

SPECIFICATIONS BOOK

Addendum – March 2011

The following is a list of changes made:

Item	Change
4 th . Edition Page	Remove requirement for printed copies. Added: Revised to March 2011.
120	Add page 2 that was not printed in the electronic web page edition. This will add in Items 125,126,128, 129.
200	Page Index updated
222	Revised to include 1050 and 1200 HDPE profile pipe. Deflection test not to be used for HDPE profile pipe when Insert-a-T's are installed.
223	Mueller Adjustable frames are to used in asphalt streets, parking lots, etc.
230	Contractor to supply marker balls. Change 150mm steamer port to 114mm steamer port. Operating nut for hydrants to be 32mm.
321	Correct error in numbering
351	Anti-strip agent required for all asphalt. Gradation changes
404	Correct error in numbering
412	Correct error in numbering
422	Correct error in numbering
500	Page Index updated
511	Cut-off dates for landscaping
512	Cut-off dates for landscaping
513	Cut-off dates for landscaping
700	Page Index updated
704	Site Conditions- Addition to traffic control diagrams, CSJ-RM Raised Manholes
705	Correct error in numbering
814	Correct error in numbering
10-223-04	Correct error
10-223-13	Add requirements for Mueller adjustable
10-223-30	Correct errors
10-230-05	Correct error
10-230-10	Add marker
10-602-03	Correct error

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FOURTH EDITION

MARCH 2010

Revised up to March 2011

All CSA & ASTM designations or test standards shall be those shown here, or the latest revision.

The Master Copy of the Specifications book is available for inspection at the City's Web Site www.stjohns.ca/cityservices/construction/index-jsp

The Specifications Book has received a major update, and you are encouraged to review the specifications in its entirety.

ITEM 120**LINES & GRADES**

Engineer will provide only those survey control points and set such stakes as necessary to define general location, alignment and elevations of work. Give Engineer reasonable notice of requirements for such control points and stakes.

Before the commencement of any work, the accuracy of the lines, positions, elevations, and grades shown on the drawings shall be checked and agreed on the site jointly by the Contractor and Engineer.

Set grades and lay out work in detail from control points and grades established by Engineer.

Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.

Provide devices needed to lay out and construct work.

Supply stakes and other survey markers required for laying out work.

The checking of, or setting out, of lines or levels by the Engineer shall not in any way relieve the Contractor of his responsibility for the correctness thereof and the Contractor shall carefully protect and preserve all bench marks, profiles and other things used in setting out the Works. If at any time during the progress of the works, any error shall appear or arise in the Works, the Contractor shall at his own expense rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer.

The Contractor shall keep the Engineer informed a reasonable time in advance of the time and places at which he wishes to do the Work in order that information lines, elevations and grades may be confirmed and necessary measurements for record and payment purposes may be made with the minimum of inconvenience. No payment shall be made for the cost to the Contractor of any work or delay occasioned by establishing or checking lines and grades or making other measurements and no extensions of time shall be allowed for any delay occasioned thereby.

ITEM 121**STORAGE FACILITIES**

The Contractor shall supply proper storage facilities at his own expense and shall be responsible for the care of all materials until placed in the works.

ITEM 122**NOTICE BY CONTRACTOR**

All necessary notices to waterworks, gas, electric light & power, cable television or telephone companies, owners or occupants of property, or other interested parties shall be given by the Contractor at least one (1) week in advance of the work, except where the serving of such notices is the express duty of the City. One (1) copy of all such notices shall be forwarded by registered mail to the Engineer.

ITEM 123**TEMPORARY SUPPLY OF WATER TO RESIDENTS**

Where residents have existing wells which are used as a source of domestic water, and should loss of water occur as a result of the lowering of the groundwater table due to water and sewer installation, the Contractor will supply affected residents with water on a temporary basis until the system becomes operational.

The Contractor shall test as required by the Engineer and make operational any newly installed valved section of water main and install service connections to affected properties as directed by the Engineer.

ITEM 125

EXISTING UNDERGROUND SERVICES

Prior to commencing work, the Contractor shall establish location and extent of all existing underground services and other obstructions in area of work and notify the Engineer of findings.

Where unknown services are encountered, the Contractor shall immediately advise the Engineer and confirm findings.

ITEM 126

PRIVATE PROPERTY

The Contractor shall not enter upon or occupy with men, equipment, tools, or materials of any nature, any property other than public streets and roadways, except for the rights-of-way shown on the drawings, or other areas designated by the Engineer and required for the performance of the work.

ITEM 128

SUBSOIL INVESTIGATION

The bore hole information presented on the drawings is provided for guidance and is only accurate for the exact location where drilled.

Contractors wishing to undertake additional subsoil investigations will be required to obtain a Street Excavation Permit from the City and carry out this investigation under the City's supervision.

Any work undertaken on the site without the proper permit and supervision will be liable for damages to the site.

ITEM 129

ST. JOHN'S TREE REGULATIONS

The Contractor shall adhere to the requirements of the City of St. John's Tree Regulations.

When performing work within the drip line of existing trees or removing or relocating trees, the contractor shall obtain a permit and approval of the Municipal Arborist to undertake the work.

DIVISION 2
SPECIFICATIONS FOR WATER & SEWER SERVICES

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ITEM 222**STORM SEWER****222.01 SCOPE OF WORK**

The Contractor shall supply, transport, lay, joint and inspect storm sewer pipe as shown on the plans and do all other work necessary to make a proper connection to the existing sewer system in accordance with the following specifications.

222.02 PIPE & FITTINGS**General**

Diameter, material, strength class and dimensional ratio of pipe and fittings: as indicated.

Polyvinyl Chloride Pipe

DR 35 Pipe - shall be certified to CSA B182.2 for 200mm to 675mm sizes. Joints shall conform to CSA B182.1 or ASTM D3212. Rubber gaskets shall conform to ASTM D3212.

Profile wall polyvinyl chloride pipe - pipe and fittings to be certified to CSA B182.4 and ASTM F794. Pipe stiffness to be 320 kPa. This pipe not to be used for diameters less than 300mm or for catch basin leads.

Corrugated HDPE

Corrugated double walled pipe shall have a smooth inner wall. Pipes may be bell and spigot style or plain end fastened with a coupling recommended by manufacturer. For sizes 300mm to 900mm, pipe shall be certified to CSA B182.8, have a pipe stiffness of 320kPa, and conform to ASTM F667 for storm sewers. For sizes above 900mm to 1200mm pipe shall conform to ASTM F667 and comply with AASHTO M294. Minimum pipe stiffness for 1050mm pipe shall be 140kPa and for 1200mm pipe shall be 125kPa. This pipe not to be used for diameters less than 300mm or for catch basin leads.

Concrete

Non-reinforced circular concrete pipe and fittings: certified to CSA A257.1, designed for flexible rubber gasket joints, mortar joints to CSA A257.3.

Reinforced circular concrete pipe and fittings: certified to CSA A257.2, designed for flexible rubber gasket joints, mortar joints to CSA A257.3 and to ASTM C655M.

222.03 PIPE LAYING

Where a Contractor is required to install storm sewer mains beginning at an existing manhole or section of existing main, the Contractor shall install a temporary 6mm mesh screen over the outlet pipe of the first downstream existing manhole to prevent silt and gravel from entering the existing system from the new work. If this location is not appropriate, the Engineer may choose a suitable location.

All sewers shall be constructed in an open trench and laid to the lines and grades as set by the Engineer. The pipe shall be well bedded on a solid foundation along the full length of each pipe. The bottom of the trench shall be recessed at bells such that the barrel of the pipe shall be completely supported over its entire length on a solid foundation.

In order to ensure adequate lateral and vertical stability of the pipe during jointing and embedding operations, a sufficient amount of bedding material to hold the pipe in rigid alignment shall be uniformly deposited, and thoroughly compacted on each side and back of the bell of each pipe.

Alignment and grade of the pipe shall be established by the Contractor using appropriate laser technology. Horizontal alignment tolerance for pipe shall be +/- 75 mm.

The trench shall be kept dry and no pipe shall be laid in water or upon a wet, muddy or frozen bed. All pipes must be thoroughly cleaned and protected from dirt and no water shall be allowed to flow through any pipe during construction, except as allowed for under the item "Excavations and Embankments".

222.04 PIPE ASSEMBLY

Pipe shall be assembled in accordance with the manufacturer's instructions. All pipes shall be unloaded and handled with reasonable care. Pipe bells shall be laid on the upstream end. Sewer laying shall commence at the lowest elevation and shall terminate only at manholes, service branches or clean outs. Where a sewer ends in a stub end outside of a manhole for purposes of a future extension, the pipe shall end in a bell and plug.

222.05 CLEANING

The storm sewers are to be flushed and cleaned of any debris and building material prior to the television inspection.

222.06 CATCH BASIN LEADS

Sections of the storm sewer connecting catch basins to the main sewer (catch basin leads) will not be required to be television inspected or deflection tested unless otherwise called for in the Contract Documents.

No formal grading plan will be provided for catch basin leads, but in no case will catch basin leads be permitted to be installed at a grade less than two percent (2%).

Manhole drop requirements applicable to storm sewer mains do not apply to catch basin leads. Catch basin leads may enter the manhole at any convenient height above the invert of the outlet pipe.

222.07 TELEVISION INSPECTION

A television inspection shall be carried out on all sections of the sewer in accordance with the item "Television Inspection".

222.08 DEFLECTION TEST FOR PVC AND CORRUGATED HDPE PIPE

A deflection test shall be carried out on all sections of the sewer. In accordance with Item 221.07 "Deflection Test". Deflection testing will not be required on sewer sections (manhole to manhole) where Insert-a-T's are used.

222.09 MEASUREMENT FOR PAYMENT

Pipe - shall be the centerline distance in metres from beginning to end including pipe running through manholes, or in the case of branch lines from the center of the intersecting manhole to the end of pipe laying, or the outside wall of the catch basin or headwall, for each pipe size and class described in the Schedule of Quantities and Prices.

Connection to Existing Sewers, catch basins, headwalls and pipe shall be for each pipe connection made. Connection to new sewer, catch basins, headwalls and pipe shall be included in the price bid for each unit of pipe supplied and installed.

222.10 PAYMENT

Payment shall be on a unit price basis for pipe, supplied, transported, laid, jointed, tested, inspected and connected to new and existing manholes, catch basins, headwalls and pipe. The bid price shall include all labour, equipment and materials necessary to complete the work in accordance with this specification.

The Contractor will only be paid to a maximum of ninety (90%) of the value of this item until such time as the section of work

has passed all tests. This ten (10%) will be called the "Storm Test Allowance". In addition, the ten (10%) mechanics lien holdback shall apply.

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ITEM 223**MANHOLES, CATCH BASINS, DITCH INLETS HEADWALLS & CHAMBERS****223.01 SCOPE OF WORK**

The Contractor shall construct manholes, catch basins, ditch inlets, headwalls and chambers. Location of structures shall be as shown on the drawings and/or as directed by the Engineer.

223.02 FORM AND DIMENSIONS

The form and dimensions of the items shall conform to contract drawings or, if not shown, the standard drawings.

223.03 PRECAST CONCRETE UNITS

Precast concrete shall be manufactured and installed in accordance with CSA A23.1 and the standard drawings.

Where the precast plant is not CSA certified to manufacture precast units, third party verification by a professional engineer is required to insure units are designed and manufactured to applicable standards.

Flexible gasket joints may be used in accordance with CSA 257.3 and the standard drawings.

All pipe openings shall be pre-drilled at the factory or on site with the proper drilling equipment. After installation of the pipe, all holes shall be grouted from the inside and outside before backfilling.

223.04 FORMWORK

All formwork shall be approved by the Engineer and shall comply with CSA A23.1 - Section 11. The forms shall be erected, jointed and finished to secure uniform concrete surfaces.

Forms shall be thoroughly oiled before concrete is deposited. All mortar and dirt shall be removed from forms that have been previously used.

All form tying devices left in the concrete shall not be less than 25mm from the exposed surface.

Fittings and pipe to be built-in shall be installed at the time of pouring of the concrete structure. Boxing-out will not be permitted, unless approved by the Engineer.

The Contractor shall ensure that concrete is not damaged during and after the removal of formwork.

Formwork shall remain in place until the concrete has reached seventy (70%) of its design strength, or longer, if directed by the Engineer.

223.05 CONCRETE**General**

Concrete shall conform to Item 404 "Concrete Structures".

223.06 REINFORCEMENT

Reinforcement shall conform to Item 405 "Concrete Reinforcement".

223.07 TRASH RACKS

Trash racks are required on all inlet headwalls unless otherwise noted. The size and shape of the trash rack shall be as shown on the standard drawings, or as modified by the Engineer. Final design of each trash rack shall be approved by the Engineer prior to fabrication.

223.08 ACCESS COVERS AND GRATINGS

Access covers or gratings shall be as shown in the standard contract drawings and shall be supplied and set to the finished grade. In asphalt streets, parking lots, etc., frames shall be mueller adjustable or approved equal.

In subdivision developments and other projects where top course asphalt is not to be placed until the next construction season, manhole covers located in the asphalt surface shall be set at base course grade and adjusted to finished grade just prior to placement of the top lift of asphalt. Catch basins located at the face of curb may be placed at finished grade.

223.09 GROUTING

Where it is necessary to grout around a pipe opening, parge a concrete surface or adjust a frame and cover where there will be less than 40mm between the underside of the frame and the top of the existing concrete, a non-shrink grout is to be used.

223.10 INFILTRATION

No visible signs of infiltration will be permitted in the sanitary sewer manholes even when pipe sections pass infiltration tests. All sanitary manholes shall be inspected after construction and during the maintenance period to ensure water tightness. The Contractor shall be responsible for correcting any leakages detected.

223.11 EXFILTRATION

Each sanitary sewer manhole shall be tested as follows: Plug the inlet and outlet pipes and fill the manhole with water to within 300mm of finished grade and no further. Filling may be done up to 24 hours prior to time of testing to allow for normal water absorption into the manhole.

Test by letting the water stand in the manhole for three (3) hours and observing the drop of water level at the end of the period. The drop in water level at the end of the test will be a measure of leakage from the manhole. "Permissible Exfiltration Leakage" will be at the rate of 1.6ml/h/mm of manhole diameter/m height of test water column.

If permissible leakage is exceeded and subject to the Engineer's approval, correct defects on site in accordance with manufacturer's instructions. **Concrete mortar grouting is not acceptable.** Repeat testing until acceptable. If rejected by the Engineer, the manhole must be replaced at the Contractor's expense.

If the Engineer has any reason for suspecting that the manhole has been damaged during the backfilling of the structure or by any other cause, such that the manhole will no longer comply with the requirements of the test, then he may order the Contractor to carry out a second test, and should the manhole be defective, the Contractor shall repair or make good the defects in accordance with the manufacturer's instructions. **Concrete mortar grouting is not acceptable.** No extra payment will be allowed for carrying out any such second test, even though the manhole proves to be satisfactory.

223.12 SAFETY LANDINGS

Safety landings shall be required in all manholes having a depth of 5m measured from the top of cover to the invert of the outlet pipe.

223.13 MEASUREMENT FOR PAYMENT

Measurement for payment shall be as follows and as further detailed in the Schedule of Quantity and Prices:

Manholes, Catch Basins, Ditch Inlet - the number of each kind and size of unit supplied and installed.

Headwalls and Chambers - the number of headwalls or chambers supplied and installed or the theoretical volume of concrete, measured in cubic metres rounded to one decimal place, required to construct the unit.

Trash Rack - the number of trash racks of various sizes required. Sizes will be denoted by the inlet pipe size unless otherwise noted.

223.14 PAYMENT

The Contractor shall be paid at the respective unit price bid for each unit installed. The unit prices shall constitute full compensation for all labour, equipment, and materials required to complete the work as specified.

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ITEM 230**WATERMAINS****230.01 SCOPE OF WORK**

The Contractor shall supply, transport, lay, joint, clean, disinfect and test all watermain pipe, fittings, valves, hydrants and water services in accordance with this specification, the standard drawings and do all work necessary to make a proper connection to the existing water system.

230.02 ABBREVIATIONS

ESD = Environmental Services Division

230.03 ELECTRICAL GROUNDING TO WATERMAINS IS PROHIBITED

As of January 1, 2009, the grounding of electrical services to watermains and water services is prohibited.

