 CONCRETE FOOTINGS

- .1 Unless otherwise detailed, the minimum footing dimensions shall be 1,200 mm (4 ft.) deep, footing diameter, 150 mm (6 in.) larger than outside post diameter, post depth embedment in footing, 75 mm (3 in.) from bottom of footing.
- .2 Posts shall be installed in concrete footings prior to installation and welding of top and bottom rail.

3.3 FENCE CONSTRUCTION

- .1 Unless otherwise noted, fence posts, top, bottom, and mid rail connections shall be all welded construction. Weld all ends continuously to adjoining member. Grind all welds smooth.
- .2 Weld connections to be coped. No crimping or flattening will be permitted. Connections not meeting this Specification will be rejected and replaced with specified construction at the Contractor's expense:
 - .1 Cope all posts to accept top rail.
 - .2 Cope all mid rail and bottom rails to fit posts.
- .3 Mid rails shall be installed at all end sections and all sections adjacent to gates and corners, for all fences. All fences 2.4 m (8 ft.) high or higher shall have horizontal mid rails installed continuous in all sections.

- .4 Install tension bands where fabric terminates at all terminal, corner, and gate posts. Tack weld as required.
- .5 Unless otherwise indicated, place fusion bonded metal mesh fabric on the inside (active use side) of all areas to be enclosed:
 - .1 Place the fusion bonded metal mesh fabric by securing one end with stretcher bar and hog rings, applying sufficient tension to remove all slack before making end or mid post connections 100 mm (4 in.) above finished grade. Clearance to be measured at the post locations. Fusion bonded metal mesh fabric shall be tighten to provide a smooth uniform appearance free from sags.
 - .2 Insert stretcher bar, connect stretcher bar to end post with hog rings at 380 mm (15 in.) on centre, maximum spacing. Cut the fusion bonded metal mesh fabric at tension bar, finish by creating knuckled selvedge at bottom and twisted selvedge at top.
 - .3 Fasten fusion bonded metal mesh fabric to line posts at 150 mm (6 in.) on centre and mid, bottom or top rails at 100 mm (4 in.) on centre with tie wire.
 - .4 Join rolls of fusion bonded metal mesh fabric by weaving a single picket into the ends of the rolls to form a continuous mesh.
- .6 Tack weld firmly in place all post tops.

3.4 FINISH

- .1 Unless otherwise indicated, all posts, rails, mid posts, braces, gates, and miscellaneous hardware are to be left unpainted galvanized metal.
- .2 Do not paint fusion bonded metal mesh fabric.

3.5 CLEAN UP

- .1 Clean up all excess and waste material and remove from the Site to satisfaction of City of New Westminster staff inspector.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

1 General

1.1 GENERAL

- .1 Stainless steel fencing (mesh and support frame) shall be provided in accordance with the details provided in the Contract Drawings and as specified herein.
- .2 Preferred Mesh Product (subject to final approval):
 - .1 GKD - Futura 3110PC Mesh: Type 316 stainless steel mesh with 67% open area; bright finish; weight 8.6 kg/m² (1.76 lb/ft²); mesh thickness 9.9 mm (0.39 in.).

1.2 SUBMITTALS

- .1 Manufacturer's Instruction / Data Sheets, including:
 - .1 The proper preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .2 Shop Drawings: Submit drawings indicating the following:
 - .1 Mesh series and pattern name.
 - .2 Panel sizes.
 - .3 Panel thickness.
 - .4 Installation details.
 - .5 Details of stainless steel support frame.
- .3 Verification Samples:
 - .1 Provide two samples, size 24 inch (600 mm) square, representing actual product, color, and patterns, and section of support frame.

1.3 ALTERNATIVES

- .1 Any proposed alternative shall be submitted for consideration as early as possible, including a 24 inch (600 mm) mesh sample, but no later than 10 days before tender close. Alternatives shall have a bright finish, have a 64% to 67% open area, and be physically and technically equal to the preferred mesh product specified. The Engineer has the sole discretion to accept or reject any alternative.

1.4 PAYMENT

- .1 No measurement will be made under this Section. Include the fencing mesh panel costs in applicable lump sum prices of the related fencing work in which they are included. The portion of the Lump Sum Price associated with the stainless steel fencing panels shall include samples, manufacturer's instructions, shop drawings, fabrication, and installation of stainless steel mesh panels and supporting stainless steel frames, and all ancillary parts.

2 **Products**

Not Used

3 **Execution**

Not Used

END OF SECTION

1 General

1.1 GENERAL

- .1 Galvanized steel fencing (mesh and support frame) shall be provided in accordance with the details provided in the Contract Drawings and as specified herein.
- .2 Preferred Mesh Products (subject to final approval):
 - .1 TWG – M13Z-145 Mesh: Pre-galvanized steel mesh with 64.5% open area; weight 8.6 kg/m² (1.75 lb/ft²); mesh thickness 9.3 mm (0.365in.).

1.2 SUBMITTALS

- .1 Manufacturer's Instruction / Data Sheets, including:
 - .1 The proper preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .2 Shop Drawings: Submit drawings indicating the following:
 - .1 Mesh series and pattern name.
 - .2 Panel sizes.
 - .3 Panel thickness.
 - .4 Installation details.
 - .5 Details of hot-dipped galvanized support frame.
- .3 Verification Samples:
 - .1 Provide two samples, size 24 inch (600 mm) square, representing actual product, color, and patterns, and section of support frame.

1.3 ALTERNATIVES

- .1 Any proposed alternative shall be submitted for consideration as early as possible, including a 24 inch (600 mm) mesh sample, but no later than 10 days before tender close. Alternatives shall be physically and technically equal to the preferred mesh product specified. The Engineer has the sole discretion to accept or reject any alternative.

1.4 PAYMENT

- .1 No measurement will be made under this Section. Include the fencing mesh panel costs in applicable lump sum prices of the related fencing work in which they are included. The portion of the Lump Sum Price associated with the galvanized steel fencing panels shall include samples, manufacturer's instructions, shop drawings, fabrication, and installation of pre-galvanized steel mesh panels and supporting hot-dipped galvanized steel frames, and all ancillary parts.

2 Products

Not Used

3 Execution

Not Used

END OF SECTION

PART 1 General

1.1 SUMMARY

- .1 This section describes the requirements for all mechanically stabilized earthen (MSE) retaining walls to be furnished and installed in the Work and associated components and fills, specifically the following:
 - .1 SierraScape retaining wall system.
 - .2 Deltalok retaining wall system.
 - .3 Face fill and backfill.
 - .4 Geotextile and drainage composite.

1.2 REFERENCES

- .1 AASHTO M288 Standard Specification for Geotextiles
- .2 AASHTO T289 Determining pH of Soil for Use in Corrosion Testing
- .3 AASHTO Standard Specification for Highway Bridges
- .4 ASTM A 82/A 82M Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
- .5 ASTM A 123/A 123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .6 ASTM A 185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement
- .7 ASTM A 641/A 641M-03 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
- .8 ASTM D 422 Particle Size Analysis
- .9 ASTM D 698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
- .10 ASTM D 1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method
- .11 ASTM D 2166 Unconfined Compressive Strength of Cohesive Soil
- .12 ASTM D 2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- .13 ASTM D 2922 Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- .14 ASTM D 3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- .15 ASTM D 3080 Direct Shear Test of Soils Under Consolidated Drained Conditions
- .16 ASTM D 4318 Liquid Limit, Plastic Limit and Plasticity Index of Soil
- .17 ASTM D 4355 Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
- .18 ASTM D 4595 Tensile Properties of Geotextiles - Wide Width Strip
- .19 ASTM D 4716 Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
- .20 ASTM D 5262 Unconfined Tension Creep Behavior of Geosynthetics

- .21 ASTM D 6637 Determining Tensile Properties of Geogrids by the Single or Multi-Rib Test Method; 2001
- .22 ASTM D 6638 Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)
- .23 ASTM D 6706 Geosynthetic PULLOUT Resistance in Soil
- .24 ASTM F 904 Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials; 1991
- .25 GRI-GG2 Standard Test Method for Geogrid Junction Strength
- .26 GRI-GG4 Determination of Long Term Design Strength of Geogrid
- .27 Tensar Earth Technologies, Inc. "Design Guidelines for Tensar Geogrid Reinforced Soil Walls with SierraScape Facing Units," TTN: SierraScape-DG.
- .28 National Concrete Masonry Association, Design Manual for Segmental Retaining Walls.