Where an electric service is already grounded to an existing metallic watermain or service and the watermain or service is to be replaced by non-metallic piping, a new electrical grounding system is to be provided. The size and configuration of the new electrical grounding system is to be approved by the Chief Electrical Inspector, Department of Buildings & Property Management.

230.04 WATER MAIN MARKING

All new water mains shall be marked using 3M Ball Marker technology (programmable). Marker balls shall be supplied by the contractor and installed at the following locations:

- Bends
- Tees
- Reducers
- Corporations
- Curb Stops
- Stub ends of pipes
- Or a maximum spacing of 30m

The balls shall be placed no deeper than 1.5 metres and located directly above the water main or fitting.

For curb stops tie straps shall be used to secure the marker ball to the street side of the curb stop box.

Prior to the start of the project, the Contractor shall contact the ESD and supply a copy of the construction drawings and a sufficient quantity of marker balls for the project. Upon review the drawings the ESD will program and identify the appropriate markers required for the project.

The Engineer shall ensure that the appropriate marker balls are installed in their assigned location. The Engineer shall also record the ID number and location of each marker ball on the As-Built drawings.

At completion of the project, the City will locate the markers and collect the data.

Marker balls cannot be re-programmed without re-excavation.

230.05 PIPE SIZES

For new work:

Watermains and services larger than 50mm: 100mm, 150mm, 200mm, 300mm, 400mm, and as specified in larger sizes.

Domestic services: 25mm, 38mm and 50mm.

Repairs to existing: as specified by the Engineer.

230.06 SHOP DRAWINGS

For concrete pressure pipe and fittings, submit tabulated materials list and drawings indicating internal pressure rating, maximum external load, type of joints and identification mark numbers.

230.07 SCHEDULING OF WORK

Coordinate and organize work to minimize interruptions to existing services.

Notify Engineer and building occupants a minimum of 24 hours in advance of planned interruptions in service.

Do not interrupt water service except between 10:00 a.m. and 4:00 p.m. local time, unless otherwise authorized.

Notify ESD and Fire Department if any planned or accidental interruption in water service occurs.

230.08 OPERATION OF EXISTING WATERMAIN VALVES AND HYDRANTS

Existing water main valves shall only be operated by ESD. The Contractor shall give 24 hours notice for his request to have an existing valve opened or closed.

The City views illegal operation of City owned valves and hydrants by Contractors or others as a serious safety and Public Health matter. If a Contractor illegally operates a valve or hydrant to turn on or off the municipal water supply the City will shut down the Contractor's operation immediately. In addition, the Contractor may be fined up to \$5,000.00 in accordance with current City by-laws or latest revision.

230.09 PROCEDURE FOR SUPPLY OF TEMPORARY MUNICIPAL WATER

The Contractor is responsible for supply of his own water for construction and testing purposes. The City will make temporary municipal water available for this purpose from a City hydrant.

Supply of temporary water does not constitute City acceptance of ownership of the water main, and the City shall not own the new water main or fittings until such time as subdivision Phase 1 works are accepted by the City or Substantial Performance for City construction contracts is reached.

Temporary Water Supply from City and Non-City Owned Hydrants

In order to obtain a temporary municipal water supply during construction, the Contractor shall obtain a Hydrant Permit. The contractor shall supply a valve assembly consisting of a valve, RPZ backflow preventer, reducer, pressure pipe, and a connector to a hydrant side nozzle. The Contractor will be permitted to connect to, and operate his own valve assembly. The Contractor will be responsible for any street crossing that may be required for the hosing to reach the construction site, and the Contractor shall be liable to obtain all permits associated with such street crossings.

Once the backflow prevention is in place, the Contractor may connect the hose to the new water mains, in order to provide pressure for wet tapping. The only acceptable methods of connection are:

1. Connection to an end cap
2. Connection to a contractor's on site hydrant
3. Connection to a service tee.

In certain areas of the City, discoloured water will result from sudden large volume withdrawals of water, such as operation of the Contractor's valve as described above. The Contractor will be responsible for all claims due to water quality. The City reserves the right to restrict water use at its sole discretion if the City believes the site water is affecting water quality. Should the Contractor be found to repeatedly be in violation of the temporary water supply procedure outlined here, he shall lose the privilege of access to a temporary municipal water supply, in addition to any legal remedies the City may take.

230.10 TAPPING OF EXISTING WATERMAINS

The ESD shall perform all tapping of existing watermains at the Contractors expense. The Contractor shall supply all materials and pay all applicable fees or costs. The price bid for tapping of an existing watermain shall include cost of all fees or work payable to ESD for the tapping of existing watermains, unless otherwise specified.

For connection to existing PVC water mains, the contractor shall supply to the City a Mueller BR series service saddle. Direct threaded tapping of PVC pipe is not permitted.

230.11 PRODUCTS

Ductile - Iron Pipe and Fittings (Maintenance Applications Only)

Pipe: designed to AWWA C150/ANSI A21.50, manufactured to AWWA C151/ANSI A21.51, Special Thickness Class 52, cement mortar lined to AWWA C104. Pipe shall be delivered to site complete with capped ends.

Fittings: to AWWA C110, cement mortar lined to AWWA C104, minimum pressure rating 1035 kPa for cast iron, minimum pressure rating 1720 kPa for ductile-iron.

Joints: mechanical or push-on to AWWA C111; flanged where indicated, to AWWA C110 with class 125 flanged ends to ANSI B16.1 with cloth-inserted rubber gasket; grooved type coupling joint with malleable iron couplings and gaskets.

Pipe Restraints: restraints must be ductile iron with twist off nuts for proper torque. Wedges shall be ductile iron. Product shall be UL or ULC listed and FM approved. The restraint shall have a working pressure of 1720 kPa (250 psi) with a 2:1 safety ratio when tested in a dead-end situation. Acceptable Products: Uni-Flange Series 1400 (mechanical joints), Uni-Flange Series 1450 (push on joints), EBAA Megalug, or approved equal.

Polyvinyl Chloride Pipe

Pipe: shall conform to AWWA C900 and certified to CSA B137.3 for sizes 100mm to 300mm and AWWA C905 and CSA B137.3 for sizes 350mm to 900mm. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi). Pipe shall be Factory Mutual, ULC and ULI approved and NSF-61 certified. Pipe shall be delivered to site complete with capped ends.

Molded Fittings: shall conform to AWWA C907 and certified to CSA B137.2 for sizes 100mm to 200mm and conform to AWWA C900 and certified to CSA B137.3 for sizes 250mm to 300mm. They should also be UL listed and FM approved.

Fabricated Fittings: shall be made from segments of AWWA C900 DR 18 (pressure class 235 psi) pipe bonded together and over-wrapped with fiberglass-reinforced polyester. The fittings must meet the requirements of CSA B137.3.

Lubricant: shall be non-toxic, water soluble and listed by the National Sanitation Foundation.

Pipe Restraints: restraints shall be same as for ductile iron but specifically designed for use on PVC pipe or PVC integral joint restraint.

Colour Coding: Pipe and fittings shall be color coded blue.

Concrete Pressure Pipe and Fittings

Pipe and Fittings: steel cylinder type, pre-tensioned, concrete lined: to AWWA C303, with minimum 31mm thick cover over tension bar reinforcement using Type 50 cement to ASTM C150 containing fifteen percent (15%) fly ash.

Joints: bell and spigot, plain end, victaulic and welded with performance requirements to AWWA C303. Flanged to AWWA C207, 1 MPa rating drilled to ANSI B16.1 (flat face).

Protective Coating: (when specified in the Schedule of Quantities and Prices)

Hydrants and Extensions

Hydrants: dry barrel type: to AWWA C502 and ULC-S-520, designed for maximum working pressure of system; depth of bury: 1800mm unless otherwise specified; barrel: two-piece with safety break-away flange and stem; main valve: compression type, 125mm opening; inlet connection: mechanical joint, 150mm diameter; nozzles: two (2) 63.5mm threaded hose outlets and one (1) 114mm steamer port; Hydrant to open counter clockwise; threads, outlets and operating nut to be 32mm square. Approved hydrant list: McAvity Brigadier (Clow), Darling (Mueller).

Hydrant Extensions: As manufactured by the hydrant manufacturer.

Hydrant Markers: As detailed in the standard drawings.

Valves

Gate Valves - 50mm: Resilient seat to AWWA C509, UL or ULC listed, minimum working pressure of 1380 kPa, cast iron body, non-rising stem, stainless steel nuts and bolts, open counterclockwise, and IP threaded joint. AVK valves acceptable. Valve shall have cast iron hand wheel to ASTM A126 Class B, with fusion-bonded epoxy resin coating to AWWA C550. Wheel shall be secured to stem with bolt ASTM zinc coated steel 8.8.

All valves 100mm and larger shall be: cast iron body; non rising stem; stainless steel nuts and bolts, mechanical joint, unless otherwise specified; fusion-bonded epoxy resin coated to C550; O ring seals; open clockwise; operating nut St. John's Standard.

Gate Valves - 10 mm and larger: Resilient seat to AWWA C509, minimum working pressure rating 1380 kPa.

Butterfly Valves - 400mm and larger: to AWWA 504, short body, Class 150B, minimum pressure rating 1035 kPa; Mechanism: cast iron, cast steel, alloy cast-iron or ductile iron disc, type 304 stainless steel shafts to ASTM A276, rubber seated for positive shut-off at minimum 1 MPa differential pressure, either direction.

Valves 400mm in diameter and greater shall be gear operated. Valves 900mm and greater shall have an operating gear ratio of no less than 1 to 180. All valves 400mm and greater shall be joint restrained.

Air and vacuum release valves: to CSA B64-M88, heavy duty combination air release valve employing direct acting kinetic principle. Valves to be constructed of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure. Valves to expel air at a high rate during filling, at a low rate during operation, and to admit air while line is being drained. Valve to be complete with a suitable check unit. Ends to be flanged to ANSI B16.1

Valve Boxes: to be ABS composite lower section, complete with ductile iron upper section, 125mm diameter. The minimum overlapping distance between the top of the ABS section and the bottom of the ductile iron section shall be 150mm. Acceptable products: Mueller MVB Composite Valve Box or equal. Top of the box shall be marked "WATER" except for hydrant valves which are to be marked "HYDRANT".

Tapping Sleeve: Mechanical joint tapping sleeve, branch outlet flanged, 1379 kPa working pressure. Brand shall be as approved by the City of St. John's. Approved products: Mueller H-715 (cast iron), Smith Blair Style 623.

Water Services 50mm and smaller

Copper tubing: To ASTM B88, type K, annealed for service laterals up to 50mm in diameter.

Copper Pipe Joints: To be compression type suitable for 1 MPa working pressure.

Polyethylene / Aluminum / Polyethylene composite pipe: To CSA B137.9, AWWA C903 and ASTM F1282. Compression fittings to be as per manufacturers specifications and suitable for underground service (red brass). Approved products: IPEX Q-Line.

Cross linked polyethylene pipe: To conform to ASTM C904, certified to CSA B137.5, and conform to ASTM F816, F877 and F2023, NSF 14 and 61, with co-extruded UV shield to allow exposure to natural sunlight for up to one (1) year. The minimum degree of cross linking shall be 80%. Approved products: Municipex, IPEX Blue 904 Pex.

Brass Corporation Stop: Red brass to AWWA C800/ASTM B62, compression type. For working pressures up to 690 kPa, ball style can be used. For working pressures in excess of 690 kPa, ball style must be used.

Ball Type Curb Stop (38mm and smaller): Ball type with neoprene gasket to AWWA C800/ASTM B62, compression type with drain and must have stainless steel key and cotter pin. Approved Products: Ford, Canada Brass.

Curb Case: Curb stops to have 1.5 metres to 1.8 metres adjustable bituminous coated, cast iron service box with stainless steel stem to suit depth of bury. Top of cast iron box marked "WATER".

Compression Connections: Only compression connections with a pull out resisting device and approved by the City shall be permitted to be used. Approved products: Ford Grip Joint Connection, Mueller Grip Joint Connection.

Miscellaneous Items

Thrust Blocks and Anchors: 25 MPa concrete, see standard drawings.

Disinfectant: sodium hypochlorite or calcium hypochlorite: to AWWA B300.

Reducing Agent: hydrogen peroxide: 35% by weight commercial grade.

Insulation: to CAN/CGSB 51.20, Type 4 extruded polystyrene.

Paint: as specified for Item "Hand Rail".

Anodes: All sacrificial zinc anodes shall conform to ASTM B-418 Type II and shall be made of high grade electrolytic zinc, 99.99% pure. The standard anode size shall be 10.9 kg. (24lb.) and 1.2 metres (48'') in length, ZN 24-48. The anode lead wire shall be at least 3 metres of No. 10 AWG stranded copper wire having TWH blue insulation. The lead wire shall be connected to the steel core with silver solder.

230.12 PIPE LAYING

Watermain shall be constructed in an open trench and laid to the lines and grades set by the Engineer. The pipe shall be well bedded on a solid foundation along the full length of each pipe. The bottom of the trench shall be recessed at bells such that the barrel of the pipe shall be completely supported over its entire length on a solid foundation.

In order to ensure adequate lateral and vertical stability of the pipe during jointing and embedding operations, a sufficient amount of bedding material to hold the pipe in rigid alignment shall be uniformly deposited, and thoroughly compacted on each side and back of the bell of each pipe.

The trench shall be kept dry and no pipe shall be laid in water or upon a wet, muddy or frozen bed. All pipes must be thoroughly cleaned and protected from dirt and no water shall be allowed to flow through any pipe during construction.

At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug. If water enters the

trench, this plug shall remain in place until the trench is pumped completely dry.

Existing water service laterals that straddle the trench shall be preserved without being cut unless the engineer agrees that the works require the laterals be cut. Cut pipes shall have a temporary cap placed at each open end. The Engineer shall be present to inspect proper workmanship for reconnection of cut laterals, to guard against pull out of pipe from the couplings later due to trench settlement.

230.13 PIPE ASSEMBLY

Ductile Iron

Pipe shall be assembled in accordance with the manufacture's recommendation.

Pipe restraints are permitted in place of thrust blocks under certain conditions. The restraint distance must be in accordance with the manufacturer's recommended length. The Engineer shall submit a design for pipe restraints for each location where pipe restraints are proposed.

Polyvinyl Chloride Pipe

Pipe shall be assembled in accordance with the manufacture's recommendations. Where PVC pipe is used, associated tees, bends and fittings are to be PVC. Ductile iron fittings are only to be used when joining onto existing cast iron or ductile iron piping. Where ductile iron fittings are used, fittings are to be incased in 50mm concrete .

Concrete Pressure Pipe

Pipe shall be assembled in accordance with the manufacture's recommendations.

230.14 THRUST BLOCKS

Thrust blocks as called for in the standard drawings shall be provided with all plugs, caps, tees and bends.

230.15 SETTING OF HYDRANTS

Hydrants shall be located as shown on the plans or as directed by the Engineer.

All hydrants shall stand plumb and shall have their nozzles parallel with the curb, with the pumper connection facing the curb. Hydrants shall be set to the established grade, with the break away flange approximately 75mm to 150mm above the finished sidewalk or ground elevation. Where a hydrant extension is required to bring a new hydrant to grade, the extension will be supplied, installed and paid for under "Adjusting Hydrants to Grade."

Where a hydrant is set in pervious soil, drainage shall be provided at the base of the hydrant by placing 40mm washed stone from the bottom of the trench to at least 150mm above the drain opening in the hydrant and to a distance of 300mm around the elbow.

Where a hydrant is set in clay or other impervious soil, a drainage pit 600mm in diameter and 900mm deep shall be excavated below each hydrant and filled with 40mm washed stone under and around the elbow of the hydrant and to a level of 150mm above the drain openings.

Where the bowl of the hydrant will be located below the high water table, the drain holes of the hydrant are to be plugged and the hydrant marked, by a sign as a "Wet Hydrant". Where this situation is encountered, further direction from EDS is required.

The bowl of each hydrant shall be well braced against undisturbed earth at the end of the trench with concrete backing, or it shall be secured to the main line using approved mechanical restraining devices. Hydrant lead valves less than 2.0m from the hydrant shall be restrained to the main by the use of a mechanical joint restraining system.

Hydrants and hydrant markers shall be painted in standard City colours or as specified. Paint and coat application shall be as specified in the Item 603 "Hand Rail".

230.16 VALVES

Valves, unless otherwise shown, shall be installed in accordance with the manufacturer's instructions and installed with a valve box and extensions to extend from the valve bonnet to the top of finished grade.