1.3 SUBMITTALS

- .1 Submit under provisions of Division 02.
- .2 Product Data: manufacturer's datasheets on each Product to be used, including the following:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .3 Shop Drawings: engineering Drawings, elevations, and large-scale details of elevations, typical sections, details, and connections:
 - .1 Include design calculations sealed by a registered Professional Engineer licensed in the Province of British Columbia.
 - .2 Manufacturer's certifications that the ultimate tensile strength and junction strength of the geogrid are equal to or greater than those specified.
- .4 Samples: two samples of each wall system component including:
 - .1 Geogrids: 4 in. by 18 in. (102 mm by 457 mm) piece.
 - .2 Facing Unit: 12 in. (305 mm) wide section of welded wire facing with one diagonal strut and 12 in. (305 mm) section of connection rod.
 - .3 Geotextile: 4 in. by 8 in. (102 mm by 203 mm) piece.
 - .4 Turf Reinforcement Mat: 4 in. (102 mm) by 8 in. (203 mm) piece.
 - .5 Drainage Composite: 4 in. by 8 in. (102 mm by 203 mm) piece.

- .5 Manufacturer's Certificate: certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- .1 Design Requirements: design retaining wall systems in accordance with the local codes and regulations and the design guidelines of AASHTO, NCMA, or Tensar Earth Technologies, Inc. Design shall be by a Professional Engineer registered in the Province of British Columbia and who is employed by a firm that has designed at least five Projects of similar construction and scope.
- .2 Manufacturer Qualifications: MSE wall system components manufactured by Tensar Earth Technologies, Inc. and companies approved and authorized by Tensar Earth Technologies, Inc.
- .3 Installer Qualifications: firm with documented experience of at least five Projects of similar construction and scope. Include brief description of each Project and name and phone number of Owner's representative knowledgeable in each listed Project.
- .4 Pre-Construction Meeting: prior to construction of retaining walls, conduct a meeting at the Site with the retaining wall materials Supplier, the retaining wall installer, and the Contractor to review the retaining wall requirements. Notify the Owner and the Consultant t at least three days in advance of the time of the meeting.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Check all materials upon delivery to assure that the proper type, grade, color, and material certification have been received.
- .2 Handle all materials in accordance with manufacturer's recommendations and in a manner to prevent deterioration or damage from moisture, contaminants, breaking, chipping, or other causes.
- .3 Store Products in manufacturer's unopened packaging until ready for installation.
- .4 Prevent excessive mud, fluid concrete, epoxy, or other deleterious materials from coming in contact with and affixing to retaining wall materials.
- .5 Polymeric Materials: store at temperatures above -20 deg. Fahrenheit (-29 deg. Celsius); rolled materials may be laid flat or stood on end.

1.6 PROJECT CONDITIONS

- .1 Do not place backfill when subgrade is wet or frozen.
- .2 Do not place backfill during wet or freezing weather that prevents conformance with specified compaction requirements.

1.7 MEASUREMENT PROCEDURES

- .1 No measurement will be made under this Section. Include Mechanically Stabilized Earthen Retaining Walls costs in applicable lump sum prices of related landscaping work to which they are applied.

2 Products

2.1 MANUFACTURERS

- .1 Acceptable SierraScape Manufacturer:
 - .1 SierraScape facing unit, diagonal strut, and connection rod manufacturers approved by Tensar Earth Technologies, Inc., #200 - 5883 Glenridge Drive, Atlanta, GA 30328. ASD. Telephone: (404) 250-1290 (international), Toll Free: (888) 828-5128, Fax: 404-250-0461, Website: www.tensarcorp.com/A, EMail: info@tensarcorp.com.
 - .2 Tensar Structural Geogrid: The Tensar Corporation, Inc. 1210 Citizens Parkway, Morrow, GA 30309.
- .2 Acceptable Deltalok Manufacturer:
 - .1 SierraScape facing unit, diagonal strut, and connection rod manufacturers approved by Tensar Earth Technologies, Inc., #200 - 5883 Glenridge Drive, Atlanta, GA 30328. ASD. Telephone: (404) 250-1290 (international), Toll Free: (888) 828-5128, Fax: 404-250-0461, Website: www.tensarcorp.com/A, EMail: info@tensarcorp.com.
 - .2 Tensar Structural Geogrid: The Tensar Corporation, Inc. 1210 Citizens Parkway, Morrow, GA 30309.
- .3 Substitutions: not permitted.

2.2 MATERIALS

- .1 SierraScape Facing System: steel welded wire mesh facing unit, bent 90 degrees at long centreline to form "L" shaped unit; vertical section as face to retain fill, and horizontal leg extending into fill, with structural geogrid mechanically

connected to rear edge of horizontal leg and diagonal struts supporting top edge of vertical leg:

- .1 Wire Mesh Facing Unit: galvanized, in accordance with ASTM A 82, ASTM A 185, and ASTM A 123/A 123M.
 - .2 Wire Strut Type: galvanized, in accordance with ASTM A 82 and ASTM A 641/641M.
 - .3 Wire Mesh Spacing: 1.80 in. by 12.75 in. (45 mm by 324 mm) (vertical x horizontal wires) unless otherwise indicated on the Drawings.
 - .4 Wire Mesh Minimum Diameters: 0.192 in. (4.87 mm), vertical wires and 0.243 in. (6.17 mm) horizontal wire (before galvanizing).
 - .5 Wire Strut Minimum Diameter: 0.243 in. (6.17 mm).
 - .6 Tie wire or cable ties to connect vertical wires of adjacent facing units.
 - .7 Method of Connecting Geogrid to Facing Unit: inverted U-shaped or V-shaped loops in wires of horizontal leg near rear edge fit through alternate apertures between geogrid ribs and bear against transverse direction bars of geogrid, forming mechanical connection to transfer load between facing unit and geogrid. Connection secured by 3/4 in. (20 mm) diameter by 54 in. (1.37 m) long SierraScape connection rod placed through loops and over geogrid ribs. The rods are formulated with 25% glass filled HDPE.
- .2 SierraScape Structural Geogrid: Tensar UX1400MSE: polymeric grid formed by regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock or earth and function primarily as reinforcement:
 - .1 Ultimate Tensile Strength: 4,800 lb/lin. ft. (70 kN/M), minimum average roll value, when tested in accordance with ASTM D 6637.
 - .2 Junction Strength: 4,520 lb/lin. ft. (66 kN/m), minimum average roll value, when tested in accordance with GRI-GG2.
 - .3 SierraScape Stone Fill: free draining, uniformly graded stone placed immediately behind the face of the wire mesh facing unit:
 - .1 Gradation for 4 in. and 2 in. Materials:
 - .1 100% passing a 4 in. (102 mm) sieve.

- .2 0% to 10% passing a 2 in. (51 mm) sieve.

- .4 Reinforced Backfill: SierraScape granular fill with a pH range of 2 to 12, when tested in accordance with AASHTO T 289, and graded as follows:
 - .1 100% to 75% passing a 2 in. (51 mm) sieve.
 - .2 100% to 75% passing a 3/4 in. (19 mm) sieve.
 - .3 100% to 20% passing a No. 4 sieve.
 - .4 0% to 60% passing a No. 40 sieve.
 - .5 0% to 35% passing a No. 200 sieve.

- .5 Geotextile: non-woven geotextile, AASHTO M288, Class 3.

- .6 Deltalok System: steel welded wire mesh facing unit, bent 90 degrees at long centreline to form "L" shaped unit; vertical section as face to retain fill, and horizontal leg extending into fill, with structural geogrid mechanically connected to rear edge of horizontal leg and diagonal struts supporting top edge of vertical leg:
 - .1 Wire Mesh Facing Unit: galvanized, in accordance with ASTM A 82, ASTM A 185, and ASTM A 123/A 123M.

- .7 Reinforced Backfill: Deltalok granular fill shall consist of well graded 38 mm minus sand and gravel containing less than 5% passing the No. 200 US sieve size or approved equivalent:
 - .1 Deltalok Structural Geogrid: Checkmate Flexgrid UX50PET, or approved (polyester) equivalent.

3 Execution

3.1 PREPARATION

- .1 Do not begin installation until excavation to foundation elevation has been completed and the foundation for the reinforced fill and levelling pad has been properly prepared.

- .2 The suitability of the proposed wall installations relative to actual conditions in the field shall be confirmed by the geotechnical Consultant prior to construction.

- .3 Excavation:
 - .1 Excavate subgrade vertically to plan elevation and horizontally to designed geogrid lengths.
 - .2 Geotechnical Consultant will inspect foundation area to ensure proper bearing strength.
 - .3 Remove soils not meeting required strength and replace with geotechnical Consultant approved materials.

- .4 Compaction: compact foundation materials to a minimum of 95% Standard Proctor Dry Density in accordance with ASTM D 698.

3.2 CONSTRUCTION

- .1 Construct SierraScape wall system in accordance with approved Shop Drawings and manufacturer's instructions:
 - .1 Facing Unit Installation:
 - .1 Place the first course of wire mesh facing units with the connection loops on the horizontal legs resting on the foundation material.
 - .2 Verify that the first row of facing units is level from end to end and from front to back.
 - .3 Connect geogrids to facing units as specified below.
 - .4 Overlap the horizontal wire extensions of front faces of adjacent facing units. Tie together vertical wires of adjacent facing units as required to maintain alignment and prevent escape of backfill material.
 - .5 Use a string line or equivalent to align straight sections.
 - .6 Place subsequent courses of facing units on previous courses, at a setback, if any, as shown on Shop Drawings.
 - .7 Align subsequent courses of facing units using a string line or other suitable method that is independent of the final position of the underlying course of facing units.
 - .2 Geogrid-to-Facing Unit Connection and Connection Rod Installation:
 - .1 Unroll geogrid and cut to length shown on plans, minus distance between front face and front of the connection loop of the facing unit, approximately 15 in. (380 mm). Cut geogrid ribs at the front side of the transverse bar.
 - .2 Place the geogrid ribs over the connection loops of the facing units such that the loops extend up through every other aperture of the geogrid. Pull the geogrid back such that the transverse bar is in contact with the connection loops. Use two full widths of geogrid per facing unit. The two ribs on outer edges of the geogrids should be positioned between the first two wires on the edges of the facing unit. The two ribs on the opposite edges of the geogrid should be

- positioned between the centre wire and the wires adjacent to it.
Tworibs of geogrid shall be positioned between each pair of wires.
- .3 Where the transverse bar cannot engage the wire connection loop due to misalignment of apertures and wire loops, cut the transverse bar midway between the wire loops to allow the geogrid to be spread or overlapped slightly to achieve correct alignment of grid apertures with connection loops. The transverse bar will usually have to be cut at the ends of the third, fifth, and seventh apertures from both edges of the geogrid and occasionally at a few apertures in the centre section of the geogrid to achieve the correct alignment with the wire connection loops.
 - .4 Thread the SierraScape connection rods through the wire connection loops over the geogrid ribs.
 - .5 After placement of geogrid and any required face wrap, place seven wire support struts on approximately 18 in. (475 mm) centres connecting the upper horizontal wire on the face of facing unit to back wire behind the connection loop. Place one of the support struts at each end of the facing unit between the outer two wires.
- .2 Construct Deltalok wall system in accordance with approved Shop Drawings and manufacturer's instructions:
- .1 The geogrid reinforcement shall be attached to the Deltalok fascia by means of Deltalok's standard connectors. Once attached to the fascia, the geogrid reinforcement shall be pulled taut toward the back of the reinforced fill zone, in order to remove all slack prior to fill placement (on top of it). It is imperative that the geogrid lie flat on the fill such that it will not become pre-tensioned upon placement of the next lift of fill.
 - .2 The geogrid reinforcement shall be continuous with no splicing of shorter lengths.
 - .3 Construction Equipment shall not be operated directly on the geogrid. A minimum thickness of 150 mm of the backfill shall be placed over the geogrid prior to allowing any Construction Equipment on the geogrid.
 - .4 As the wall height varies between survey stations, the Contractor shall ensure that the final uppermost row of geogrid is located within 0.4 m of the top of the wall. Where this condition is not met, the Contractor shall add on an extra layer of geogrid 0.3 m below the top of the wall.
- .3 Fill:

- .1 Pull connection tight and secure by placing facing fill over the connection prior to placement of reinforced fill over rest of geogrid.
 - .2 SierraScape Stone Face Fill (2 in. to 4 in.): place stone face fill over horizontal leg of facing unit to dimensions shown on Shop Drawings and cover with geotextile to separate from reinforced backfill. Compacted Lift Thickness: maximum 9 in. (229 mm).
 - .3 Backfill: place reinforced backfill material in compacted lifts, maximum 9 in. (229mm) deep. Compact to minimum of 95% Standard Proctor Dry Density in accordance with ASTM D 698.
 - .4 Use only hand-operated compaction equipment within 1.2 m of front face, operated parallel to the wall façades. Compaction shall start at the façade and Work away from the walls. Use a minimum of three passes to compact this zone.
 - .5 Mechanical vibrating plate compactors shall not be run on top of Deltalok bag units.
 - .6 Do not perform soil density testing within 1.0 m of front face.
 - .7 Smooth and level backfill to ensure geogrid lays flat.
- .4 SierraScape Geogrid Placement:
- .1 Confirm the orientation (i.e., maximum strength direction) of the geogrid with the geotechnical Consultant.
 - .2 Unroll the geogrid on the compacted backfill and cut to the length indicated.
 - .3 Pull the geogrid taut to remove slack in the geogrid and at the facing unit connection.
 - .4 Stake or pin the geogrid near the end to maintain alignment and tension during filling.
 - .5 Place a minimum of 3 in. (75 mm) of fill between overlapping layers of geogrid where overlapping occurs behind curves and corners of a wall.
 - .6 Rubber tired vehicles may travel on the geogrid at low speeds, less than 5 mph. Turning of vehicles should be avoided to prevent dislocation or damage to the geogrid and the connected wall facing units.

- .7 Tracked vehicles shall not be operated directly on the geogrid. A minimum of 8 in. (200 mm) of fill cover over the geogrid is required for operation of tracked construction vehicles in the reinforced zone.
- .5 Deltalok Facing:
- .1 Refer to the Deltalok technical manual for bag placement and preparation considerations. Questions should be directed to Deltalok Inc. (B. Stickney).
- .2 The wall façades shall consist of Deltalok Bag Type GTX R031 “W”.
- .3 The Contractor shall check the wall façade angle regularly to confirm that the specified batter (as shown in the attached design Drawings) is maintained.
- .4 Properties of sail for bag filling shall be as per the Deltalok technical manual.
- .5 Deltalok standard connector units shall be utilized to connect the wall façade to the geogrid. Dimensions are height 42 mm b length 286 mm by width 100 mm.
- .6 All debris shall be cleaned off the top of the bags prior to placement of the next lift.
- .7 A minimum of 0.6 m burial of the wall shall be implemented. The actual number of bags to be buried will be dependent upon bag thickness.
- .8 GTX bags shall be filled completely, to a consistent weight, density, and size, allowing adequate material for secure closure of the bag (refer to the Deltalok technical manual for approved bag closure methods).
- .9 The Contractor shall place Deltalok standard connection units longitudinally to straddle each juncture of sail bags (as shown in the Deltalok technical manual).
- .10 The Contractor shall arrange regular field reviews with Deltalok Inc. to assure germination and/or coverage of the bag material within three months following seeding and planting.

3.3 FIELD QUALITY CONTROL

- .1 Testing and inspection will be provided by the Owner’s testing agency as specified in Division. Notify the Consultant 72 hours in advance of testing.
- .2 Perform laboratory material tests in accordance with ASTM D 698.

- .3 Perform in place compaction tests in accordance with the following:
 - .1 Density Tests: ASTM D 1556, ASTM D 2167, or ASTM D 2922 as appropriate for material tested.
 - .2 Moisture Tests: ASTM D 3017.
- .4 Frequency of Tests:
 - .1 Subgrade Soil: a minimum of one test per 100 sq. m (1,000 sq. ft.) of surface area.
 - .2 Reinforced Backfill: provide one test for every 40 cu. m (50 cu. yd.) of fill placed.
- .5 Submit test results regularly to the Consultant in a timely manner.

3.4 FIELD REVIEW

- .1 The Contractor is responsible for ensuring that the Consultant is contacted in a timely manner to perform field reviews for all relevant elements of the retention system.
- .2 The Consultant shall be contacted to perform field reviews prior to the following stages of construction:
 - .1 Geogrid reinforcement material confirmation.
 - .2 Backfill material confirmation and placement.
- .3 The Consultant shall be contacted to confirm their field review requirements prior to construction.
- .4 Compaction testing of all engineered fills shall be conducted by the geotechnical Consultant.

3.5 PROTECTION

- .1 Protect installed Products until completion of Project.
- .2 Touch-up, repair, or replace damaged Products before substantial completion.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

PART 1 General

1.1 DESCRIPTION

- .1 Work included: Supply all labour, services and material necessary to prepare, supply and install growing medium and mulch as specified herein.

1.2 REFERENCES

- .1 Conform to the BC Landscape Standard (BCSLA & BCLNA), 7th Edition: Section 6 – Growing Medium and Section 10 – Mulching.
- .2 Agriculture and Agri-Food Canada
 - .1 Canadian System of Soil Classification, Third Edition, 1998.
- .3 Canadian Council of Ministers of the Environment
 - .1 PN1340-2005, Guidelines for Compost Quality.