230.17 TAPPING SLEEVES AND VALVES

Tapping sleeves and valves shall be used to connect to a live municipal water supply, unless otherwise approved by the Engineer.

Prior to ordering a tapping sleeve and valve, the Contractor shall excavate at the location of the tap, and measure the outer diameter (OD) of the existing water main. The Contractor shall also provide ESD an opportunity to view the location prior to backfilling the excavation.

The Contractor shall provide the tapping sleeve and valve (TS&V), fasten the sleeve to the pipe, and pressure test to prove no leakage. The Contractor then shall request ESD to perform the tap, and retrieve the coupon.

Pipe joints shall be restrained using a megaholder (or approved equal) for a branch pipe length as recommended by the pipe restraint manufacturer.

The Contractor is advised to allow for sufficient lead time between delivery and order of cast iron tapping sleeve and valve assemblies.

230.18 CATHODIC PROTECTION

Sacrificial anodes shall be installed at the following locations:

- At the connection point between a non-metallic watermain and the existing metallic watermain;
- all metallic fittings and bends;
- all metallic valves;
- all fire hydrants;
- all metal services.

Anodes shall be installed horizontally, a minimum of 500mm to the side of the watermain and at a depth of 30 mm below the watermain and shall be backfilled with native material.

Anodes shall be installed complete with their cardboard container and enclosed selected backfill.

The anode lead wire shall connected to the watermain, metallic fitting, valve, service or hydrant as shown on drawing 10-230-10. Sufficient slack shall be left in the wire to prevent any stress on either the anode or the wire-to-pipe connection during backfill and subsequent soil settlement.

230.19 WATER SERVICES INSTALLATION

Water services shall not be buried shallower than 1.8 metres and no deeper than 2.0 metres.

When new PVC mains are beings installed, service tees are to be installed for each water service. Installed on mains 400mm and smaller. Service saddles are to be used on mains larger than 400mm. Direct tapping to connect a water service to a new main is prohibited.

Water services shall be installed at the centre of lots and 3 metres beyond the back of the future sidewalk, unless otherwise

directed. If the services are to be installed in conjunction with sewer services than the water service shall be located on the right side of the sewer services. When a water service is installed by itself, then the end of the service shall be marked with a stake as detailed in Item 225.02. Each water service shall be suitably plugged or capped to prevent leakage and to prevent dirt or other harmful material from entering the pipe.

Water Service to Building

When a water service lateral is to be constructed to a proposed or existing residential building from an existing water main, or extended from its termination point at the street line, the entire length of the service pipe must be inspected and approved by ESD or the City's representative prior to backfilling. The Contractor must contact ESD to arrange for an inspection. Any portions of a water service lateral that are buried without being inspected shall be uncovered for inspection at the Contractor's expense.

The Contractor must avoid joining separate pieces of pipe with couplings, unless absolutely necessary and approved by the Engineer. A service of less than 20 metres in length shall have no coupling connections.

The service pipe shall be brought under the footing of the building in one piece prior to termination.

Size of Water Services

Specification of the diameter of a water service depends on such factors as length, building fixture units, allowance for future building expansion, internal building plumbing sizes and available street pressure. It is the responsibility of the Developer or his agent to properly specify water service sizes in order that the finished development will have a water service which is properly sized in accordance with the Canadian Plumbing Code.

The minimum water service size allowed by the City under any circumstance is 25mm.

Minimum Water Service Size for Single Family Housing:

In the case of a single family residence the minimum water service size shall be 25mm, for a length, not to exceed 30 metres and where the main floor elevation of the house is within 2 metres of street elevation. For cases outside these parameters, the developer shall submit detailed calculations for review and approval of size of service.

The service length shall be measured from the watermain to the location where the service enters the building.

Provision of services to this minimum standard for single family residences does not constitute automatic compliance with the Canadian Plumbing Code, and the onus is on the Developer or his agents to ensure compliance with the Code.

230.20 ABANDONING OF WATER SERVICE LATERALS

50mm or less

An existing water service to a property that is proposed to be abandoned shall be excavated by the Contractor at the connection to the water main, and abandoned at the main.

ESD or the City's representative shall inspect that the corporation stop has been closed prior to backfilling. The Contractor shall provide twenty-four (24) hour notice.

If upon excavation it is found that a corporation stop does not exist, City forces will place a repair sleeve on the pipe at the Contractor's expense.

Larger than 50mm

The City shall determine requirements depending on each circumstance. Contractor shall contact the City to obtain direction.

230.21 TIE-INS

The Contractor shall record on drawings or in tabular form "As Built" tie-ins for all valves, curb stops, bends and pipe ends. When the work is completed this information shall be presented to the Engineer.

230.22 CONNECTION TO THE EXISTING MUNICIPAL WATER SUPPLY

No pipe shall be physically connected to the existing municipal water system, or to a tapping sleeve, prior to pigging and City acceptance of satisfactory pressure, leakage and chlorination test results. A gap of one (1) metre minimum length shall remain in place until the City formally approves connection to the municipal water system.

The Contractor shall disinfect all existing water main end caps and pipe segments before connection of new water main pipe.

230.23 PIGGING

Appropriately sized poly pigs as manufactured by Gerard, or approved equal, having a minimum density of 2lb/ft² and recommended for wiping shall be installed into the main to ensure watermains are swept when the system is first charged. Hydrant leads will not be required to be pigged.

To insure the pigging is properly undertaken the following procedures must be used and will be rigidly enforced:

- (a) Before any water main is placed, the Contractor, the Engineer and representatives of ESD shall meet and agree on the procedures and schedule for pigging, i.e. where and when the poly pigs are inserted, how they will be removed, when the pigging should be done, in what direction the poly pigs will be forced, etc...
- (b) The Engineer will verify the insertion of each poly pig.
- (c) Upon the request of the Contractor and Engineer, ESD will witness the removal of the poly pig and certify that the appropriate section has been properly pigged.

230.24 PRESSURE TEST

Water from the existing distribution system shall be supplied as described in the item entitled "Procedure for the Supply of Temporary Municipal Water".

After the pipe has been laid, backfilled, thrust blocks have reached sufficient strength and subsequent to the installation of service fittings, all newly laid pipe, or valved section thereof, shall be subjected to a hydrostatic pressure of 1050kPa or 1.5 times static pressure, which ever is greater. Every valve shall be pressure tested in the closed position on either side of the valve and in the open position. Where hydrants are in the test section, the test shall be made against the closed hydrant.

Each valved section of pipe shall be slowly filled with water and the test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection and all necessary apparatus shall be furnished by the Contractor.

Before applying the test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points the Contractor shall install corporation cocks at such points so the air can be expelled, the corporation cocks shall be closed and the test pressure applied.

The pressure test shall be of duration of at least two (2) hours and the pressure shall not vary by more than +/- 35kPa.

Where water services are installed onto an existing main or onto a new main that has been pressure tested the service shall be pressure tested to 690kPa and visually inspected before backfilling. All faulty or leaking connections shall be corrected before backfilling.

230.25 LEAKAGE TEST

A leakage test shall be conducted concurrently with the pressure test. The Contractor shall supply all equipment necessary for the conducting of this test.

"Leakage" shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof, to maintain pressure within 35/kPa of the test pressure after the air in the pipeline has been expelled.

No pipe installation will be accepted if the leakage is greater than the allowable leakage for joints + the allowable leakage for closed metal seated valves.

Allowable leakage for pipe is 0.0000449 l/hr/mm of pipe/mm of nominal pipe diameter for maximum test sections of 300 metres. If testing more than 300 metres, no leakage is allowed.

Allowable leakage for closed metal seated valves shall be 0.0012 l/h/mm of nominal valve size. No leakage allowance will be allowed for resilient seat valves.

ALLOWABLE LEAKAGE TABLE		
Pipe Diameter (mm)	Watermain (l/hr/m)	Valves (closed) (l/hr)
150	0.00674	0.18
200	0.00898	0.24
300	0.01348	0.36
400	0.01797	0.48

If any test of pipe discloses leakage greater than the allowable, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

230.26 DISINFECTION

Disinfection of watermains shall be done in accordance with AWWA C651 and the following:

Prior to being chlorinated the mains shall be filled to eliminate air pockets and shall be flushed to remove particles. The flushing velocity in the mains shall be not less than 0.76m/s unless the Engineer determines that conditions do not permit the required flow to be discharged to waste.

Water from the existing distribution system shall be supplied as described in the item entitled "Procedure for the Supply of Temporary Municipal Water". Water shall be made to flow at a constant measured rate into the newly laid water mains and hydrant leads.

At a point not more than 3 metres downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate, such that the water will have not less than 25mg/l free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals.

Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall remain in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. Upon completion and acceptance of the initial chlorination of the water main, the water main shall be retested for a second 24 hour period. If the testing proves unsatisfactory, the disinfection shall be repeated until acceptable results are received. After acceptance, the treated water in all portions of the main shall have a residual of not less than 10mg/l free chlorine.

After the final flushing and before the water main is placed in service, water samples shall be collected from the line and tested for bacteriological quality and shall show the absence of coli form organisms. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained.

The Contractor shall get the approval of the governing agency or agencies before the heavily chlorinated water can be

discharged into storm, sanitary or other receiving systems. If the heavily chlorinated water cannot be accepted by nearby storm, sanitary or other receiving systems, the water shall be discharged into tanks and disposed of at an approved site. The cost associated with disposing of heavily chlorinated water shall be borne by the Contractor.

230.27 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be:

Connection to Existing Main - a lump sum price for each connection to an existing system.

Pipe and Fittings - the centerline end to end distance of watermain installed, measured in metres. No deletions shall be made for valves or other fittings.

Valves - the number of valves of each size or classification installed.

New Hydrants - each new hydrant and hydrant marker supplied and installed.

Relocate Hydrants - each hydrant and hydrant marker relocated and adjusted to grade but not requiring a hydrant extension

Adjust Hydrant to Grade - the number of each length installed.

Supply Hydrant Marker - each new hydrant marker supplied and installed separate from those called for in other parts of this specification.

Water Services:

- (a) the number of services of each size connected to the main.
- (b) the number of services of each size connected to an existing service or building plumbing.
- (c) the length of service measured in metres from the centerline of the water main to the end of pipe laying, as approved by the Engineer.

Pipe Restraints - the number of each size installed.

Sacrificial Anodes – the number of sacrificial anodes installed.

230.28 PAYMENT

Payment shall be on a unit price basis per metre for pipe and fittings supplied, transported, laid, jointed, disinfected, tested, and connected to existing watermain. The bid price shall include all labor, equipment and materials necessary to complete the work in accordance with this specification.

The Contractor will only be paid to a maximum of 90% of the value of this item until such time as the section of work has passed all tests. This 10% will be called the "Water Test Allowance". In addition, the 10% mechanics lien holdback shall apply.

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ITEM 321**STREET EXCAVATION****321.01 SCOPE OF WORK**

The work to be done consists of the construction of subgrade for the street. The bottom of all excavation and the top of all fill, when completed shall be known as the subgrade and shall be true to lines and grades as set by the Engineer. Excavation and fill is to be made in all cases to such a depth that the compacted subgrade shall be at the required depth below the elevation of the finished roadway.

321.02 CLASSIFICATION

These are the classifications of excavation unless otherwise noted:

- (a) Solid Rock (SR) which shall be solid beds or masses of igneous, sedimentary or metamorphic rock which, prior to its removal was integral with its parent mass, and cannot normally be excavated without blasting or pneumatic hammer, and boulders or rock fragments having individual volume in excess of 0.5 m³ determined from three mutually perpendicular dimensions.
- (b) Other Material (OM) - which shall include all excavated material not classified as Solid Rock or Unsuitable Material.
- (c) Unsuitable Material (USM) - shall be all excavated material other than Solid Rock which is unsuitable to be placed in the subgrade.
- (d) Concrete (CON) - shall be all non reinforced and reinforced concrete and rock and concrete composite structures.
- (e) Asphalt (ASP) - shall be asphalt concrete.

321.03 STRIPPING

All topsoil on the streets and the area which will be cut or filled shall be removed and stockpiled on the site for use in landscaping or as otherwise directed by the Engineer.

321.04 BLASTING

The Contractor shall design a blasting pattern for solid rock so that the blasted rock will meet the requirements of Item 322.02 (b) "Rock Borrow".

321.05 OTHER MATERIAL CUTS

Where the work is in cut the Contractor will be generally expected to excavate material to the true surface of the subgrade. Should the Contractor excavate below the true surface of the subgrade he shall place and compact other material as necessary to restore the excavation to subgrade. There shall be no payment for this work except where unsuitable material is excavated below the subgrade.

The Contractor shall remove stones larger than 150mm in greatest dimension from the top 300mm of sub-grade.

321.06 ROCK CUTS

All rock cuts shall be excavated and mucked out fully to 300mm below sub-grade.

In rock cuts where pockets which will not drain are formed below the sub-grade by blasting, the contractor shall, at his own expense, provide drainage by ditching to a free outlet, as ordered, and then backfill and compact to 95% of Proctor Density both the pockets and the trench to an elevation 300mm below subgrade. Backfill material shall be broken rock or coarse gravel.

Back slopes shall be carefully scaled down and all rock and fragments, liable to slide or roll down the slopes, removed to the satisfaction of the Engineer.

321.07 FILL

Where fill material is required to raise the embankment to the proper subgrade elevation such material shall be obtained from surplus excavation and excavated rock meeting requirements of Item 322.02.

The Contractor shall remove unsuitable material as directed by the Engineer. No fill material shall be placed until the area to be filled has been approved by the Engineer.

On no account will the Contractor be allowed to construct a core through the fill and complete the fill by side dumping.

Fill material shall be deposited and spread in uncompacted layers not exceeding 500mm for the full width of the fill, except that the Engineer may order this thickness reduced, if such thickness does not respond to compaction methods.

The thickness of each successive layer shall be maintained uniform for the full width of the fill.

All stones larger than 150mm in greatest dimension shall be removed from the material comprising the top 300mm of the fill.

The moisture content of the material in the embankment shall be controlled at all stages of construction by ensuring that the top surface of each layer of fill material is suitably compacted and sloped with a cross-fall not to exceed 5% in order to shed surplus rain water.

Material shall be compacted to 95% Standard Proctor Density.

If the moisture content of the material is deficient, the Contractor shall add sufficient water to obtain the necessary compaction. The water shall be placed in controlled amounts and added uniformly. The placing of water shall be considered as included in the unit price bid for "Street Excavation".

321.08 DISPOSAL OF SURPLUS MATERIAL

All surplus material to be legally disposed off the site and at a pit provided by the Contractor.

321.09 REMOVAL OF OBJECTS ABOVE GROUND LEVEL

Unless otherwise provided for by a separate pay item, the Contractor shall be deemed to have included in his bid price for Street Excavation the removal and disposal of trees, shrubs, hedges, fences, signs, boulders, and other objects that rise above the original ground level.

321.10 REMOVAL OF EXISTING ASPHALT AND CONCRETE WORKS

Unless otherwise provided for by a separate pay item, existing asphalt and concrete works which are to be removed shall be classified as "Street Excavation (USM)".

321.11 FILL ADJACENT TO STEEP SLOPES

Where new fill is to be placed adjacent to an existing steep slope or embankment, the Contractor shall, concurrent with the placement of new fill, bench the existing slope as described herein to provide proper bonding of new work to existing.

Each bench shall be 2 metres in width, and at the same height above original ground (or above the next bench below it) as the thickness of the adjacent layer of new fill, such that the bench forms a 2 metres wide extension of the new fill layer into the existing slope.

Material cut out of the existing slope shall be placed in the fill area and compacted.

321.12 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be the number of cubic metres of material excavated, rounded to the nearest whole number, and as shown on the cross-section sheets, between the original ground lines and the completed and accepted embankment lines. On areas where clearing and grubbing is required, cross-sectioning for excavation quantities will be done after clearing and before grubbing operations. A depth of grubbing of 150mm will be assumed and deducted from the excavation quantities. Material placed or removed outside the lines of the Contract and beyond the toe of slope or top of slope, for fill and cut sections respectively, shall not be included in the calculations for pay quantities.

The volume of fill shall be computed by the average end area method of computation.

During excavation operations whenever the character of material changes from one type to another, the Contractor shall notify the Engineer in order that proper measurements or cross-sections shall be made. No allowance will be made for material excavated before such measurements or cross-sections have been made.

In areas where rock excavation is required for street excavation, rock shall be cross-sectioned after removal of overburden; shattering to 300mm below road subgrade shall be paid for as excavation.