1.3 DEFINITIONS

- .1 For the purpose of this specification the term ‘growing medium’ shall mean a mixture of mineral particulates, micro organisms and organic matter which provides a suitable medium capable of supporting the intended plant growth.
- .2 Compost:
 - .1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
 - .2 Compost is processed organic matter containing 40% or more organic matter as determined by WalkleyBlack or Loss On Ignition (LOI) test.
 - .3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth, and contain no toxic or growth inhibiting contaminants.
 - .4 Composed biosolids to: CCME Guidelines for Compost Quality, Category A.

1.4 INSPECTION

- .1 Verify the size, location and depth of all existing site services and sub-surface utilities prior to commencement of the work. Repair all damage as result of failure to perform adequate inspection at no cost to Owner.
- .2 Notify the Consultant when the site is prepared for growing medium placement. Do not place growing medium until subgrades have been inspected and approved.

- .3 Provide at least two days (48 hours) notice in advance of each required inspection.

1.5 SUBMITTALS

- .1 Provide submittals in accordance with Division 02 - General Requirements.
- .2 Quality control submittals :
 - .1 Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in PART 2 - SOURCE QUALITY CONTROL. Tested shall be done by an approved independent soil testing laboratory, (such as Pacific Soil Analysis; Mr. Bill Herman, #5 11720 Voyageur Way, Richmond B.C. Ph. 273-8226). Submit soil test results from a professionally accredited soil analysis lab to the Landscape Consultant.
 - .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 QUALITY ASSURANCE

- .1 Advise the Consultant of sources of growing medium to be utilized on this Project a minimum of thirty days (30) prior to starting work of this Section.
- .2 Carry out growing medium preparation and placement such that the final product matches the standard set by the samples submitted, within a range of variation that may reasonably be expected with good quality control.
- .3 The Consultant may appoint an independent testing laboratory to ascertain compliance with this specification and to recommend modifications to make the growing medium meet the requirements of this specification

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.
- .2 Divert unused soil amendments from landfill to official hazardous material collections site approved by the Consultant.
- .3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

1.8 PRODUCT HANDLING

- .1 Do not move or work growing medium or additives when they are excessively wet, extremely dry, or frozen or in any manner which will adversely affect growing medium structure. **Growing medium whose structure has been destroyed by handling under these conditions will be rejected.**
- .2 Protect growing medium and additives against extreme wetting by rain or other agents, and against contamination by weeds and insects.
- .3 Stockpile materials in bulk form on paved areas and provide protection by storing under roof or tarpaulins. Take all necessary precautions to prevent contamination of component materials from wind blown soils, weed seeds and insects. Contamination of individual components may result in rejection, if used.
- .4 Deliver and store fertilizers and other chemical ingredients in the manufacturer's original containers. Protect against damage and moisture until incorporated into the work.

1.9 APPROVED EQUALS

- .1 All items as specified or pre-approved equals.

1.10 MEASUREMENT PROCEDURES

- .1 No measurement will be made under this Section. Include Growing Medium Preparation And Placement costs in applicable lump sum prices of related landscaping work to which they are applied.

PART 2 Products

2.1 GENERAL

- .1 In this Section, a range of measurable physical and chemical properties are set out as being acceptable in a growing medium. Compliance with this Section is to be determined by testing for those properties. When imported or on-site soil is used, it is to be tested and modified as necessary by admixture of other components to bring its properties within ranges set in 2.10 for growing medium.

2.2 ON-SITE SOIL

- .1 On-site soil may be used as a component of on-grade growing medium if it can be modified to meet the requirements established by the BCNTA / BCSLA Landscape Standard (Current Edition) outlined in Section 6.2.1 and 6.2.2.
- .2 On site soil proposed for re-use on site as growing medium must be tested by an approved independent soil testing laboratory, (such as Pacific Soil Analysis; Mr. Bill Herman, #5 11720 Voyageur Way, Richmond B.C. Ph. 273-8226). Submit soil test results from a professionally accredited soil analysis lab to the Landscape Consultant.
- .3 The soil analysis shall be of tests done on the proposed growing medium and additives proposed for the work from samples taken at the supply source, within three weeks immediately prior to growing medium placement. Costs of the initial analysis, and subsequent tests to ensure compliance with the specification shall be borne by the Contractor. Failure to submit soils analysis is cause for immediate rejection of any placed growing medium. (The Contractor is responsible for testing the on -site soil to determine its suitability for amendment to meet specifications of this Section to serve as the growing medium).
- .4 The analysis shall include a breakdown of the following components: total nitrogen by weight, available levels of phosphorous, potassium, calcium, magnesium, soluble salt content, organic matter by weight, % sand, % fines (silt and clay)and pH value. In addition, the analysis shall clearly indicate the Project Name, Date Tested and Contractor's Name.
- .5 Submit with the above analysis, the testing laboratory's recommendations for amendments, fertilizers and other modifications to make the proposed growing medium meet the requirements of this specification.
- .6 Submit to the Consultant one composite sample of each type of proposed growing medium for each different application within the project (e.g. lawns, shrubs, on-slab planters). Each sample shall be a composite of at least three samples from the proposed source and shall be at least one (1) litre in volume.
- .7 At the discretion of the Consultant, submit up to two additional samples, including samples of proposed additives to the growing medium from material delivered to the site as required to ascertain compliance with this specification. Results of these tests shall be submitted to the Consultant for approval.
- .8 After the completion of the soils analysis, a one litre sample of the completed / mixed growing medium, including all amendments shall be submitted at least twenty-one (21) days before placement of growing medium to allow for evaluation of samples and testing for noxious weed content.

2.3 IMPORTED GROWING MEDIUM

- .1 Imported growing medium for on-grade applications to be friable loam, neither heavy clay nor of very light sandy nature, containing a minimum of 4% organic matter for clay loams and 2% for sand loams, to a maximum of 20% by volume. To be free from subsoil, roots, noxious grass, weeds, toxic materials, stones over 30mm, foreign objects, and with an acidity range (pH) of 5.5 to 7.5. To be free from crabgrass, couchgrass, equisetum or noxious weeds or seeds or parts thereof.
- .2 Freedom from rock or debris to be such that 95 – 100% of particles pass a 25 mm sieve and 85 – 100% pass a 9.5 mm sieve.
- .3 Population of any single species of plant pathogenic nematode to not exceed 1000 per litre of growing medium.

2.5 PEAT MOSS

- .1 Peat moss is not to be used as a soil amendment.

2.6 SAND

- .1 Sand to be hard, granular sharp sand to CSA A82.50, well washed and free of impurities, chemical or organic matter.
- .2 Particle size in sand to be:
 - .1 95 – 100% passing a 4.75 mm sieve.
 - .2 0 – 40% passing a 0.500 mm sieve.
 - .3 0 – 5% passing a 0.050 mm sieve.

2.7 MANURE

- .1 Manure to be well-rotted farm animal manure, rotted to extent that liquids have been eliminated, and material is crumbly, free from weed seeds, rocks, sticks, rubble and containing not more than 40% sawdust, straw or shavings.
- .2 Manure to be free of harmful chemicals such as any used to artificially hasten decomposition, and to have salt content that gives an electrical conductivity reading of less than 0.5 mmho/cm.
- .3 Manure to contain not less than 1.0% nitrogen based on dry weight.

- .4 All particles in manure to pass a 6.35 mm sieve.
- .5 Manure to be free of viable seed, maximum two plants per litre of manure.

2.8 WOOD RESIDUALS

- .1 Where wood residuals such as fir or hemlock sawdust are present in growing medium, their quantities and properties to be such that total Carbon to total Nitrogen ratio is a maximum of 40:1.
- .2 Cedar or redwood sawdust to not be present in growing medium.

2.9 FERTILIZERS

- .1 Chemical Fertilizers:
 - .1 Fertilizers to be standard commercial brands, meeting requirements of Canada Fertilizer Act.
 - .2 All fertilizers to be in granular, pelleted or prill form and to be dry, free flowing and free from lumps.
 - .3 Fertilizers to have a guaranteed N-P-K analysis.
 - .4 Fertilizer to be packed in standard waterproof containers clearly marked with name of manufacturer, weight and analysis.
 - .5 Fertilizer to be stored in weatherproof storage place and in such a manner that it will stay dry and its effectiveness is not impaired.

2.10 GROWING MEDIUM - ON-GRADE LAWN AREAS, TREES AND SHRUBS

- .1 Growing medium is any soil, substitute, or mixture whose chemical and physical properties fall within ranges required by this Section for a particular application.
- .2 Growing medium to be free of plants or their roots, sticks, building materials, wood chips (in excess of 10 mm I maximum dimensions), chemical pollutants, and other extraneous materials not contributing to generally desirable physical and chemical properties for landscaping purposes.
- .3 Growing medium to require not more than 0.5 kg/m² of dolomite lime to reach required pH level.
- .4 Fertility (nitrogen, phosphorous and potassium) and pH: may be modified after growing medium is placed, by incorporation of lime and fertilizers, or by

incorporating these chemicals when mixing and screening. Phosphorus is to be prevented from entering the site where possible.

- .5 Salinity: saturation extract conductivity to not exceed 3.0 millimhos/cm at 25° C.
- .6 Boron: concentration in saturation extract to not exceed 1.0 ppm.
- .7 Sodium: sodium adsorption ratio (SAR) as calculated from analysis of saturation extract to not exceed 8.0.
- .8 Total Nitrogen: to be 0.2% to 0.4% by weight.
- .9 Available Phosphorous: to be 50 to 70 ppm. Phosphorus is to be prevented from entering the site where possible.
- .10 Available Potassium: to be 50 to 100 ppm.
- .11 Cation Exchange Capacity: to be 30 to 50 meq.
- .12 Carbon to Nitrogen Ratio: to be not more than 40:1.
- .13 Acidity: to be within pH range shown in Table 2 for intended application.
- .14 Texture: particle sizes and proportions of each size particle to be within ranges shown in Table 2 for intended application.
- .15 Organic Content: to be within range shown in Table 2 for intended application.
- .16 Drainage of growing medium can be measured only after growing medium in place. Mixing and handling of growing medium to be done in such a manner that minimum saturated hydraulic conductivity shown in Table 2 is achieved.
- .17 Tolerances: samples of growing medium taken just before planting to have above properties to within tolerances of $\pm 20\%$, except salinity, which is to be less than stated limit.
- .18 Prepared growing media that meets the specification includes BioSoil Planter Blend supplied by Yardworks Supply, telephone 604-607-3002 or approved equivalent (key item being weed free - treated to a high temperature).

2.11 MULCH

- .1 The objectives of mulching are:

- .1 To protect the soil from structural damage that results from winter freezing.
 - .2 To discourage the germination of weeds.
 - .3 To reduce compaction of soil and leaching of nutrients resulting from heavy rains.
 - .4 To make removal of weeds easier.
 - .5 To provide a source of organic matter for the soil.
- .2 Bark mulch shall be partially decomposed, minimum 6 months aged, finely shredded Douglas Fir or Hemlock bark mulch with a dark brown colour and free of excessive fine particles, soil, stones, salts or other harmful chemicals, stringy material and chunks of wood thicker than ½“.
- .1 Submit samples of mulch to Consultant for approval prior to installation.
 - .3 Due to potential negative environmental impacts, mulch cannot be stockpiled or stored on site prior to placement. Under extreme circumstances the Contractor may submit a written request to the Consultant for approval to stockpile mulch on site. Written approval from the Consultant must be received by the Contractor prior to any stockpiling or storing.
 - .4 After finish grading is complete and immediately after each area requiring mulch is planted (with the exception of plants such as ground covers as per item 2.12.5.1 below), place mulch in an even layer on the growing medium. The required depth of mulch is 75mm (3”) after settling, unless specified otherwise in the Contract Documents.
 - .5 Ensure that all plant material is fully uncovered after placing/blowing mulch.
 - .1 Plants such as ground covers may have to be planted after mulch is installed to ensure that they are not permanently covered with mulch. Confirm with the Consultant.
 - .6 Maintenance of mulch to Total Performance:
 - .1 Mulch will settle to a stable configuration, however traffic or other causes may displace mulch at some locations. Mulch shall be periodically restored to its intended depth.

2.12 SOIL AMENDMENT

- .1 As required by soil analysis.

- .2 Soil amendments are to be mechanically pre-blended with the growing medium. Coordinate with the growing medium supplier, to arrange for the pre-blending of growing medium and soil amendments prior to delivery.

3.0 Execution

3.1 TEMPORARY EROSION AND SEDIMENT CONTROL

- .1 Inspect, repair and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

3.2 STRIPPING OF ON-SITE SOILS

- .1 Strip existing soils in accordance with Section 31 22 13 – Rough Grading.

3.3 preparation of subgrade

- .1 Prepare subgrade in accordance with Section 31 22 13 – Rough Grading.
- .2 Verify that grades are correct. If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant.
- .3 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.
- .4 Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material to approved off-site disposal area.
- .5 Coarse cultivate entire area which is to receive growing medium to minimum depth of 150 mm immediately before placing growing medium. Cross cultivate areas where equipment used for hauling and spreading has compacted soil.

3.4 PROCESSING GROWING MEDIUM

- .1 Ensure commercial processing and mixing of growing medium components are done thoroughly by mechanized screening process. Do not mix by hand. Ensure resulting product is homogeneous mixture having required properties throughout.
- .2 Do not prepare or handle growing medium in a wet or frozen condition.

3.5 PLACING GROWING MEDIUM

- .1 When subgrade accepted by Consultant commence placing growing medium.
- .2 Place growing medium over prepared subgrade and allow to settle or compact by light rolling such that it is firm against deep footprints. Do not compact growing medium more than necessary to meet this requirement.
- .3 Do not prepare or handle growing medium in a wet or frozen condition.
- .4 Manually spread growing medium around trees, shrubs and obstacles.
- .5 Growing medium is to be placed at a minimum depth of 450mm for all planting areas except lawn, unless specified otherwise in the contract drawings.
- .6 Growing medium is to be placed at a minimum depth of 150mm for all lawn areas, unless specified otherwise in the contract drawings.

3.6 APPLYING FERTILIZERS

- .1 Fertilizers shall be added to bring growing medium fertility within the ranges set out in this standard, as recommended by the laboratory soil specialist on the basis of testing of the growing medium.
- .2 Lime (if required) may be added to the growing medium at the time of screening. All other fertilizers (such as nitrogen, phosphorus and micronutrients) shall be added to the growing medium by thorough cultivation after it is in place (if required) or after placement of growing medium. Top dressing lime shall be cultivated in to the top 100mm of the growing medium.
- .3 Fertilizers shall be spread evenly over the growing medium with a suitable mechanical spreader.
- .4 Fertilizers shall be raked into the growing medium to a minimum depth of 50mm.
- .5 There shall be at least one week separation between the application of lime and fertilizers.

3.7 FINISHED GRADING

- .1 Fine grade growing medium after placing to specified elevations and contours. Re-grade rough spots and low areas to ensure positive surface drainage.
- .2 Finish surface to be smooth, uniform, firm against deep foot printing with a fine loose surface texture.

3.8 ACCEPTANCE

- .1 Consultant will inspect and test growing medium in place and determine acceptance of material, depth of growing medium and finish grading. Approval of growing medium material subject to soil testing and analysis.

3.9 RESTORATION OF STOCKPILE SITES

- .1 Restore stockpile sites as specified in Contract Documents.

3.10 CLEAN UP

- .1 Dispose of surplus materials and all construction debris off-site.

END OF SECTION

This page intentionally blank. Formatted for double-sided printing.

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 Conform to the BC Landscape Standard (BCSLA & BCLNA), Current Edition.

1.3 DESCRIPTION

- .1 Work includes but is not limited to the supply, labour, and installation of hydraulic seed slurry/mulch and miscellaneous materials required to fully cover and establish a vigorously growing seeded landscape.

1.4 DELIVERY AND STORAGE

- .1 Deliver grass seed in original containers showing:
 - .1 Analysis of seed mixture.
 - .2 Percentage of pure seed.
 - .3 Year of production.
 - .4 Date when tagged and location.
 - .5 Percentage germination.
 - .6 Name and address of distributor.
- .2 Deliver wood fibre mulch in moisture-proof containers indicating manufacturer, content, and net air-dry mass.
- .3 Deliver erosion control agent in moisture-proof containers showing manufacturer, content, and net mass.
- .4 Store all seed, hydraulic mulch, fertilizers, and related materials in dry, weatherproof storage place. Protect from damage by heat, moisture, rodents, or other causes until completion of Work of this section. Do not deface labels or other identification.

1.5 FINAL ACCEPTANCE

- .1 Conditions for Final Acceptance:
 - .1 Hydraulic seed slurry/mulch areas have been maintained for a minimum period of 90 days after substantial performance.

- .2 Hydraulic seed slurry/mulch areas are fully established and exhibit a uniform, thick, dense stand of plant material.
 - .3 Hydraulic seed slurry/mulch areas are free of eroded or exposed growing medium, areas that are dead, brown, or exhibiting poor health.
 - .4 Hydraulic seed slurry/mulch areas are substantially free of foreign plant material including all weeds that are currently listed on the provincial noxious weed list www.agf.gov.bc.ca/cropprot/weedguide.
 - .5 No surface growing medium is visible either before or after cutting practices prescribed in this section have been implemented.
- .2 Areas where hydraulic seed slurry/mulch has been applied after October 1st will be not be reviewed for acceptance until April 30th of the following year.
 - .3 Schedule seeding to coincide with completion of soil surface preparation.
 - .4 Schedule completion of work to coordinate with the growing seasons August 15 – September 15 and April 1 – May 15.