321.13 PAYMENT

Payment shall be made at the respective unit price bid for each cubic metre of material excavated. Payment for placing and compacting materials into fill areas shall be considered included in the unit price bid for excavation.

Payment shall be full compensation for all labour, equipment, and material necessary to excavate, fill, compact, and remove surplus material in accordance with this specification.

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ITEM 351**HOT MIX ASPHALTIC CONCRETE****351.01 SCOPE OF WORK**

This specification covers the City's requirement for the production, placing and compaction of hot mix, hot laid asphaltic base course and asphaltic surface course asphaltic concrete for pavement construction. Also covered are the requirements for Asphaltic levelling course to fill pavement depressions.

The base, surface and levelling course asphaltic concrete pavement shall consist of asphaltic cement, coarse and fine mineral aggregate, blending sand, plus mineral filler if required, combined as hereinafter specified, placed and compacted on a prepared base in conformity with the lines, grades, dimensions and cross sections, as staked by the Engineer.

351.02 MATERIALS**Asphalt Cement**

Unless otherwise specified, the asphalt cement (binder) shall conform to the latest edition of AASHTO M320 entitled Standard Specification for Performance Graded Asphalt Binder. The Performance Grade (PG) of asphalt binder shall be PG 58-28 and shall conform to the requirements of Table 1 in the AASHTO Specification. Other PG Binders may be specified in individual contracts when warranted.

All PG asphalt binders will be subject to testing for acceptance prior to and during use.

Prior to the start of and throughout pavement production current copies of certification of all project asphalt binders shall be provided to the City.

Any asphalt binder other than the asphalt binder specified must be removed from the Contractor's tanks to prevent contamination. Binders meeting the performance specifications but obtained from different sources cannot be stored in the same tank unless approved by the asphalt suppliers.

Performance Graded Asphalt Binder (PGAB) Sampling

The Contractor shall collect samples of asphalt cement as required by the Engineer. At least one sample shall be collected per project and per additional 5000 T of hot mix asphalt produced. Samples shall be taken from the Contractor's storage tank in accordance with ASTM D140 Standard Practice for Sampling Bituminous Materials. The sample size shall be at least two litres placed in one litre containers. The sample shall be appropriately identified including the time and date of samples, grade and type of binder, supplier, refinery and the name and proportions of any additives added.

It shall be the City's responsibility to submit PGAB samples for quality assurance testing.

Anti-Stripping Additive

An anti-stripping additive will be required for all Hot Mix Asphaltic Concrete. Modified Lottman tests in accordance with AASHTO T 283 Resistance of Compacted Hot Mix Asphalt (HMA) to Moisture-Induced Damage shall be completed within the mix design procedure, to determine the required amount of anti-stripping additive. Liquid anti-stripping additives and/or hydrated lime ($\text{Ca}(\text{OH})_2$) can be utilized as an anti-strip additive.

Contractors may choose to use an approved liquid anti-stripping additive in order to meet the AASHTO T283 requirements below. The liquid anti-stripping additive application rate added to the hot mix asphaltic concrete shall be the greater of 0.5% of additive by weight of asphalt cement, or the recommended percentage as determined from Lottman test results. Approved liquid anti-stripping additives include the products AD-here LOF 65-00 (ARR-MAZ Custom Chemicals) and Redicote C-3082 (Akzo Nobel Chemicals). All other products must be approved by the City's Engineering Department.

An additional rate of liquid anti-stripping additive will be required if one of the following conditions occurs as determined by AASHTO T 283:

- The tensile strength ratio of the hot mix asphalt concrete is less than 0.80
- There is visual evidence of stripping. Acceptable specimens shall have a visual stripping rating of 1.0 or lower based on a scale from 0 to 10 (with 0 being no visual stripping and 10 being fully stripped).

Suppliers of the asphalt cement and liquid anti-stripping additives shall provide in writing all mixing requirements and proof of product compatibility. The treated asphalt PG binders must meet the relevant performance grade specifications.

Contractors must inform the Engineer and advise workers of the proper procedures, use of protective clothing and equipment when handling anti-stripping additives. Hot mix asphaltic concrete with liquid anti-strip additives is known to produce strong odors. Contractors must ensure the mix materials are used under proper environmental conditions to guarantee the safety and comfort of construction personnel and the public.

In addition to AASHTO T 283 requirements, the asphalt hot mix containing liquid anti-stripping additive shall pass a boiling water test in accordance with ASTM D3625 Standard Practice for the Effect of Water on Bituminous-Coated Aggregate Using Boiling Water within the mix design procedure. The pass criterion for ASTM D 3625 is 95% or greater retained bitumen coating of aggregate.

An additional rate of liquid anti-strip and/or an alternate anti-stripping additive will also be required if the aggregate is known to be prone to stripping from past performance and the minimum application rate was insufficient. Modified Lottman Tests (AASHTO T 283) and Boiling Water Tests (ASTM D3625) shall also be conducted on field produced samples of hot mix. All field produced samples shall also pass the requirements above.

Hydrated lime ($\text{Ca}(\text{OH})_2$) can also be utilized as an anti-strip additive. Where hydrated lime is used as an anti-strip additive the dosage requirement shall be the greater of one half (1/2) percent by mass of total dry aggregate, or the recommended percentage as determined from Lottman test results.

Where hydrated lime is utilized the hydrated lime shall be added to all aggregates by either of the following methods:

- (a) Hydrated lime slurry shall be homogeneously mixed with the aggregate in a pug-mill or tumble mixer prior to entering the asphalt plant (the hydrated lime slurry shall be produced at the approximate rate of 1 part lime to 3-4 parts water).
- (b) Dry hydrated lime shall be homogeneously mixed with wetted aggregate in a pug-mill or tumble mixer prior to entering the asphalt plant. The wetted aggregate shall have a minimum moisture content of 2% by weight for coarse aggregate and 3% by weight for fine aggregate.

Hydrated lime shall be mixed with the aggregate at least 4 hours prior to entering the asphalt plant. Aggregate treated with hydrated lime shall be used within the same construction season. Treatment shall include both coarse and fine aggregate components of the asphalt aggregate.

Where hydrated lime is required, the Contractor shall provide the Department with complete information on how the Hydrated lime to be used in the treatment of aggregates. Hot mix produced containing hydrated lime, shall conform to all requirements of the contract before acceptance.

The requirement for hydrated lime anti-stripping additive will be determined following the mix design. The design amount of hydrated lime will be added as a percentage of the total dry aggregate weight. Measurement for hydrated lime anti-stripping additives shall be determined by the Department on the basis of the computed quantity calculated from the percentage of anti-stripping additive specified in the mix design and the total asphalt cement or dry aggregate used by the Contractor. If hydrated lime anti-stripping additive is required, mix the hydrated lime with water (if necessary) and add the hydrated lime in accordance with the requirements set forth above.

If an anti-stripping additive or additional/alternative anti-stripping additives are required, a further 10 working days will be required after the Contractor has advised the City of its new anti-strip proposal and all materials have been received by the materials Engineering Division. The Contractor and his supplier shall provide sample materials, any technical information and manufacturer's recommended application rates.

Coarse Aggregate

Coarse Aggregate shall consist of hard, durable crushed stone or crushed gravel particles, reasonably uniform in quality and free from soft or disintegrated pieces. The portion of material retained on the 4.75 mm sieve shall be known as coarse aggregate. The coarse aggregate stockpile shall contain no more than 20% passing the 4.75 mm screen.

Coarse Aggregates shall be washed if necessary to have clean surfaces free from coatings of foreign matter. Coarse Aggregates shall conform to the physical requirements shown in Table 1.

Irrespective of compliance with the physical requirements of Tables 1, any coarse aggregate may be accepted or rejected on the basis of past field performance at the discretion of the department.

TABLE 1
Physical Requirements for Coarse Aggregates

TEST METHOD	TEST NO.	ALL COURSES
Los Angles Abrasion - % Maximum (A)	ASTM C131	35
Absorption - % Maximum	ASTM C127	1.75
Magnesium Sulfate – Soundness – 5 cycles - % Maximum	ASTM C88	12
Petrographic Number – Maximum	CSA A23.2 – 15A	135
Freeze - Thaw Test - 5 cycles- % Maximum	CSA A23.2 - 24A	8
Crushed Particles - % Maximum (B)	ASTM D5821	90
Flat & Elongated Particles - % Maximum (C)	MTO LS608	10
Loss by Washing - % Maximum Passing (D)	ASTM C117	1.75
Micro Deval (% Max.)	ASTM 6928	20
Clay Lumps (% Max.)	CSA A23.2 – 3A	1
Low Density Particles (% Max.)	CSA A23.2 – 4A	1
Friable or Slatey Siltstone (% Max.)	CSA A23.2 – 15A	1

Notes:

- (a) The ratio of the loss after 100 revolutions to the loss after 500 revolutions shall not exceed 0.265.
- (b) Pieces having two (2) or more freshly fractured faces only will be considered as crushed material. Pieces with only small chips removed will not be considered as crushed.
- (c) Flat and elongated pieces are those whose greatest dimension exceeds four (4) times their least dimension.
- (d) When only quarried rock is used as a source of coarse aggregate, a maximum of two percent (2%) passing the 75µm sieve shall be permitted.

Fine Aggregate (Crushed Fines)

The portion of the material passing the 4.75mm sieve shall be known as fine aggregate.

Fine aggregate shall conform to the physical requirements shown in Table 2.

In any fine aggregate, not more than twenty percent (20 %) of the material passing the 75µm sieve shall be finer than 2µm in size.

Fine aggregate shall consist of clean, tough, rough-surfaced grains, free from clay, loam and other foreign matter. The fine aggregate stockpile shall contain no more than 20% retained on the 4.75 mm screen.

The maximum allowable percentage of non-crushed fine aggregate in the total combined aggregate shall be 20% inclusive of all natural occurring fines and blending sands.

Irrespective of compliance with the physical requirements of Table 2 any fine aggregate may be accepted or rejected on the basis of past field performance at the discretion of the City.

Natural Fines and Imported Blend Sand

Blending sand shall consist of clean, tough, rough surfaced grains, free from clay, loam, or any other foreign matter. Blending sand is considered as a fine aggregate and thus must meet the requirements of Table 2.

The graduation of the blending sand shall be such that when used in the asphalt mix, the resulting mix shall meet the requirements of Tables 2 and 3 of this section. In any case, the blending sand shall have 100% (by dry weight) passing of the 9.5 mm sieve and at least 80% (by dry weight) passing the 4.75mm sieve. The combined total of blending sand and naturally occurring fine aggregate shall not exceed 15% (by dry weight) of the total combined dry aggregate.

Filler

Material Filler shall meet the requirements of ASTM D242 Standard Specification for Mineral Filler for Bituminous Paving Mixtures. Where filler is required, it shall be supplied by the contractor

Passing 600µm Sieve	97% - 100%
Passing 75µm Sieve - not less than	70% - 100%

TABLE 2

Physical Requirements for Fine Aggregates

Test Method	Test No.	All Courses
Micro-Deval Test for Fine Aggregate % Maximum (See note 1)	CSA A23.2-23A	20
Plasticity Index	ASTM D4318	0
Sand Equivalent (minimum)*	ASTM D2419	50
Fine Aggregate Angularity (% min)**	ASTM 1252	45

** Sand Equivalent testing to be conducted on each individual fine aggregate component. When combined in accordance with the Marshall Mix design the minimum value SE shall be 50.

** FAA tests shall be conducted on a representative sample of the total fine aggregate inclusive of all fine aggregate materials as indicated in the mix design including blending sand. The test will be conducted in accordance with Standard Graded Sample Method A.

Note 1 If equipment for Test Method CSA A23.2-23A is not available, the magnesium sulfate soundness test, as detailed in ASTM C88, is acceptable, providing the limit does not exceed 15% for Surface, Base or Leveling courses.

Recycled Asphalt Pavement (RAP)

If the Contractor wishes, the Contractor will be permitted to use Recycled Asphalt Pavement (RAP) in leveling or base course asphalt. The amount of RAP in the pavement mixture will be limited to 10% and subject to the following conditions:

Preparation and submission of a Marshall Asphalt Design Mix Formula (including all supporting documentation) for the asphalt mixture containing RAP, for the City's approval, is the responsibility of the Contractor. The Contractor shall use professional engineering services and a qualified testing laboratory to assess the aggregate materials, asphalt binders, blending sands, mineral fillers, anti-stripping agents and asphalt cement rejuvenation agents proposed for use and to carry out the

design of the asphalt concrete mix. No compensation will be provided to the Contractor, for the production of the asphalt design mix formula for the asphalt mixture containing RAP.

The asphalt mixture containing RAP shall be designed in accordance with the Ontario Ministry of Transportation, Design Procedure for Recycled Hot Mix Asphalt, latest edition, except that all test methods referred to shall be replaced with the appropriate ASTM Standards. Copies of this document are available from the City's Engineering Department.

RAP percentages may require the use of asphalt cement rejuvenation agents to ensure the overall asphalt cement characteristics meet the specified Performance Grade. Testing to confirm the rheological characteristics of the combined Performance Graded Asphalt Cement and the RAP asphalt cement shall be supplied as part of the Marshall Mix Design. In all cases the Performance Grade of the asphalt cement shall meet the project specifications.

RAP shall be comprised of asphalt millings and be free of uncoated particles. The use of non-milled reclaimed asphalt pavement is subject to the approval of the City of St. John's.

The quality of the aggregate in the RAP and the quality of the final pavement mixture shall meet all requirements set forth in this specification.

Where RAP is included in base or leveling course mixes that following process will be followed:

- RAP shall be fractionated into a minimum of three separate sizes.
- The gradation of the individual fractionated RAP shall be:
 - 9.5mm and above
 - 4.75mm to 9.5mm
 - minus 4.75mm
- The asphalt plant must be equipped with a metering system that allows the fractionated RAP to be added in a controlled manner acceptable to the City.

The Contractor shall provide the City with a minimum 30 day notice of his intention to use RAP. The City reserves the right to accept or reject any particular source of RAP, irrespective of its quality.

351.03 COMPOSITION OF MIXTURE

General Requirements for Asphalt Pavement Mixture

All aggregate stockpiles are to be tested by an independent third party materials testing laboratory and the results are to be submitted to the City for record and field verification purposes.

Designation of Mixture

The composition of the asphalt pavement mixture shall be the responsibility of the contractor, subject to review and acceptance by the owner. The mix designs shall be conducted within the current work season and be reflective of existing stockpiled materials. New mix designs shall be conducted representative of each "major quarry blast". The mixture shall consist of uniformly graded fine and coarse aggregate mixed with asphalt cement as specified. The pavement mixture shall be designed using the Marshall Method of Mix Design as specified by the Asphalt Institute Manual Series No. 4, Item 4.3, Asphalt Hot Mix Design Methods. A Marshall Mix design shall be completed complementary to the processing of coarse or fine aggregates or with changes in the asphalt cement. The Marshall mix designs shall be submitted to the owner for review a minimum of ten (10) working days prior to the start of paving operations. Unless otherwise specified, the aggregates shall be combined in such proportions to produce a mixture conforming to the grading and asphalt content requirements of Table 3.

TABLE 3
ASPHALT AGGREGATE MIXTURES

Sieve Size (mm)	Percent Passing by Dry Weight		
	Base Course	Surface Course	Leveling Course
22.0mm	100	100	100
19.0mm	100	100	100
12.5 mm	80-100	100	100
4.75 mm	35-75	55-75	55-75
2.00mm	20-60	35-55	35-55
425µm	10-35	18-30	18-30
75µm (note 1)	4-10	4-10	4-10
Asphalt Cement (% by weight of total mixture)	5.0-7.0	5.0-7.0	5.0-7.0

Note 1: The dust/effective asphalt ratio of all mixes shall be between 0.6 and 1.2. Dust is defined as material passing the 75µm sieve.