1.6 SITE EXAMINATION

- .1 The Contractor shall fully examine the entire area to have hydraulic seed slurry/mulch applied prior to the commencement of Work and report to the Consultant, in writing any improperly prepared sections. Work of this section placed on improperly prepared sections will be rectified by the Contractor at no extra cost to the Owner.

1.7 MEASUREMENT PROCEDURES

- .1 No measurement will be made under this Section. Include Hydro-Mulching costs in applicable lump sum prices of related landscaping work to which they are applied.

Part 2 Products

2.1 MATERIALS

- .1 Grass Seed Mixture: Certified Canada No. 1 Grade to Government of Canada, Seeds Regulations and having minimum germination of 75% and minimum purity of 95%.

% Seed Count	% Weight	Species
28	25	Creeping Red Fescue
9	20	Perennial Ryegrass

% Seed Count	% Weight	Species
10	25	Annual Ryegrass
6	5	Orchardgrass
5	0.5	Red Top
8	0.5	Colonial Bentgrass
16	7	Timothy
3	2	White Clover
12	10	Alsike Clover
3	5	Single Cut Red Clover

Acceptable Products include but are not limited to:

- .1 Coastal Revegetation Mix, Premier Pacific Seeds - Surrey BC.
- .2 Rapid Grow Slope Stabilizer, Richardson Seeds, Abbotsford, BC or pre-approved equal.
- .2 Hydraulic Mulch and Erosion Control Agent:
 - .1 Hydraulic Mulch and Erosion Control Agent: thermo-mechanically defibrated softwood fibres designed for hydroseeding:
 - .1 Acceptable Products include "EcoFibre + Tac" as manufactured by Canfor, or pre-approved equivalent.
- .3 Water: potable, free of impurities that would inhibit germination.
- .4 Fertilizer: complete synthetic, slow release fertilize. Type and composition shall be as required by the growing medium analysis report.

Part 3 Execution

3.1 WORKMANSHIP

- .1 Provide for proper water management and drainage of Site during construction. Include silt traps, erosion control measures, temporary water collection ditches as well as their adequate maintenance during construction period.
- .2 The Contract is to ensure that any hydraulic seed slurry/mulch or other debris spilled onto pavement is to be cleaned up immediately.
- .3 The Contractor shall take care to prevent over spray of hydraulic seed slurry / mulch beyond the limit of hydraulic seed slurry/mulch application areas indicated

on the Contract Drawings. The Contractor shall ensure that structures, signs, guardrails, fences, and any other landscape elements within the areas to be receive hydraulic seed slurry/mulch are properly protected from over spray of hydraulic seed slurry/mulch. As part of the Work of this section, the Contractor shall clean all over spray and make good all damage.

3.2 SEED BED PREPARATION

- .1 Verify that grades are correct. If discrepancies occur, notify Consultant and do not commence work until instructed by Consultant.
- .2 Fine grade surface free of humps and hollows to smooth, even grade, to contours and elevations indicated to tolerance of plus or minus 15mm, surface draining naturally. Ensure areas to be seeded are free of deleterious and refuse materials.
- .3 Cultivate fine grade approved by Consultant to 25 mm depth immediately prior to seeding.
- .4 Ensure areas to be seeded are moist to a depth of 150mm before seeding.
- .5 Obtain Landscape Consultant's approval of grade and topsoil depth before starting to seed.

3.3 EQUIPMENT

- .1 All hydraulic seed slurry/mulch equipment shall match the tank volume certified by identification plate or sticker that is affixed to the equipment by the manufacturer. The identification plate is not to be removed or altered.
- .2 Hydraulic seed slurry/mulch equipment shall be sized and capable of sufficient agitation to mix materials into homogeneous state during the entire application process.
- .3 Discharge pumps and gun nozzles shall be capable of applying materials uniformly over designated areas with minimal disturbance.

3.4 APPLICATION OF HYDRAULIC SEED SLURRY/MULCH

- .1 Application of hydraulic seed slurry/mulch shall be scheduled to take place in the spring (April 1st to June 15th) or fall (September 1st to September 30th) when conditions are most favourable for the establishment of a healthy plant material.
- .2 Do not apply hydraulic seed slurry/mulch during freezing or abnormally hot, dry, weather or on frozen surfaces or surfaces covered with standing water.
- .3 Hydraulic seed slurry/mulch shall not be applied when winds exceed 10 km/h (6 mph).
- .4 Charge hydraulic seed slurry/mulch tank by adding materials to tank while it is being filled with water in the following sequence:
 - .1Seed.
 - .2Fertilizer and mulch.
 - .3Erosion control agent.

- .5 Quantity of seed, mulch and erosion control agent used to prepare the hydraulic seed slurry/mulch mix shall be in strict accordance with the manufacturers written instructions.
- .6 Quantity of fertilizer to be added to the hydraulic seed slurry/mulch mix shall be in accordance with the recommendation of the growing medium test recommendations.
- .7 After charging process has been completed, no additional water, seed mulch, or erosion control agent shall be added to the tank. Ensure materials are thoroughly mixed into a homogeneous water slurry prior to the start of application.
- .8 Do not leave hydraulic seed slurry/mulch mix in tank for more than four hours. Slurry left in tank over specified time is not to be used and is to be disposed of off Site.
- .9 Monitor the distribution of the hydraulic seed slurry/mulch mix during the application operation to ensure that a homogeneous solution is being applied in a consistent and even manner according to the rates and quantities recommended by the manufacturer over the entire area to be receive hydraulic seed slurry/mulch mix.

3.5 MAINTENANCE

- .1 The Contractor shall begin maintenance of hydraulic seed slurry/mulch areas immediately after the application process. Maintenance operations shall continue until the Consultant notifies the Contractor in writing of final acceptance of the Work.
- .2 All maintenance equipment and practices are to conform to the BCNLA Landscape Standard, current edition, 'Level 2, Groomed'.
- .3 The Contractor shall ensure that the entire area that has received hydraulic seed slurry/mulch mix is kept moist during germination period and receives adequate water during the maintenance period.
- .4 All applications of water shall be sufficient to ensure that moisture penetrates 75 mm to 100 mm (3 in. to 4 in.) into the underlying growing medium.
- .5 The Contractor shall be responsible for the repair and re-application of hydraulic seed slurry/mulch to areas that have washed out, eroded, or scoured by wind.
- .6 Application of fertilizer during the grown in period shall be as per the BCNLA Landscape Standard, current edition, 'Level 2, Groomed' established maintenance program. Areas that have received hydraulic seed slurry/mulch after September 15th shall not be fertilized until after April 15th of the next year.

3.6 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 General

1.1 SUMMARY

- .1 Materials and installation for plant material, accessories, mulch, planting, tree support, mulching and maintenance.
- .2 Supply and install plant material, stakes and deadmen. Perform all work incidental to completion of the work specified in this section.

1.2 REFERENCES

- .1 Conform to the BC Landscape Standard (BCSLA & BCLNA), Current Edition: Plants & Planting.
- .2 Agriculture and Agri Food Canada (AAFC).
 - .1 Plant Hardiness Zones in Canada 2000.
- .3 Canadian Nursery Landscape Association (CNLA).
 - .1 Canadian Standards for Nursery Stock 2001.
- .4 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Transportation of Dangerous Goods Act (TDGA), 1992, c.34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .6 Guide Specifications for Nursery Stock (BCNTA).
- .7 Guide Specifications for Landscape Construction (BCNTA).
- .8 Canadian Standards for Nursery Stock (BCNTA), 5th Edition.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Division 02.
- .2 Submit product data for:
 - .1 Fertilizer.
 - .2 Anti desiccant.
 - .3 Guying assembly including clamps, collar, guying wire, anchors and wire tightener.
 - .4 Composted bark mulch
- .3 Submit samples for:

- .1 Composted bark mulch, as specified in Section 32 91 20 – Growing Medium Preparation and Placement, item 2.13.
- .4 Submit inspection certificates as required by law for each shipment of plant material.