Subsequent to notification of acceptance of the Marshall Mix Design the contractor shall produce a 'Plant Batched Trial Samples' of any asphalt pavement types proposed for the project. The 'Trial Samples' shall be blended in accordance with the aggregate and asphalt cement proportions described in the approved 'Marshall Mix Design' report. Trial samples shall be tested to determine the volumetric and physical properties of the pavement mixture as identified in Table 4. Dependent upon the resultant Marshall mix properties the composition of the pavement mixture may require adjustments. In this occurrence a second 'Trial Mix' shall be conducted to confirm the properties of the adjusted pavement mixture. Upon review and acceptance of the 'Trial Mix' properties by the owner the approved pavement mixture shall be known as the 'Job Mix Formula' and utilized throughout the project. Aggregate and asphalt cement components of the approved 'Job Mix Formula (JMF)' shall be regulated as follows:

Aggregate passing 4.75µm sieve	± 5%
Aggregate passing 2.0mm sieve and 425µm sieve	± 4%
Aggregate passing 75µm sieve	± 2%
Asphalt Cement content	± 0.25%

In all cases the asphalt/aggregate combination may be adjusted at the owner's discretion.

Physical and volumetric properties of all asphalt pavements shall meet the specifications provided in Table 4.

Physical Requirements for Mixture

The aggregates and the asphalt cement shall be mixed in such proportions as to satisfy the criteria contained in Table 4. These criteria are based on the Standard Marshall Test Procedures and using a compactive effort of 75 blows on each face of the specimen.

All test procedures used shall be the latest versions of ASTM or AASHTO standards, except where indicated.

TABLE 4**Physical Requirements for Asphaltic Concrete Mixture (All Courses)**

	Minimum	Maximum
Marshall Stability N. At 60° C		
(i) Local Streets	5400	-
(ii) Collector & Arterial Streets	8000	-
Marshall Flow Index MM	2.0	4.0
% Air Voids (A)	2.0	4.0
% Voids in Compacted Mineral Aggregates		
(i) Leveling & Base Course	14.0	-
(ii) Surface Course	15.0	-
Immersion Marshall MTO LS-283 & Retained Stability (B)	70	-

Notes:

- (a) The test method, ASTM 2041 "Theoretical Maximum Specific Gravity and density of Bituminous Paving Mixture", shall be modified as follows: the uncompacted test specimens shall be oven cured at 143°C for at least four (4) hours, in order to account for maximum absorption of asphalt cement in porous aggregates.
- (b) The residual pressure in the vacuum cell shall be 30mm ± 1mm.
- (c) Asphaltic Leveling Course shall have the same mix composition as Asphalt Surface Course except where there is no item for Asphalt Surface Course, in which case Asphalt Base Course may be used instead.

351.04 USE OF PITS, QUARRIES AND STOCKPILES

Should the Contractor intend to use a Drum Mix Asphalt Mixing Plant, then the designated aggregates shall be split on the 4.75mm screen and each material shall be stockpiled separately such that intermixing of each size and type does not occur. The course aggregate stockpile shall contain no more than fifteen percent (15%) passing the 4.75mm screen.

351.05 PLANT INSPECTION

Where a drum mix asphalt mixing plant is used, cold feed calibration and asphalt cement pump calibration shall be performed at the start of each contract and whenever deemed necessary by the Engineer. The calibration shall be done in the presence of the plant inspector. The cold feed shall be calibrated whenever the weighing conveyor is moved.

Where batch plant asphalt mixing plants are used with coarse and fine aggregate cold feed bins each individual bin shall be calibrated. Hot bin samples shall be recovered and tested for gradation and the individual gradations provided for each bin size along with the blended gradation based on the corresponding bin weights. Asphalt buckets shall also be calibrated on a yearly basis.

351.06 EQUIPMENT**Mixing Plants**

Mixing Plants should comply with the requirements of the Department of Transportation & Works Specifications 330.05.03.01.

Haulage Equipment

Trucks for hauling asphaltic mix shall be of the metal box type and their use shall be approved by the Engineer. The metal box shall be treated with an approved release agent and be in smooth condition with no rust scales or foreign material.

Vehicles shall be equipped with tarpaulins of water repellent material (no open mesh types) of sufficient size to completely cover the truck box and overhang the box on all sides by a minimum of 150 mm. The tarpaulins shall have enough tie-down points so that they can be properly secured, and shall be in good condition and be free of holes and tears. They shall be securely tied down as an effective barrier against rain infiltration and air flow over the HMA mixture.

Tarpaulins are to be used at all times for protection of the load of Hot Mix Asphalt. Tarpaulins shall be rolled back to uncover the hot mix for inspection immediately prior to dumping into the paver.

Spreading Equipment

Mechanical self-powered pavers shall be used which are capable of spreading the mixture true to line, grade and crown as specified by the Engineer.

Pavers shall be equipped with hoppers and distributing screws to place the mixture evenly in front of the screeds.

Pavers shall be equipped with screeds and shall be capable of spreading the mixture, without segregation, in thickness of from 10mm to 200mm and in widths of from 2500mm to 4000mm in increments of 150mm.

The Contractor shall provide on each paver a 3 metre straight edge with a level recessed in its upper surface parallel to the lower face and capable of detecting a variation from the horizontal of 3mm in 1000mm.

The term "screed" shall mean any strike-off device operating by cutting, crowding, or other practical action which is effective on the mixture and which produces a finished surface of the evenness and texture required. The screed shall be adjustable as to level and crown and shall be heated in an approved manner.

Pavers shall be equipped with automatic screed controls, as recommended by the paver manufacturer, for the control of longitudinal grade and transverse slope. The longitudinal grade control shall be equipped to operate from a joint matching shoe when required. The transverse slope control shall be capable of operating from either side of the paver.

Rollers

All rollers shall be of the types specifically designed for asphalt compaction.

All rollers shall be in good condition and capable of reversing without backlash. They should be operated at all times by competent and experienced operators.

All rollers shall be weighed in the presence of the Engineer and ballasted, if required, immediately before commencing work and whenever subsequently required by the Engineer.

Steel tired rollers shall be equipped with satisfactory means to supply water to the rolls to prevent adhesion of asphalt mixture. The rear rolls of three-wheel rollers shall each be not less than 450mm in width. Rolls of the tandem rollers shall each be not less than 1250mm in width. Steel wheeled rollers shall weigh at least 9 tonnes and shall exert a load on the compression roll of at least 4.5 tonnes per metre of wheel width.

All pneumatic tired rollers shall be self-propelled and shall have not less than nine (9) wheels revolving on two (2) axles. The tires on the front and rear axles shall be staggered to cover the entire area over which the roller travels with a minimum overlap of 15mm. Under working conditions, the roller shall exert a load of not less than 5 tonnes per metre of tire width on the asphalt surface. The tires shall be inflated to an air pressure of not less than 400kPa. The roller shall be equipped with an adequate scraping or cleaning device on each tire to prevent the bituminous mixture from accumulating on the tires. The roller shall be equipped with a water system which will keep all tires uniformly wet, and which will have a capacity that will provide not less than two hours continuous operation without refilling.

351.07 CONSTRUCTION**Preparation of Gravel Road Surface**

Where paving is to take place directly on top of a gravel surface, then the Contractor shall prepare the road to the satisfaction of the Engineer before paving. Not less than 300m of prepared grade shall be maintained in front of the paver at all times, except at the end of the paving operation for that day.

Where the top layer of Granular "A" was placed under the same contract as the paving, then the preparation of the Granular "A" prior to paving shall be carried out in accordance with the Item 323 "Gravel for Streets".

Preparation of Old Paved Surface

When required by the Engineer, old paved surfaces shall be treated with Tack Coat prior to repaving with asphaltic concrete.

Such treatment with Tack Coat as may be required shall be carried out in accordance with the Item 354 "Tack Coat".

Placing of Asphaltic Courses

The base on which paving is to take place shall be cleaned of all loose or foreign material before paving may take place.

The asphaltic mixture shall be laid only upon a base which is dry or at least free from standing water, and when weather conditions are suitable. No paving shall take place during rain.

No course shall be placed upon a previously laid course less than twelve (12) hours after final compaction of the latter, except with the permission of the Engineer in circumstances where in his opinion this requirement would be practical.

No hot mix shall be placed unless the air temperature at the surface of the road is 7°C or above without the written permission of the Engineer.

The temperature of the mixture immediately after spreading and prior to initial rolling shall not be less than 135°C or greater than 160°C. At no time over the life of the mix shall the mixture be hotter than 175°C.

The width of succeeding courses shall be adjusted by an offset of width of from 150mm to 300mm so that longitudinal joints do not coincide.

The longitudinal joints in the surface course shall correspond to the demarcation between driving lanes, speed change lanes, tapers, etc. indicated in the contract or as directed by the Engineer.

Immediately after any course is laid and before roller compaction is started the surface and edges shall be checked and any irregularities adjusted by the addition or removal of mixture.

All pavers which are equipped with a tamping device or other mechanical apparatus designed to aid compaction of the mixture shall have such devices operating continuously when the mixture is being placed unless otherwise directed. Where screed extensions are used, such extensions shall be designed so that the tamping or vibratory action of the screed is effectively transferred to the extensions in such manner as to provide a uniform degree of initial compaction across the full width of the freshly laid mat.

To ensure continuous operation of the pavers they shall operate at whatever speed necessary to match the output of the plant provided that a consistent and satisfactory mat is being laid. However, in no case shall the speed of the paver exceed 0.7km/h.

Mixtures may be spread by hand only in places inaccessible to the paver. Hand placing shall be from a steel dump board by means of hot shovels. Hand spreading shall be with rakes of suitable design. The mixture shall be spread to the depth required to give the compacted design thickness after rolling.

No loads of mixture shall leave the plant so late in the day as to preclude the spreading and compacting of the mixture during daylight.

Paving Season for Asphalt Surface Course

The placing of top course asphalt will not be permitted to be placed prior to May 24 or after September 30, of any given year unless otherwise approved by the City.

Joints

All joints shall be made in such a manner as to ensure a thorough and continuous bond and to provide a smooth riding surface.

All foreign material and all loose material, shall be removed from all faces against which joints are to be made. All cold faces against which joints are to be made shall be cut back to full depth to expose a fresh vertical face, and painted with a continuous thin coating of hot asphalt cement.

Longitudinal joints shall be rolled immediately upon placement of the fresh mixture and before the adjacent strip has completely cooled. The joint shall be set-up with the back of a rake or lute at proper height and grade to receive the required compression under rolling.

The depth of the newly laid mat shall be adjusted to allow for compaction. The paver shall overlap the existing mat by at least 50mm.

On surface courses the method of making joints shall be such that the excess material is not scattered on the surface of the freshly laid mat. Such excess material shall be carefully removed and disposed of as directed.

Transverse joints shall be checked with a straight edge immediately after initial rolling. Any irregularity in the pavement surface at the joint shall immediately be corrected by the addition of or removal of mixture. When possible, the transverse joints shall be initially rolled in a direction perpendicular to the direction of paving.

General Requirements for Compaction

The mixture shall be compacted to a density of 97% of the density of the laboratory compacted mixture based on the criteria given in item 351.03 "Physical Requirements for Mixture".

It is an express condition of this specification that all mixtures be compacted to the density immediately following placement. If, during the course of the paving operation, measured in-site densities fall below the specified minimum, the Contractor shall revise his operation by slowing the rate of progress of the pavers, by using additional rollers or by any other means necessary to achieve the specified degree of compaction.

Rollers should normally operate with the drive wheel forward in the direction of paving. In all cases, the production and placing of mixture shall be controlled so that all rolling shall be completed before sunset.

Compacting Asphaltic Base and Surface Courses with Static Wheel Rollers

Where the Contractor elects to compact the mixture using static wheel rollers, a minimum of two (2) steel wheel and one (1) pneumatic tired rollers will be required to operate with each paver used.

The initial breakdown rolling by a steel wheel roller shall commence as soon after placing as the mixture will bear the roller without checking or undue displacement. Rolling shall start longitudinally at the lower edge and proceed toward the higher edge of the course, overlapping on successive passes. Alternate passes of the roller shall be staggered.

Intermediate rolling, using a pneumatic tired roller, shall follow the breakdown roller as closely as possible. Passes shall be so arranged as to ensure overlapping successive tire paths. The Contractor shall be responsible for ensuring that the tires are in proper condition at all times to prevent pick-up of the mixture.

Finishing rolling, using a steel wheel roller, shall be accomplished with the minimum number of passes required to produce a satisfactory surface. Rolling shall start longitudinally at the higher edge and proceed towards the lower edge.

The operating speed of static steel rollers shall not exceed 5 km/h and shall be slow enough to avoid displacement of the mix.

Compacting Asphaltic Base and Surface Courses with Vibratory Rollers

Where the Contractor elects to compact the mixture using vibratory rollers, a minimum of one vibratory roller and one pneumatic tired roller will be required to operate with each paver used.

The required compaction shall be obtained by the vibratory roller followed by the pneumatic tired roller. Rolling shall commence as soon after placing as the mixture will bear the roller without checking or undue displacement.

In areas where a vibratory roller proves ineffective (i.e. intersections and bridge decks) compaction shall be obtained using a suitable static steel wheel roller.

Compacting Asphaltic Leveling Course

Where the Contractor elects to compact leveling course using a static steel wheel roller, or a double steel wheel vibratory roller, then a pneumatic tired roller shall be used following the steel wheel roller.

However, where the Contractor elects to compact leveling course using a vibratory roller of the type consisting of two or more pneumatic tires and a vibratory steel drum, then a separate pneumatic tired roller will not be required.

Requirement for Asphaltic Leveling Course

Asphaltic Leveling Course shall be used to fill surface depression on old pavement to restore the surface to the original profile and cross-section.

Patching and leveling shall not be carried out simultaneously at the same place. The patch, consisting of asphaltic base course, shall be placed and fully compacted before leveling operations may proceed over the patch.

Requirements for Completed Asphaltic Base and Surface Courses

Each course after final compaction shall be smooth and true to the established crown and grade, shall have the average thickness specified, and shall at no point vary more than 6mm from the specified thickness. The surface of each course shall be free from deviations exceeding 3mm as measured with a 3 metre straight edge paralleling the centre line of the roadway.

Any low or defective places shall immediately be remedied by cutting out the course as required and replacing it with fresh hot mixture which shall be immediately compacted to conform with the surrounding area and shall be thoroughly bonded to it.

Segregation and Other Surface Defects

The finished surface of any Pavement Course shall have a uniform texture and be free of visible signs of poor workmanship.

Any obvious defects, as determined by the Engineer, will be cause for rejection of the pavement course. Such defects shall include but not necessarily be limited to the following:

- | | |
|---|-----------------------------------|
| 1. Segregated Areas | 6. Tire Marks |
| 2. Areas of Excess or Insufficient Asphalt Cement | 7. Improperly Constructed Patches |
| 3. Roller Marks | 8. Improper Cross Slope |
| 4. Cracking or Tearing | 9. Fuel Spills on the Mat. |
| 5. Improper Matching of Longitudinal and Transverse Joints. | |

Segregation is defined here as areas with predominantly coarser texture than that of the surrounding pavement, and will normally be first identified visually.

Severe Segregation:

Area appears very stony, with stone against stone and little or no matrix. All areas of severe segregation in any pavement course will require removal and repair across the full lane width.

Medium Segregation:

Area has significantly more stone than the surrounding acceptable mat and usually exhibits some lack of surface matrix. Medium segregation in surface-courses will be subject to a penalty of \$15/m² for the area in question, but for base-courses will normally be left in place with no price reduction. However, any areas of medium segregation that deteriorate prior to being overlaid by another pavement course must be repaired at the Contractor's cost.

Slight Segregation:

Area where the matrix is in place between the stones but there is slightly more stone in comparison with the surrounding acceptable mix. Slight segregation will normally be left in place without price adjustment. The severity of segregation can be determined through a number of test methods, as specified by the Engineer.

Defects as determined by the Engineer, which occur in the finished surface of any pavement course during the one year warrantee period resulting from poor workmanship, shall be repaired by the Contractor. The Contractor's method of repair shall be approved by the Engineer and performed according specifications.

351.08 MEASUREMENT FOR PAYMENT

Measurement for payment will only be made for those materials accepted for use under this specification and then only when incorporated into the work at the grades, lines and location specified by the Engineer.

Measurement for payment for the particular type of asphaltic course shall be by the weight of that material in tonnes, rounded to one decimal place.

The material shall be weighed by means of the truck scales. Only loads certified by the City Road Checker as being placed in the works at the required locations shall be considered for inclusion in the measurement for payment.

351.09 PAYMENT

Payment shall be at the respective unit price bid for this item. The price bid shall be full compensation for all labour, equipment and materials necessary to complete the work in accordance with this specification.

ITEM 404**CONCRETE STRUCTURES****404.01 SCOPE**

The scope of this specification is to cover the supply of materials for concrete structures, production, delivery, placement, sampling and testing of concrete, curing, and the subsequent protection. All work, plant, equipment and materials shall be in strict accordance with CSA A23.1.

The plant from which the ready mix concrete is supplied shall be certified in accordance with the requirements for certification as published by the Atlantic Concrete Association or equivalent. A copy of the certification of conformance shall be provided to the Engineer prior to the start of delivery under the proposed contract.

A job meeting shall be held prior to the deck concrete placement to discuss all aspects of the concrete work including production, supply, delivery, placing, curing and any other related items. This meeting is to be called by the Engineer; the Contractor and all others deemed necessary by the Engineer shall be in attendance.

404.02 MATERIALS

All concrete materials shall be in accordance with CSA-A23.1.

Cement

All cementing materials shall be in accordance with CSA-A3001.

Cement for Superstructure, Substructure, MSE Panels and Reinforced Wharf Deck Concrete (with the exception of Pile, Mass and Tremie Concrete) shall be a blended Portland, fly ash, silica fume cement, Type GUBF/SF. Contractors are advised that the minimum proportion by mass of the total cementing materials for silica fume shall be 6% and a maximum of 8%. Contractors are advised that the maximum proportion by mass of the total cementing materials for fly ash is 25%.

Cement for deck and curb resurfacing in Section 419 "Rehabilitation of Concrete Structures" shall be Type GU unless otherwise specified.

Cement for all other concrete shall be Portland cement Type GU, a portion of which may be replaced by fly ash up to ten percent (10%) by mass of the total cementing material.

Aggregate

The source of the aggregate will be determined by the Contractor but all aggregate shall meet the requirement of CSA-A23.1. The maximum petrographic number will be 130.

Concrete aggregate shall consist of natural sands and gravels, crushed rock or other inert materials having clean, uncoated grains of strong and durable minerals.

Fine and coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent the materials at the edges of the piles from becoming intermixed.

Aggregate shall be free from alkali, organic matter or other deleterious substances and shall not contain soft, friable, thin, flaky, elongated or laminated particles totaling more than three percent (3%) nor contain shale in excess of one and half percent (1½%), nor silt and crusher dust finer than 75µm sieve size, in excess of two percent (2%). The percentages shall be based on the weight of the combined aggregate as used in the concrete. When all three (3) groups of these deleterious materials are present, the combined amounts shall not exceed five percent (5%) by weight of the combined aggregate.

The maximum size of stone to be used for the different thickness of concrete shall be 20mm unless otherwise ordered by the

Engineer. In no case shall the maximum size of stone used be greater than either 3/4 the clear distance between the reinforcement or 2/3 the clear distance between the exterior bars and the face of the structure except for girders where the latter criteria shall be in accordance with CSA A23.1 clause 6.6.6.2.

Stock piles of approved fine and coarse aggregate, in amounts of one quarter to one half of that required for the job, shall be placed on the site of the work at least one month previous to concrete placing operations. The stockpiles shall be protected by tarpaulins or plastic sheeting against formations of ice and accumulation of snow.

The Contractor shall provide with the concrete mix design relevant test data for all aggregate material indicating conformance to the requirements of CSA-A23.1 and this specification. The sources and test results of all aggregate materials shall be clearly identified. The aggregate tests shall be conducted by a testing laboratory CCIL or CSA Certified in accordance with CSA Standard A-283. Test results are only considered valid for up to two years in advance of the date of the project mix design submission. The test data required but not be limited to shall include:

- Sieve Analysis of Fine and Coarse aggregate CSA-A23.2-2A
- Amount of Material Finer than 75 µm in Aggregate CSA-A23.2-5A
- Bulk Relative Density and Absorption of Fine and Coarse Aggregate (SSD basis) CSA-A23.2-6A
- Fineness Modulus of Fine Aggregate CSA-A23.2-2A
- Clay Lumps and Light Weight Pieces CSA-A23.2-3A
- Test for Organic Impurities in Fine Aggregate CSA-A23.2-7A
- Flat and Elongated Particles in Coarse Aggregates CSA-A23.2-13A
- Petrographic Analysis of Coarse Aggregate CSA-A23.2-15A
- Resistance to Degradation of Coarse Aggregate by Abrasion and Impact in the Los Angeles machine CSA-A23.2-16A
- Micro-Deval test for Coarse and fine Aggregate CSA-A23.2-23A and 29A
- Soundness of Coarse & Fine Aggregate by Use of Magnesium Sulphate CSA-A23.2-9A
- Test for Detection of Alkali-Aggregate Reactivity (AAR) on Coarse and Fine Aggregate CSAA23.2-25A
- Unconfined Freeze Thaw test CSA-A23.2-24A

Water

All water shall be clear and free from injurious substances and shall be potable.

All water used for curing shall be clean and free of any material which would cause staining or discoloration of the concrete. The contractor shall not use water from shallow, stagnant or marshy sources.

Air Entraining Agent

All concrete shall be air entrained with the air entraining agent conforming to CSA-A23.1 Clause 4.2.4.2.

Admixtures

Any other admixture must be approved by the Engineer and shall conform to CSA-A23.1 Clause 4.2.4.3.

Reinforcement

Reinforcement shall conform to Item 405 "Concrete Reinforcement".

Formwork and Falsework

Formwork and falsework shall conform to Item 407 "Formwork and Falsework".

Burlap

Burlap shall conform to AASHO M182 "Specification for Burlap Cloth made from Jute or Kenaf".

Filter Fabric

Filter fabric shall be a, non-woven geotextile with a minimum mass of 340gm/m² and a minimum thickness of 3.3mm; all properties tested in accordance with C.G.S.B. CAN 24.2 test methods.

Filter fabric or non-woven geotextile may be used for curing on flat horizontal surfaces but not on vertical surfaces. Vertical surfaces, i.e. abutments shall be cured using saturated burlap only.

Moisture Barrier

Moisture barrier shall conform to ASTM C171, "Sheeting Materials for Curing Concrete".

Miscellaneous Materials

The supply and installation of miscellaneous materials shown on the drawings or mentioned in the Supplementary General Conditions but which have not been listed on the Unit Price Table, are considered incidental to the work and no separate payment will be made.

This shall include, but not necessarily be limited to, all miscellaneous concrete accessories, confirm evaporation retardant, abutment weep holes, drip grooves and guide rail modified end shoes.

Membrane Curing Compounds

Membrane curing compounds shall meet the requirements of ASTM C309, and shall only be used with the approval of the Engineer.

404.03 EQUIPMENT

The Contractor shall supply the Engineer before commencement of the project with adequate details of all equipment to be used. The intention is not to limit the Contractor's operation but to ensure adequate planning is undertaken.

The contractor shall maintain all equipment used for handling, mixing, transporting, depositing, compacting, curing and finishing the concrete in a clean condition and in proper working order.

Pumping equipment may be utilized by the Contractor. Details of the pumping equipment and operation must be approved by the Engineer. The contractor shall submit to the Engineer, manufacturer's specifications detailing pumping capacity and pressure at the required elevations. Aluminum pipelines shall not be used. The Contractor shall be prepared in the event of a breakdown in pumping operations. These emergency preparations shall be discussed with and approved by the Engineer prior to the commencement of concrete placement utilizing pumping equipment.

Compaction equipment shall be capable of giving dense concrete in accordance with specification requirements. Internal vibrators shall have a frequency of 160 Hz.

An approved self-propelled mechanical bridge deck finisher shall be used to strike off and finish concrete decks as per specifications. The approved machine shall travel on guides or rails supported so that they are completely clear of the finished surface. The guide or rail supports that extend through the roadway areas of the deck shall be such that they can be removed to at least 50mm below the top of concrete. Two (2) work platforms shall be used for finishing and curing operations.

Batching equipment shall be as defined in Section 404.04, "Mixing Concrete".

The equipment required for heating materials for Cold Weather Concreting shall be of adequate capacity and be approved by the Engineer, it shall be available, installed and tested ready for use before it is proposed to place concrete. Heating equipment shall be ready for use between September 1 and April 30 when so required by the Engineer. Alternative methods of keeping concrete temperatures at acceptable levels may be approved. Where the heating equipment is to be used for heating the housing as well as the materials at the same time, the term adequate capacity means that the equipment shall have adequate capacity to heat both materials and housing simultaneously to the required temperature.

Boilers used for heating materials or housing shall meet the inspection requirements and operating conditions laid down by Provincial Acts and Regulations.

404.04 CONCRETE PRODUCTION, DELIVERY AND PLACING**Measurement of Materials**

Materials shall be measured by weighing. Other methods shall be used only if specifically authorized, in writing, by the Engineer.

The apparatus provided for weighing the aggregate shall be suitably designed and constructed for this purpose. Each size of aggregate shall be weighed separately with a required accuracy of two per cent.

Cement in standard bags need not be weighed.

The mixing water **shall be measured** by volume or by weight.

All measuring devices shall be subject to approval of the Engineer.

Concrete Quality

Concrete strength shall be as shown on the drawings unless particular specifications require higher strength.

Concrete mixes shall be designed in accordance with CSA-A23.1. Note that ACI standard 211.1 should be used as a guide for determining mix proportions for normal and mass concrete. Verification of the following specified properties through trial batching will be a requirement as a prerequisite to approval of the mix design. In addition, test cylinders may be requested by the Engineer prior to approval of the concrete mix design.

Parameters	45MPa (1,4)	40MPa (1,4)	35 MPa	30 MPa	25 MPa	20 MPa
Water/Cement Ratio	0.35 max.	0.37 max.	0.39 max.	0.42 max.	0.45 max.	0.55 max.
Slump	As per approved mix design	As per approved mix design	As per approved mix design	80 ±20mm*	100 ± 30mm*	100 ±30mm*
Rapid Chloride Permeability (ASTM C1202)	<1000 coulombs	<1000 coulombs	<1000 coulombs	N/A	N/A	N/A
Air Content (3)	6 ± 1%*	6 ± 1%*	6 ± 1%*	6.5 ± 1.5%*	4 ± 1%*	4 ± 1%*
Air Void Spacing Factor (Average)	230 µm max.	230 µm max.	230 µm max.	230 µm max.	N/A	N/A
Specific Surface (Average)	25 mm ² /mm ³ min.	25 mm ² /mm ³ min.	25 mm ² /mm ³ min	25 mm ² /mm ³ min.	N/A	N/A
Concrete Use	Superstructures	Substructure	Substructures Retaining Walls, Manholes & Catch Basins	Curb, gutter & sidewalk	Pile Concrete	Mass & Tremie Concrete (2)

*The above specified tolerances apply to concrete mix production and not to concrete mix design.

N/A = Not applicable

- Notes: (1) The cementitious material content for 40 and 45 MPa concrete is 480 kg/m³ maximum.
 (2) Tremie concrete shall require additional 10 % cement and slump shall be 180± 30 mm.
 (3) Concrete for severe exposure conditions (decks, curbs, end blocks, barriers and grade separation columns) and which contains superplasticizer as an admixture to produce flowable concrete, shall have an air content of 7± 1%.

- (4) The above mix design do not include required adjustments for prestressed girder concrete.

The Contractor will be responsible for the mix design and quality control of concrete production.

The City will review and approve mix designs and provide quality assurance with regard to concrete testing. All concrete mix design proportioning including the mix quality control operations shall be performed by a Laboratory CCIL or CSA Certified in accordance with CSA Standard A-283. All testing shall be as conducted as stated in CAN.CSA-A-23.1 and A23.2. The proposed mixture design shall be signed by a Professional Engineer registered to practice in Newfoundland and Labrador. The Professional Engineer shall attest to the validity of the material test data. Proposed mix designs and test results are only considered valid for up to two (2) years in advance of the date of the project mix design submission. The Contractor shall provide with the proposed mix design the following information based on actual trial mixes at least two (2) weeks in advance of concrete placement:

- Slump CSA A23.2-5C
- Air Content of Plastic Concrete by Pressure Method CSA A23.2-4C
- Mass Density and Yield CSA A23.2-6C
- Compressive Strength Testing CSA A23.2.9C
- Air Void Analysis on Hardened Concrete tested at seven (7) days ASTM C457
- Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration tested at fifty-six (56) days ASTM C1202
- Alkali Reactivity Test Results A23.2-25A

Also to be included with each mix design submission is the following necessary information:

- Project number and title description
- Contractor company name with contact information
- Ready mix supplier
- Certifying laboratory with signing Engineer
- Type of concrete, intended use, approximate quantity and method of placement
- Mix slump and air entraining agent range plus all admixtures with dosage rates
- Aggregate test information as per requirements of 904.02 Aggregates

No concrete shall be placed until approval of the mix design has been obtained from the Engineer. The Contractor shall submit copies of the concrete mix design fourteen (14) days in advance of any concrete placement operation.

Once approved, no adjustments shall be made to the concrete mix design without the approval of the Engineer. If material characteristics change after the original mix design approval a revised mix design shall be submitted for approval.

Acceptance by the Engineer of the Contractor's concrete mix design does not relieve the Contractor of the responsibility for providing concrete which meets the specifications.

High range water reducing agents (superplasticizers) may be used at the Contractor's request, if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained. The Contractor shall state his method of concrete placement when submitting his concrete mix design

Where 40 and 45 MPa concrete is specified on the contract drawings, a trial batch consisting of a minimum of 20m³ of Superstructure Concrete shall be placed in the Substructure, i.e. abutments and footings, at least twenty-eight (28) days prior to the placement of any 40 or 45 MPa Superstructure Concrete. The purpose of this exercise is to allow for fine tuning of the mix to achieve proper air and slump, and to obtain an early indication of the expected compressive strength. The additional cost of this trial batch and fine tuning of the mix design shall be considered incidental to the works.

If superplasticizers are used, the maximum concrete slump in a superplasticized condition shall be 230 mm. The mix design shall state the design slump before and after the addition of superplasticizers along with the appropriate tolerances. Note that the slump in the above table may not be applicable when using superplasticizers.

Samples for concrete testing quality assurance purposes will normally be taken from concrete as delivered to the site (at the point of discharge from the delivery equipment). However, depending on the method of placement, random sampling of the concrete as incorporated into the structure may also be performed to verify the above specified properties. This process shall entail the sampling of fresh concrete as close to the point of deposit in the structure as is practicable. Coring of the in-place

hardened concrete may also be performed to verify the specified air void system. The Engineer reserves the right to designate the point of acceptance, with prior notice given to the Contractor.

Mixing Concrete

Dry batching will not normally be permitted.

The use of ready mix concrete is encouraged. Where ready mix concrete is to be used, details of scheduling and procedure must be approved by the Engineer.

The Contractor will be given permission to add cement on site if it is not feasible to have the concrete deposited in the forms within 120 minutes after charging the mixer at the plant. When cement is being added at the site, the total volume of concrete being batched or mixed shall not exceed eighty-five percent (85%) of the manufacturer's rated drum capacity. Cement shall be added in four equal increments with mixing to be carried out after the addition of each portion of cement added. All equipment, materials and procedure must be approved by the Engineer.

The mixing of concrete, unless otherwise authorized by the Engineer, shall be done in a batch mixer of an approved type. The mixer shall be equipped with a suitable charging hopper, water storage and water measuring device. It shall be cleaned at frequent intervals when in use and maintained in such a condition that the mixing will be unimpaired.

The mixing of each batch shall continue not less than one (1) minute after all the materials are in the mixer, during which time the mixer shall rotate at a speed from 14 to 20 revolutions per minute, unless otherwise rated by the manufacturer or directed by the Engineer. The Contractor may mix small quantities of concrete by hand when and as directed by the Engineer.

Concrete transported in a truck mixer, agitator, or other transportation device shall be discharged at the job and placed in its final position in the forms within 120 minutes of the introduction of the mixing water to the cement and aggregate, or the cement to the aggregate, except in hot weather or under other conditions contributing to quick stiffening of the concrete. The maximum volume of mixed concrete transported in an agitator shall be in accordance with the specified rating. Time of charging the truck shall be clearly indicated and excess time in the mixer shall be cause for rejection of a load. Each batch slip shall have the time of batching clearly clock stamped onto each such slip.

Aggregates shall be separated into fine and coarse. The coarse aggregates shall be graded for mass concrete from 40mm to 5mm and for reinforced sections from 20mm to 5mm. The equipment for batching on site shall have the capacity to produce at such a rate as to preclude cold joints in the concrete placement. It shall be capable of being charged to the operating capacity of a 16S mixer with one discharge of the batcher. In any event, the equipment is subject to the approval of the Engineer.