1.4 QUALITY ASSURANCE

- .1 All materials and execution to conform to the latest edition of the following standards or as otherwise specified:
 - .1 CNTA (Landscape Canada) Canadian Standards for Nursery Stock.
 - .2 BCLNA Standard for Container Grown Plants
 - .3 BCSLA & BCLNA Landscape Standard, Current Edition, Plants & Planting.
 - .4 Perennial Plant Association Standards for herbaceous Perennial Plants

1.5 SOURCE QUALITY CONTROL

- .1 All plants are to be supplied by nurseries approved by the Canadian Nursery Certification Institute (CNCI) and Canadian Nursery Landscape Association (CNLA), as listed under the Clean Plants Certified Nurseries on the CNCI website: www.cleanplants.ca
- .2 Obtain Contract Administrator approval of plant material at source prior to digging.
 - .1 The Contract Administrator reserves the right to require the assembly of the plant material at the source(s) for inspection and approval.
- .3 Imported plant material to be accompanied with necessary permits and import licenses. Conform to federal and provincial regulations.

1.6 DELIVERY, STORAGE AND PROTECTION

- .1 Dig and handle all plant material in a manner suitable for each species to prevent injury to or removal of fibrous roots. All plant material arriving on site with broken or loose root balls or containers will be rejected. Take precautions to avoid burning of plants by sun or wind during handling and shipping.
- .2 Keep root balls and container soil moist at all times before planting by covering with bark mulch or soil. Protect fertilizer against moisture.
- .3 Immediately store, protect and water (if necessary) plant material which will not be installed within one (1) hour after arrival at site in storage location approved by Consultant.
- .4 Protect plant material from damage during transportation:

- .1 When delivery distance is less than 30 km (18 mi) and vehicle travels at speeds under 80 km/h (50 mph), tie tarpaulins around plants or over vehicle box.
- .2 When delivery distance exceeds 30 km (18 mi) or vehicle travels at speeds over 80 km/h (50 mph), use enclosed vehicle.
- .5 Protect stored plant material from frost, wind and sun and as follows:
 - .1 For bare root plant material preserve moisture around roots by heeling or burying roots in sand or topsoil and watering to full depth of root zone.
 - .2 For pots and containers maintain moisture level in containers. Heelin fibre pots in location approved by Consultant.
 - .3 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones
- .6 Verify existence and location of any on-site utilities. Consult the Consultant immediately for directions as to procedure should any piping or utilities be encountered during excavation.
- .7 Protect existing equipment, sidewalks, landscaping reference points, monuments and markers. Make good all damage incurred during this work.
- .8 Make every effort to protect plants adjacent to any construction work.
- .9 Erect temporary continuous barriers where necessary to ensure safety of existing plants and trees.
- .10 Replace, at no expense to the Owner, any plant material damaged as a result of the work of this section.
- .11 Protect fertilizers from moisture.
- .12 Notify the Consultant a minimum of forty-eight (48) hours prior to each delivery.

1.7 SCHEDULING AND INSPECTION

- .1 Make all trees available at one location twelve (12) months and also ten (10) days prior to scheduled planting time for inspection by the Consultant. Make all other plant material available at one location six (6) months and also ten (10) days prior to scheduled planting time for inspection by the Consultant.

- .2 Notify the Consultant when plants are available for inspection. All plants are subject to inspection and may be rejected for failure to comply with this specification at any time until Total Performance. Replace rejected material and remove from the site at no cost to the Owner.
- .3 Schedule all operations to ensure optimum environmental protection, erosion control, grading, growing medium placement, planting and seeding operations as outlined in these Specifications. Organize scheduling to ensure a minimum duration of on-site storage of plant material, minimum movement and compaction of growing medium, and prompt mulching and watering operations. Coordinate work schedule with scheduling of other trades on-site.
- .4 Coordinate and schedule such that no damage occurs to materials before or after placement. In particular, meet the requirements of living plant material.
- .5 Plan, schedule and execute work to ensure a supply of water for landscape purposes in adequate amounts and at adequate pressures for satisfactory irrigation of all plants.
- .6 Notify the Consultant at the completion of work for an Inspection for Substantial Performance.
- .7 Final inspection of all planting will be made at the end of the specified warranty period. For release from the Contract, all plant materials supplied or transplanted must be alive and in a healthy, satisfactory growing condition at the time of inspection. For specified plant, the Consultant reserves the right to extend the Contractor's responsibility for another growing season, if in his opinion, leaf development and growth is not sufficient to ensure satisfactory future growth.
- .8 The Consultant at his discretion may waive one or more inspections, but this shall not impair the right of the Consultant to inspect work or materials which have been damaged or in any way do not conform to the specifications.
- .9 The Landscape Contractor shall be present during all required inspections as specified or as may be required by the Consultant.

1.8 WARRANTY

- .1 For a period of one year from the date of substantial performance, at no cost to Owner, replace all unsatisfactory plant material and continue to replace such plant material until the plants are acceptable to the Consultant.
- .2 This guarantee is based on adequate maintenance by the Owner from the date of acceptance. The Contractor will not be responsible for plant loss due to extreme climatic conditions such as abnormal freezing temperatures or hail which occur after acceptance. The Contractor shall be responsible for plant loss due to inadequate acclimatization.

- .3 Adequacy of acclimatization and existence of extreme climatic conditions shall be as determined by an independent Consultant, hired by the Owner on the basis of plant variety, location, recorded temperatures for the locale, time of planting, and other factors pertinent to the situation.

1.9 REPLACEMENTS

- .1 Replace all plant material found dead, or not in a healthy, satisfactory growing condition or which, in any other way, do not meet the requirements of the specifications, at own expense, where maintenance during the warranty period is the responsibility of the Landscape Contractor.
- .2 Replace each defective or dead plant within 72 hours after notification by the Consultant and continue to replace each plant until it has established itself to the satisfaction of the Consultant.
- .3 All required replacements shall be plants of the same size and species as specified on the plant list and shall be supplied and planted in accordance with the drawings, specifications and change orders thereto.
- .4 The cost of replacements resulting from theft, accidental damage, vandalism, carelessness, neglect on the part of others, shall be borne by the Landscape Contractor until the certified date of Substantial Performance.
- .5 The cost of replacements resulting from theft, accidental damage, vandalism, carelessness or neglect on the part of others after the certified date of Substantial Performance shall be borne by the Owner.

1.10 SUBSTITUTIONS

- .1 If it is impossible to obtain the particular plant material listed on the Landscape Drawing, the Landscape Sub-Contractor may be permitted to suggest substitutions with types and variations possessing the same characteristics. The Landscape Sub-Contractor must request any substitutions of trees in writing at least four (4) months and shrubs and groundcover at least four (4) months prior to planting. The Consultant must approve all substitutions.

1.11 AREA OF PLANT SUPPLY AND SEARCH

- .1 Before substitutions of plant material from outside the local area are proposed, documented proof that materials are not available through search on the west coast of Canada and United States must be provided. Area of supply shall include but not be limited to the area as mentioned herein

1.12 PLANT MATERIAL IDENTIFICATION

- .1 Plant material that has been located by the consultant and tagged for the project is to have the identification tags removed only after inspection and instruction by the consultant after delivery to the site.

1.13 MEASUREMENT PROCEDURES

- .1 Payment for Modify, Supply and Install Soft Landscaping shall be made at the Lump Sum Price bid. All materials and work required under this section, Section 31 22 13, Section 31 23 10, Section 32 92 13, Section 32 91 20 and other related sections to be included in Lump Sum Price bid. In relation to these specification sections, the Lump Sum Price shall include the cost of the following landscaping Work Items:
 - .1 Modification of existing irrigation and drainage, as indicated in drawings and specifications
 - .2 Supply and install soft landscaping according to new plant list, and as indicated in drawings and specifications

PART 2 Products

2.1 PLANT MATERIAL

- .1 Of sizes and quantities shown in plant lists on landscape drawings and specification: nursery grown.
- .2 Conform to the Canadian Standards for Nursery Stock and the British Columbia and Canadian Nursery Trades Association "Guide Specification for Nursery Stock". In particular:
 - .1 "Nursery stock shall be true to name, and of the size or grade stated."
 - .2 "Quality shall be normal for the species when grown under proper cultural conditions...viable, substantially free from pests and disease, and undamaged."
 - .3 "Roots shall not be subject to long exposure to drying winds, sun or frost, between digging and delivery."
- .3 "Root balls shall be free from pernicious perennial weeds."
- .4 Transplant or root-prune at least once within the year prior to planting.
- .5 Take precautions during digging, handling and shipping of plant material to avoid injury to plants and root systems.
- .6 All plants: typical of their species or variety, have a normal habit of growth and shall be first quality, sound, healthy, vigorous, well branched, and densely foliated, free of disease, insect pests, eggs or larvae, healthy well furnished root systems.