The water and approved admixture(s) shall be proportioned separately by weight or volume (i.e. metering devices(s) to an accuracy of one percent at the mixer). Metering devices which measure the volume of water discharged into the truck shall be in place both at the batch plant and on the truck if water is to be added on site. Alternatively, the water must be manually weighed or measured by volume before being placed into the mixer.

The Contractor shall provide standard certified test weights and/or devices for checking the accuracy of the controls. Checks shall be made just prior to the first concrete placement and at 150m³ intervals thereafter. If the batching plant is moved, a check shall be made prior to batching any more concrete. The Contractor shall carry out all tests in the presence of the Engineer and shall supply him with results of all tests and make any and all alterations, repairs or replacements required to the equipment before authorization will be given to place concrete.

Placing Concrete

Concrete shall not be placed if the temperature is less than 5°C or greater than 25°C without the written permission of the Engineer.

The pumping of concrete from the delivery vehicle to its place of final deposition will be permitted as approved by the Engineer.

Before concrete is placed, forms, reinforcement and placing procedure shall be approved by the Engineer. The contractor shall give twenty-four (24) hours notice (not including Sundays or holidays) of his intention to place concrete.

In preparation for the placing of concrete all sawdust, chips, and other construction debris and extraneous material shall be removed from the interior of the forms. Struts, stays, and braces shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying from the mixer to the forms shall be permitted only on written authority of the Engineer. In case an inferior quality of concrete is produced by the use of such conveyers, the Engineer may order discontinuance of their use and the substitutions of a satisfactory method of placing.

Dewatering will not be permitted during the placing of concrete or for a period of at least twenty-four (24) hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other effective means.

Pumping to unwater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.

Concrete shall not be placed with a free fall greater than 1500mm.

When placing operations would involve dropping the concrete more than 1500mm, it shall be deposited through sheet metal or other approved pipes. The pipe shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After initial set of the concrete the forms shall not be jarred and no strain shall be placed on the ends of reinforcing bars which project.

Concrete, during and immediately after depositing, shall be thoroughly compacted by mechanical vibration.

The vibration shall be internal and the intensity of vibration shall visibly affect concrete over a radius of 500mm.

The Contractor shall provide a sufficient number of vibrators and they shall be manipulated so as to thoroughly work the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted vertically and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, until the air bubbles stop breaking on the surface. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

Vibration shall not be used to make concrete flow into place. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which vibration is visible.

Vibration shall not be applied directly or through the reinforcement to concrete which has hardened. Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces. Concrete shall be placed in horizontal layers not more than 300mm thick except as hereinafter provided. When less than a complete layer is placed in one operation it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has set to protect green concrete and avoid surfaces of separation. Vibrators shall project into preceding layer to avoid construction joint formation.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete.

In the construction of box culverts more than 1200mm in height, the concrete in the walls shall be placed and allowed to set before the top slab is placed. In this case, appropriate keys shall be left in the sidewall for anchoring the cover slab.

Concrete for beams and girders shall be deposited uniformly for the full length of the beam (or between vertical construction joints authorized by the Engineer) and brought up evenly in horizontal layers. Efforts shall be made to eliminate segregation as may be evident by flow lines. In this regard, concrete must be deposited in place and thoroughly consolidated rather than be permitted to flow in place.

Concrete in beams and slabs shall be placed in one continuous operation.

Beams, girders and haunches shall be placed monolithically.

During wet weather, concrete must not be placed unless suitable means, approved by the Engineer, have been provided to prevent washing of freshly deposited concrete or marring of the exposed surface.

Depositing Concrete Under Water

Concrete shall not be deposited in water except with the approval of the Engineer and under his immediate supervision.

Concrete deposited in water shall contain ten percent (10%) excess cement prepared with a mix design approved as if concrete was not under water. Slump for tremie concrete shall be 180 ± 30 mm. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie tube or other approved method. Still water shall be maintained at the point of deposit and the forms underwater shall be watertight.

The tremie tube shall have a minimum diameter of 250mm, constructed in sections having flanged couplings fitted with gaskets.

The discharge end shall be closed at the start of the work to prevent water entering. The tremie tube shall be filled to the bottom of the hopper and the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed.

No concrete shall be spread at any greater distance than 3 metres from the discharge end of the tremie tube. When large areas are to be covered tremie tubes at maximum 6m centres shall be used and concrete placed simultaneously.

If the tremie operation is unavoidably interrupted below water level, the surface laitance shall be removed by jetting one (1) day after placing and removed by pumping.

Mass Concrete

Mass concrete shall conform to the specifications outlined herein and be placed where indicated on the contract drawings as approved by the Engineer. Where mass concrete exceeds 300mm thickness at any footing edge, the design authority shall be contacted. Mass concrete shall be placed after all unwatering operations have been made effective in maintaining dry and controlled conditions as approved by the Engineer.

Construction Joints

Construction joints in concrete shall be positioned at the location shown on the drawings or where otherwise approved by the Engineer.

The Contractor shall attach the appropriate horizontal and/or vertical strips to the face(s) of the formwork where all construction joints are planned or occur for reasons beyond the Contractor's control. The concrete shall be worked such that the finished appearance will resemble narrow, neat and straight horizontal and/or vertical line(s) at all construction and cold joints. Forms shall be kept tight throughout the entire concrete placing operation.

At the bottom of curb - top of deck interface along the longitudinal sides of all decks, construction joints shall be neat, straight and properly formed as a 20mm Vee groove and shall be straight and true to line and grade.

Where construction or cold joints are planned or occur for reasons beyond the Contractor's control, the concrete interface shall be rough, clean and free of laitance, with a full roughness amplitude of 6mm or more. One exception to this would be at prestress steel box out locations, see Item 406, "Prestressed Concrete Members".

Prior to butting the new concrete against previously hardened concrete, the joint face shall be cleaned of all debris and dirt.

In addition, the surface film of laitance and mortar shall be removed from the joint face to present a clean sound concrete face that has the aggregate particles exposed.

Contraction Joints

A contraction joint is a control joint to control volume change mainly (shrinkage). Bonding of the new and existing concrete is not required, but provisions to make the joint watertight are necessary.

Joints in concrete members shall be formed in location as shown on the plans.

Contraction joints shall extend to a depth equal to one-quarter of the member thickness. As soon as feasible the joint shall be thoroughly flushed out with compressed air and an approved flexible joint filler compound utilized to fill the joint. The joint filler compound shall be flexible over the extreme temperature conditions in the local area and must be approved by the Engineer.

Concrete Beam Seats and Bearing Surfaces

Concrete beam seats shall be magnesium floated to a level plane varying not more than 2mm from a straight edge placed in any direction across the area. The finished level plane shall not vary more than 3mm from the elevation given by the Engineer in the field.

Concrete surfaces which are used as bearing surfaces are to be finished in accordance with the bearing manufacturer's recommendations.

Tolerances

All tolerances shall conform to Clause 6.6.8 "Tolerances for location of Reinforcement" of CSA-A23.1.

Confilm

Immediately after the straight edge requirements have been met for the deck and curb concrete and the broom finish applied, the fresh concrete shall be coated with an evaporation retardant "Confilm" to preclude rapid evaporation of the bleed water. When all bleed water is gone, the concrete shall be cured as per Item 404.05, "Curing". The supply and application of "Confilm" is deemed incidental to the placement of the deck concrete and as such, no separate payment will be made by the City.

Caulking of Joints

Caulking shall be applied to all control and expansion joint locations.

The caulking or sealant and the substrate material must have a temperature greater than 5°C. Under no circumstances should sealant be applied to any surface which contains moisture, condensation or frost. Joint surfaces are to be clean, dry and free of foreign matter before application of primer and sealant.

The work shall be performed by an approved caulking applicator. Otherwise, the Contractor must designate a person for the caulking operation and that person should receive training acceptable to the Manufacturer and Engineer.

The Contractor shall supply a written guarantee of all workmanship and materials for a period of two (2) years following the date of final completion.

Sealant shall be a three component Type 1 - Dymeric (epoxidized polyurethane terpolymer) sealant as manufactured by Tremco (Canada) Limited or an approved equal, selected to most closely match the concrete colour. Primers are to be those specified by Tremco (Canada) Limited, specifically Primer #1 or an approved equal. Joint backing shall be a closed-cell non gaseous backer rod, such as Softrod specified by Tremco (Canada) Limited or an approved equal.

All work shall be in strict accordance with the Manufacturer's recommendations.

Payment shall be considered incidental to the works associated with concrete work pay items.

404.05 CURING**Fog Misting of Bridge Decks**

Prior to the commencement of curing operations a fog mist shall be applied to bridge decks. Misting shall be conducted through the use of a pressure washer capable of sustaining a minimum 14 MPa pressure. A continuous fog mist shall commence immediately behind the screeding operation until concrete has hardened sufficiently to permit covering with burlap or a non-woven geotextile fabric. The fog mist will maintain a high relative humidity above the concrete and prevent surface drying prior to curing operations. Water shall not be allowed to drip, flow or puddle on the concrete surface during fog misting at any time before concrete has reached final set.

Payment

Payment shall be considered incidental to the placement of Concrete in Superstructures.

Moist Curing

Proper curing will be considered fifteen percent (15%) of the associated unit price bid for concrete payment purposes.

Concrete shall be **continuously** kept in a damp moist condition for at least seven (7) days after placing and the temperature of the concrete shall not be less than 10°C, during this period. If ambient temperatures are at or anticipated to be:

- (a) Greater than 25°C, then the provision of Item 404.06, "Hot Weather Concreting", shall be followed.
- (b) Less than 5°C, then the provision of Item 404.07, "Cold Weather Concreting", shall be followed.

Curing shall be applied to all surfaces.

Curing shall take place as soon as possible after the finishing operation without damaging the surface.

Concrete in the deck portion of all superstructure concrete, including barriers, approach slabs, expansion joint dams, end blocks, curbs and sidewalks must be cured by means of burlap and water.

All burlap must be pre-soaked by immersing it in water for a period of at least twenty-four (24) hours immediately prior to placing. Two (2) layers of burlap must be applied to the surface of the concrete. Strips must overlap by 150mm and must be held in place without marring the surface of the concrete.

The bridge decks burlap must be applied immediately after finishing of the concrete surface within 2 metres to 4 metres of the pan or screed of the finishing machine.

Curing with burlap and water must be maintained for a minimum period of seven (7) days. The burlap must be maintained in a continuously wet condition throughout the curing period by means of a soaker hose. The burlap must be covered with a layer of moisture vapour barrier within twelve (12) hours of placing the concrete, in a manner which will prevent deformation of the surface of the concrete.

Air flow in the space between the moisture vapour barrier and the burlap must be prevented.

Regardless of ambient temperature, moist curing with burlap and water must be provided at all times. During cold weather, burlap must be prevented from freezing.

In addition to the burlap and water method as described above certain other concretes may be cured by either:

a) **Continuous Steam Curing**

Continuous steam shall not exceed 80°C and shall follow CSA-A23-4 Precast Concrete-Materials and Construction.

b) Curing with Filter Fabric and Water

One (1) layer of filter fabric shall be laid on the surface of the concrete. Sheets or strips of filter fabric shall overlap by a minimum of 150mm and shall be held down, as required, against displacement by wind, etc. The fabric shall be kept wet at all time. Filter fabric shall conform to Section 904.02, "Filter Fabric". Filter fabric or non-woven geotextile may be used for curing on flat horizontal surfaces but not on vertical surfaces. Vertical surfaces, i.e. abutments shall be cured using two (2) saturated layers of burlap only.

Air Drying

Under normal circumstances curing time required for deck concrete is moist curing for seven (7) days in accordance with this specification and a further thirty (30) days for air drying. Also, the specified design strength must be obtained.

Until the above conditions are satisfied, the application of waterproofing and the opening of the bridge to traffic will not be permitted.

If it is not practical to achieve this, the above curing times may be reduced only at the discretion of the Engineer, but in no case will the application of waterproofing and opening of the bridge to traffic be permitted until seven (7) days of wet curing and an additional seven (7) days of air drying have elapsed.

Plastic Shrinkage

Where excessive shrinkage stresses may occur, e.g. in a large expanse of concrete such as a bridge deck, the Contractor shall ascertain under the prevailing conditions the extent of the curing required as more than one method may be required.

If shrinkage cracks occur, the Contractor shall grout any cracks and repair by an approved method at his own expense.

All methods and materials employed in concrete curing must be approved by the Engineer.

Liquid Membrane Curing

At the discretion of the Engineer, liquid membrane curing compounds meeting the requirements of Section 404.02, may be used in place of moist curing on pier columns only. Liquid membrane curing shall not be permitted on other areas including bridge decks.

404.06 HOT WEATHER CONCRETING

When the air temperature is at 25°C or greater or is expected to rise to this limit, according to meteorological forecasts, then special measures shall be taken by the Contractor to protect the concrete. Surface moisture evaporation must not exceed 0.75kg/m²/hr.

Concrete placed in the forms shall be maintained at or below 27°C and the Contractor shall obtain from the Engineer approval for his measures to ensure this.

Curing shall be by moisture and with the exception of pier columns as per Section 404.05 "Air Drying", curing compounds will not be permitted.

404.07 COLD WEATHER CONCRETING**General**

When the air temperature is at or below +5°C or when, according to meteorological forecasts, it is likely to fall below this limit within the next 24 hours, then the Contractor shall take special precautions to protect the concrete placed. The Contractor shall obtain approval from the Engineer for this method of protection.

Under normal circumstances no concrete for the superstructure (or approach slabs) shall be placed between November 1 and April 1.

The following table shall apply for determining degree of protection requested by the Engineer:

PROTECTIVE CLASS	PROTECTIVE MEASURE	OUTSIDE AIR TEMPERATURE FOR LEAST DIMENSION OF SECTION	
		Less than 1m	More than 1m
A	Suitable housing plus supplementary heat or adequate insulation	Below 0°C	Below -5°C
B	Suitable covering plus adequate insulation	0°C to 5°C	0°C to -5°C
C	Normal curing - no temperature protection required	5°C to 25°C	5°C to 20°C

Any concrete damaged by freezing or by inadequate protection or curing shall be removed and replaced by the Contractor at no cost to the City.

For guidance on adequate insulation, refer to the Canadian Portland Cement Association publication "Design and Control of Concrete Mixtures", Chapter 11.

Placing

Concrete to be placed during cold weather shall be within the following temperature limits.

LEAST DIMENSION OF SECTION	CONCRETE TEMPERATURE MINIMUM °C	°C MAXIMUM
Less than 0.3 metres	10	27
0.3 metres to 1 metres	10	27
1 to 2 metres	10	25
More than 2 metres	5	20

This temperature can be obtained by heating the water or the aggregate or both; water and aggregate shall then be combined in the mixer first and the temperature of the mixture shall not exceed 38°C when the cement is added.

When the air temperature is below 0°C the water shall be heated to not greater than 66°C. The aggregates shall be uniformly heated in the stockpiles and/or bins by steam, either injected live or circulated in coils, or by using dry heat before the aggregates are placed in the mixer. Whatever system is used, it shall be designed to give uniform heating that will avoid local overheating which may be injurious to the materials.

No frozen lump of aggregate will be allowed in the concrete mix and shall be discarded before batching.

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

The ground, formwork, existing concrete and steel against which concrete is to be placed shall be free from ice and snow before the Engineer will authorize placing to commence. The Contractor shall preheat the area in which the concrete is to be placed, with live steam or moist hot air, this shall also remove snow and ice and heat the contact material to prevent the formation of a cold joint.

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

The concrete shall be placed rapidly and evenly, as near to its final position as possible to reduce the risk of segregation, flow

lines and cold joints.

The concrete shall be covered, as quickly as possible after placing.

Surface moisture evaporation must be kept below $0.75\text{kg/m}^2/\text{h}$. Concrete surfaces shall be protected by housing. Protective housing must be wind and weather tight and constructed of suitable materials on a substantial framework. The framework must be such as to keep the housing at all points 300mm from the concrete and forms. The housing must have suitable openings to let the concrete be placed and these openings shall be so designed that they may be fully covered and closed as soon as the concrete is placed. The use of "roll back" sheeting or tarpaulins supported on stools is permitted on horizontal surfaces, such as a bridge deck provided the concrete is covered progressively as soon as placed. The housing must be so constructed as to allow a uniform circulation of heat to all parts of the work. This shall include the underside of the bridge deck and beams unless the Engineer has authorized the protection of these areas by fully insulated formwork.