- .7 Conform to the measurements specified in the plant list. Measurements specified are minimum size acceptable for each variety. Plants that meet the requirements specified in the itemized plant list, but that do not possess a normal balance between height and spread will not be accepted. Plants for use when symmetry is required, or when planted in formal rows, shall be matched in form and size as nearly as possible. Do not prune prior to delivery.
- .8 All plants and all tree trunks shall be measured when the branches are in the normal position. Dimensions for height and spread as contained herein refer to the main body of the plant and not from branch-tip to branch-top. The height of tree trunks need not be as specified if the required height can be obtained by pruning the lower branches without leaving unsightly scars or otherwise damaging the trunk. Do not prune branches to obtain the required height, before the plants are delivered to the site unless so approved in writing by the Consultant.
- .9 All trees must have straight trunks with a single leader intact. There shall be no abrasion of the bark, and no fresh cuts of limbs over 3/4" (19 mm), which have not completely calloused over.
- .10 Take precautions during digging, handling and shipping of plant material to avoid injury to plants and root systems.

2.2 RELATED MATERIALS

- .1 Tree stakes: dressed 4 sides 50 x 50mm (2" x 2") treated fir stakes, lengths as detailed. Refer to the Tree Planting Detail included in the Contract Documents.
- .2 Tree ties to be 50mm wide fabric belt/banding (refer to the Tree Planting Detail included in the Contract Documents), or approved equal.
- .3 Deadmen: 100mm x 150mm (4"x6") treated construction grade lumber. Lengths to be determined on site.
- .4 Plastic Strapping: Plastic straps to be 5mm (2") wide.
- .5 Mulch: Composted bark as specified in Section 32 91 20 – Growing Medium Preparation and Placement.
- .6 Wooden headers shall be pressure treated Fir as shown on the drawings or approved equal in the following sizes:
 - .1 25 mm x 100 mm (1" x 4") edger, consecutive members lap-jointed.
 - .2 50 mm x 50 mm x 400 mm (2" x 2" x 16") stakes
- .7 Fasteners: All fasteners hot dipped galvanized.
- .8 Water: Free of impurities that would inhibit plant growth.

PART 3 Execution

3.1 PREPARATION

- .1 Preparation for planting to be in accordance with the CNTA Canadian Standards for Nursery Stock and the BCSLA & BCLNA Landscape Standard, Current Edition

3.2 TREE PITS ON GRADE

- .1 Tree pits on grade shall be of the following minimum standard, unless otherwise specified.
- .2 Two times the diameter of the root ball with the tree in the centre of the tree pit.
- .3 Tree pits shall be 300mm (12") deeper than the root ball for the entire tree pit.

3.3 PLANTING SEASON

- .1 Plant only during the season or seasons which are normal for such work, determined by weather conditions and as approved by the Consultant.
- .2 Do not plant during freezing and/or abnormally hot, dry weather.
- .3 Lawn to be seeded only during weather conditions recommended by seed supplier.

3.4 PLANT LAYOUT

- .1 Locate plants according to Planting Plan, and according to locations determined by the Consultant, for approval of plant locations and orientation. The Consultant may make adjustments in plant location and orientation prior to planting.
- .2 Stake location of all major trees for approval prior to positioning. Notify the Consultant to be present during planting of major trees to ensure proper orientation and location.
- .3 Provide root barrier between trees and paved surfaces as detailed on Landscape Drawings.

3.5 PLANTING PROCEDURE

- .1 All plants to be installed maintaining original grades of bases as in the Nursery.

- .2 Loosen bottom of planting hole to depth of 150 to 200mm (6" - 8") prior to placing growing medium.
- .3 Plant trees vertically with roots placed straight out in hole. Orient plant material to give best appearance in relation to structure, roads and walks.
- .4 Place plant material to depth equal to depth they were originally growing in nursery.
- .5 With balled and burlapped root balls loosen burlap and cut away minimum top one-third (1/3) without disturbing root ball. Do not pull burlap or rope from under root ball. With container stock, remove entire container without disturbing root ball. Non-biodegradable wrappings must be removed.
- .6 Tamp growing medium around root system in layers of 150mm (6") eliminating air voids. Frozen or saturated growing mediums unacceptable. When two-thirds (2/3) of growing medium has been placed, fill hole with water. After water has completely penetrated into soil, complete backfilling.
- .7 Water thoroughly on the interior of the tree saucer until it is filled even if it is raining. A second watering may be necessary to ensure saturation of the root ball.
- .8 Prune out any dead or broken branches in accordance with item 3.10.
- .9 Remove all tags, labels strings, etc. from plant material subsequent to approval of layout and planting by consultant.
- .10 Water plants shall be transplanted into perforated plastic planting baskets lined with filter fabric and mulched with pea gravel as detailed with materials specified.
- .11 After soil settlement has occurred, fill with soil to finish grade.
- .12 Dispose of burlap, wire and container material off site.

3.6 FERTILIZER APPLICATION

- .1 Fertilizers shall be to the requirements of Section 32 91 20 Growing Medium Preparation and Placement, item 2.9. Formulations and application rates shall be as required by soil testing.

3.7 WATERING

- .1 Watering shall be carried out when required and with sufficient quantities relative to specific plant needs to prevent plants and underlying growing medium from drying out.

3.8 MULCHING

- .1 Mulch all tree, shrub and groundcover planting areas with composted bark as indicated in Section 32 91 20 – Growing Medium Preparation and Placement, item 2.13.
- .2 Ensure soil settlement has been corrected prior to mulching.

3.9 STAKING

- .1 Stake all trees immediately after planting. Plant material not staked immediately shall be replaced if damaged.
- .2 Drive two (2) stakes per tree vertically into the ground to a depth of approx. 1000mm (42"), parallel to the closest pavement / path of travel, in such a manner so as not to injure the root or root ball or damage the membrane when planting trees on slab.
- .3 Fasten tree in accordance with the Tree Planting Detail included in the Contract Documents.
- .4 Trees to stand plumb upon completion of this operation.

3.10 PRUNING

- .1 No pruning of any plant material shall commence without prior approval of Consultant.
- .3 Prune each tree and shrub planted to preserve the natural character of the plant and in a manner appropriate to its particular requirement in the landscape design. Remove all soft wood sucker growth and all broken or badly bruised branches with a clean cut.
- .4 Prune only with sharp tools. All pruning to be made to the bark branch ridge. No flush cutting or branch stubs to be left.
- .5 Prune trees and shrubs according to accepted horticulture practices as outlined in the Pruning Manual, Publication No. 1505, by Agriculture Canada.

3.11 CLEAN-UP

- .1 Remove from the site all pots, cans, surplus materials, and other debris resulting from planting operations.
- .2 Ensure complete removal of planting tags, labels, strings, or other materials prior to substantial completion.

- .3 Neatly dress and finish all planting areas and flush all walks and paved areas clean to the satisfaction of the Consultant and Owner.

3.12 MAINTENANCE UNTIL CERTIFICATE OF SUBSTANTIAL PERFORMANCE

- .1 Begin maintenance at time of planting and continue until acceptance.
- .2 Maintenance of all plants shall be to Level 2 - Groomed, BCNLA Landscape Standard. Frequency of watering, weeding, cultivating, pruning, and any other necessary operations shall be such that the plant material is healthy and vigorously growing.
- .3 Water all planted areas as necessary to provide optimum conditions for plant growth. Ensure irrigation system is operational and will thoroughly soak the growing medium of these areas to its full depth at least twice weekly. Should the irrigation system not be operational, at no cost to the Owner provide water to the plants via watering trucks or hoses.
4. Program timing of operations in accordance with growth, weather conditions and use of site.
- .5 Complete each operation within a reasonable time period prior to proceeding.
- .6 Collect and dispose of debris or excess material on a daily basis.
- .7 Report any pest and disease issues to City of New Westminster representative immediately for control. Do not use sprays prohibited by Agriculture Canada.
- .8 Cultivate surface of planting areas and soil around trees whenever required to keep top layer of soil loose, friable and free from weeds. Any operation must be continuous without interruption.
- .9 Replace or re-spread damaged, missing or disturbed mulch.
- .10 Clean, by hand, areas that are covered with mulch. Loosen top layer of mulch without mixing it with soil underneath.
- .11 Remove weeds, including their roots, by mechanical pulling. Cultivation is not an acceptable form of weed control.
- .12 Remove dead or broken branches from plant material. Prune in accordance with accepted horticulture practises as outlined in the Pruning Manual, Publication No. 1505, by Agriculture Canada.
- .13 Keep stakes and ties in proper repair and adjustment.

- .14 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.

3.13 ACCEPTANCE

- .1 Plant material will be accepted by Consultant upon Substantial Performance of the Work and again at the end of the warranty period, provided that plant material exhibits healthy growing condition and is free from disease, insects and fungal organisms.
- .2 Plant material installed less than ninety (90) days prior to frost will be accepted in following spring, thirty (30) days after start of growing season provided that acceptance conditions are fulfilled.

END OF SECTION