When mineral fiber is used as insulation, a layer of polyethylene having a minimum thickness of 6 mils shall be placed between the surface of the concrete or formwork and the insulation. This insulation is to be protected from moisture at all times.

Protecting Placed Concrete

For concrete to be placed between September 1 and April 30, the Contractor shall supply a steam jenny, fully operational and fully capable of adequately protecting all concrete to be placed, when specifically requested by the Engineer.

Heating the Protective Housing

The contractor shall have available, tested and approved, adequate equipment for the heating of the protective housing. Heating will be used to establish and maintain the required curing conditions.

For decks and curbs, sidewalks, parapet walks, the Contractor shall on the day prior to placing concrete, conduct a trial run to verify his equipment, methods and workmanship meet the specifications.

Live wet steam shall be used for heating unless other methods are permitted in writing by the Engineer. Hot air blowers and the like may be used to supplement the steam heating as long as fine water or steam spray into the stream of hot air is provided. The humidity as measured by a wet and dry bulb thermometer shall at no time be less than ninety-five percent (95%) and the air temperature shall be not less than 13°C .

The use of salamanders, coke stoves, oil or gas burners and similar spot heaters which have an open flame and intense local heat are prohibited. In the event of any fire of the formwork or housing, the Engineer must be immediately notified.

The system of heating and positioning of steam outlets so as to give the most uniform distribution possible of the heat is subject to the approval of the Engineer. The Contractor shall make suitable arrangements to stoke boilers outside normal working hours where required. A breakdown in heating is regarded as very serious especially in the early life of the concrete.

The concrete must be cured in a moist condition and its temperature shall be at least 10°C for seven days after the day of placing.

Protection shall be withdrawn in such a manner as not to introduce thermal shock stresses in the concrete.

The temperature of the concrete shall be gradually reduced at a rate not exceeding 17°C per day to that of the surrounding air. To achieve this in a heated housing, the heat shall be slowly reduced and then shut off and the whole housing allowed to cool to within 12°C of the air temperature before the housing itself for the formwork is removed. Where work is to proceed within the same housing on the next stage of the work, the formwork may be removed as soon as the prescribed curing period is over. With fully insulated formwork, the forms themselves may be slackened and some insulation removed if needed. The forms themselves shall not be removed until the temperature of the concrete has fallen to within 12°C of the outside air temperature.

404.08 SURFACE FINISHING**General**

All concrete surfaces that will be visible on completion of the work shall conform to surface finish Class 2, with the exception of the deck, curbs and/or sidewalks which shall be Class 6 finish.

The Contractor shall take special care during the planning, forming, concrete placing, curing and stripping phases to ensure defect-free surfaces. Should remedial measures be required, they shall be carried out by personnel expert in this aspect of concrete work. The surfaces shall be uniform in colour and texture when viewed from a distance of 15 metres and shall be attained as follows.

Class 2 Rubbed Finish

Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycombs spots, broken corners or edges and other defects shall be cut back to sound concrete and thoroughly cleaned. No feather edging is permissible. If reinforcing steel is exposed, concrete shall be cut back for at least 50mm around the reinforcement.

After having been kept saturated with water for a period of not less than three hours, the cavities shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall not be more than one hour old. The mortar patches shall be cured as specified under Item 404.05 "Concrete Curing". No mortar shall be placed when the air temperature is forecasted to fall below 5°C within twenty-four (24) hours. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The resulting surfaces shall be true and uniform.

After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. However, before starting this work the concrete shall be kept thoroughly saturated with water for a minimum period of three hours but sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face.

The mortar shall be composed of extra cement and fine sand mixed in proportions such as to match existing concrete verified by a test patch. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform colour. After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

Class 6 Floated Surface Finish

The provision of an approved self-propelled Bridge Deck Finishing Machine capable of striking off and providing the required surface finish is mandatory for all structures not covered by fill.

For new bridge decks and rehabilitated bridge decks where the total deck length is greater than 15 metres, the deck shall be finished with a GOMACO 450 bridge deck finishing machine with a vibrating screed and movable work bridge or approved equal.

For (a) decks less than 15.0 metres in length, (b) thin overlay strips wider than 2.0 metres and (c) wharf decks, finishing shall be achieved with a Razorback 12HD Air Operated Vibrating Allen Screed or approved equal.

All finishing equipment shall be utilized as outlined above, shall be equipped and operated in accordance with the manufacturer's literature for the particular concrete and work being performed.

For thin overlays less than 2.0 metres wide, spotty or patchy deck repairs and corners of decks, a hand float finish is adequate.

A dry run of the finishing machine covering the entire area requiring finishing shall be made to insure the design deck thickness and profiles will be attained. The run shall be completed at least twenty –four (24) hours prior to commencing the deck concrete placement.

The finishing machine must be accompanied by a working platform with two (2) qualified cement finishers assigned to the platform at all times. The Contractor shall submit letters to the Engineer for his approval stating the qualifications of the finisher. The Contractor shall supply sufficient quantities of double railing to support the finishing machine equal to the overall length of the deck. This will enable the Engineer to check the adjustment of the railing and the finishing machine prior to any concrete being placed.

Proper allowance shall be made for camber of pre-stressed channels or girders. Concrete placement shall be at a rate to provide satisfactory progress with the finishing machine or the cement finisher.

After the deck surface has been floated and any bleed water evaporated, but while the concrete is still plastic, the Contractor shall furnish and use a 3m straight edge swung from handles half the width of the slab.

The straight edge shall be held in successive positions parallel to the road centre line and in contact with the surface and the whole area gone over from one side of the slab to the other as necessary. Advancement along the deck shall be in successive stages of not more than one-half the length of the straight edge. Any depressions found shall be immediately filled with freshly mixed concrete, stuck off, consolidated and refinished. The straight edge testing and refloating shall continue until the entire surface is found to be free from observable departures from the straight edge and the slab has the required grade and contour, until there are no deviations of more than 8mm under the 3 metres straight edge.

The concrete deck surface shall be given a broom finish when the concrete has hardened sufficiently. Exposed concrete bridge decks shall be given a coarse broom finish. Treated or waterproofed bridge decks shall be given a fine broom finish. The broom shall be of an approved type. The strikes shall be square across the slab, from edge to edge, with adjacent strokes slightly overlapped and shall be made by drawing the broom without tearing the concrete but so as to produce regular corrugations not over 3mm in depth for the coarse broom finish. The fine broom finish shall have corrugations not exceeding 1mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions and small pockets or rough spots such as may be caused by accidental disturbance during the final brooming of particles of coarse aggregate embedded near the surface. The Engineer may decide to delete the broom finish requirements but tolerances previously stated will still apply.

404.09 SAMPLING AND TESTING

Normal field quality control testing will be carried out by the Engineer in accordance with current City requirements. These will normally be in accordance with CSA-A23.2 “Methods of Test for Concrete”.

Normal quality control tests carried out by the City shall conform to the following requirements.

SUPERSTRUCTURE

Air & Slump Tests	Each load until satisfactory control is established. Then test every second load thereafter.
Strength & Temperature Tests	At least one set of lab cylinders per 100 cubic meters, minimum one (1) set per day plus one (1) set of field cures per category of concrete. A set is defined as three cylinders.
Average Air Void Spacing Factor & Specific Surface	One test per category of concrete.

**SUBSTRUCTURE, REINFORCED WHARF DECK
CONCRETE, PILE, MASS AND TREMIE CONCRETE**

Air Slump Tests	Each load until satisfactory control is established. Then test every third (3 rd) load thereafter.
Strength & Temperature Tests	At least one set of lab cylinders per 100 cubic meters, minimum one set per day per category of concrete. Field cures generally only required when cold weather concreting requirements are in place. A set is defined as three cylinders.
Average Air Void Spacing Factor & Specific Surface	One test per category of concrete. This test is not required for pile, mass, and tremie concrete.

A category of concrete shall be defined as concrete pertaining to one specific design strength, e.g. 35MPa concrete.

Satisfactory control is considered to have been established when tests on five (5) consecutive truck loads or batches of concrete are within specification requirements. If either the measured slump, air content or temperature fall outside the limits specified, a repeat test shall be made. Failure to meet the contract requirements shall result in rejection of the concrete.

Additional strength tests will be required when early indications of strength are required such as before prestressing, girder transport, removal of falsework, backfilling structure, etc.

The Contractor shall co-operate fully with the Engineer in enabling quality control and quality assurance tests to be carried out. Samples for quality testing purposes will normally be taken from concrete as delivered to the site (at the point of discharge from the delivery equipment). However, depending on the method of placement, random sampling of the concrete as incorporated into the structure shall also be performed to verify the above specified properties. This process shall entail the sampling of fresh concrete as close to the point of deposit in the structure as is practicable. Coring of the in-place hardened concrete may also be performed to verify the specified air void system. The City reserves the right to designate the point of acceptance, with prior notice given to the Contractor.

Acceptance of the concrete will depend on the results and consistency of all of the above tests results being satisfactory.

404.10 MEASUREMENT FOR PAYMENT

**Measurement for Payment for concrete work where
the Unit Price Table states the unit to be cubic metres**

For those concrete work contract items, except mass and tremie concrete, where the unit of measurement on the Unit Price Table is stated as m³, then measurement for payment will be by the volume of concrete placed, measured in cubic metres rounded to two decimal places, based on the neat lines called for in the plans.

Measurement for payment purposes for mass concrete shall be based upon cross sections measured in cubic metres to the nearest one decimal place. Prior to concrete placing and forming operations, the Engineer shall establish the lateral and vertical limits for mass concrete.

Measurement for payment purposes for tremie concrete shall be made based upon the number of cubic metres of batched concrete rounded to the nearest one decimal place and incorporated into the works as approved by the Engineer. Every precaution must be taken to prevent waste of concrete, i.e. carelessness resulting in escape of concrete from within the confines of the forms or inaccuracy in placing. In the event of such occurrence(s) an estimate of the wastage will be made by the Engineer and an appropriate deduction from the batch quantity will be made. All additional concrete required to be placed above the estimated quantity, must be approved by the Engineer.

No deductions will be made from the volume of concrete for:

- (1) Volume of reinforcement, prestressing steel or prestressing ducts.
- (2) Inserts of cross-sectional area of less than 0.1m².

When it is specified that concrete is to be placed against undisturbed soil or set in rock, and where the excavation is made wider than the neat lines of the footings, the excess amount of concrete will not be measured for payment quantities.

Where the concrete footings are placed lower than that authorized by the Engineer, any excess amount of concrete will not be measured for payment quantities.

Unless otherwise defined by the Contract Documents, the following will be the definitions for the structure and Unit Price Table:

- § Substructure concrete shall be that concrete used for slope paving, footings, abutments, backwall, bearing seats and pedestals, wingwalls and piers. Wingwall concrete shall be all concrete behind the back face of the abutment, i.e. including the cleat excluding curb (superstructure) concrete.
- § Where integral curbs and wingwalls exist, a horizontal surface at the bottom of the curb including the beveled portion thereof if any, and horizontal surface at the top of the vertical portion of the wingwall shall constitute the dividing line between substructure and superstructure concrete.
- § Retaining wall concrete shall be all concrete used in retaining walls and footings which are not cast integrally with the abutments.
- § Superstructure concrete will be all concrete used in beams, columns, sidewalks, barriers, expansion joint dams and diaphragms, decks, haunches, curbs, end blocks, including those curbs and end blocks integral with the wing walls.
- § All concrete in rigid frames used in deck, curbs, barriers, sidewalks, end blocks, vertical or inclined legs and wing walls shall be classified as superstructure concrete.
- § All concrete for rigid frame footings shall be classified as substructure concrete. All approach slab concrete shall be classified as superstructure concrete.
- § Not included are AASHTO or CPCI girders, double tees, and any other superstructure work paid for separately.

Not more than ninety percent (90%) of the units will be certified until such time as the surface finish meets the specifications and is completed to the satisfaction of the Engineer.

**Measurement for Payment for concrete work where
the Unit Price Table states the unit to be a unit other than cubic metres**

For those concrete work contract items where the unit of measurement on the Unit Price Table is stated in some unit other than m^3 , then the measurement for payment shall be in accordance with that stated in the appropriate specification for the item.

Not more than ninety percent (90%) of the units will be certified until such time as the surface finish meets the specifications and is completed to the satisfaction of the Engineer.

404.11 PAYMENT

**Payment for concrete work where
the Unit Price Table states the unit to be cubic metres**

For those concrete work items where the unit of measurement in the Unit Price Table is stated as m^3 ; , then payment at the contract price shall be full compensation for all materials, labour, equipment, plant and services necessary to complete the concrete work as outlined herein. This applies to "Concrete in Substructures", "Concrete in Retaining Walls", "Concrete in Superstructures", "Reinforced Wharf Deck Concrete", "Concrete in Rigid Frames", "Concrete in Approach Slabs", "Mass Concrete" and "Tremie Concrete".

In particular, no separate payment will be made for:

- (a) Supply of cement, aggregates and other materials, plant and equipment-use required for producing the concrete.
- (b) Mix design, production, mixing, transportation, placing, consolidation, curing and quality control during production.
- (c) Formwork and falsework.
- (d) Precautions to be taken for hot weather.
- (e) Precautions to be taken for cold weather.
- (f) Provisions of shipping crates for concrete test specimens.

No payment shall be made for any concrete required for normal testing procedures.

Where excessive camber in girders is permitted by the Engineer, the extra concrete due to the camber in excess of the specifications will not be paid for.

Concrete not placed in accordance with the provisions of Item 404.07, "Cold Weather Concreting", when the appropriate weather conditions prevail will not be paid for unless and until it can be established to the satisfaction of the Engineer that there has been no harmful effect to the concrete. The onus for establishing this will belong to the Contractor.

**Basis of Payment for concrete work where
the Unit Price Table states the unit to be a unit other than cubic metres**

For those concrete work contract items where the unit of measurement in the Unit Price Table is stated in some unit other than m³, then the basis of payment shall be in accordance with that stated in the appropriate specification for the item.

Concrete not placed in accordance with the provisions of Item 404.07 "Cold Weather Concreting", when the appropriate weather conditions prevail will not be paid for unless and until it can be established for the satisfaction of the Engineer that there has been no harmful effect to the concrete. The onus for establishing this will belong to the Contractor.

**Concrete Acceptance and Reduced Payment
Criteria on Concrete Located in New Structures**

Concrete on a project of a certain class, as defined by its specified strength at twenty-eight (28) days, must have an average tested strength at twenty-eight (28) days equal or greater than specified for payment at the bid price.

Concrete of a certain class having an average strength of less than that specified will be accepted into the job at a reduced payment, provided the difference between specified strength and tested strength is not greater than 5MPa. If the average of tests in a particular predefined portion of concrete is less than that specified by more than 5MPa that concrete shall be rejected.

When concrete is rejected, those provisions outlined in CSA-A23.1 shall be followed to determine whether or not the concrete may remain in the work. Such work will be done at the Contractors cost. Notwithstanding the above, should the concrete remain in the work it will be subject to a reduction, as outlined below, for having a strength less than that specified.

Concrete of a specific class and otherwise acceptable but having an average strength deficiency as tested of less than 5MPa compared with that specified, will be accepted but the bid price of all concrete in the predefined portion will be reduced according to the following procedure:

For concrete work where the Unit Price Table states the unit to be in cubic metres, the adjusted concrete price shall be calculated as follows:

$$\$(\text{Adjusted Concrete Price}) = \$(\text{Bid Price}) - \$ (10 * (\text{Specified Strength} - \text{Tested Strength})).$$

Division of the structure into predefined portions will be done by the Engineer when the concrete placement sequence is outlined by the Contractor at the pre-job meeting. A predefined portion shall generally be established as that concrete placed within one operation.

There will be no bonus payment under the contract when the average strength is in excess of the specified strength.

Concrete Acceptance and Reduced Payment Criteria on Concrete Located in Rehabilitated Structures

Concrete on a rehabilitation project in a certain repair class, as defined by its specified strength at twenty-eight (28) days, must have an average tested strength at twenty-eight (28) days equal to or greater than that specified for payment at the bid price.

Concrete of a certain repair class having an average strength of less than that specified will be accepted into the job at a reduced payment, provided the difference between specified strength and tested strength is no greater than 5MPa. If the average of tests in a particular predefined portion of concrete is less than that specified by more than 5MPa then that concrete shall be rejected.

When concrete is rejected, those provisions outlined in CSA-A23.1 shall be followed to determine whether or not the concrete may remain in the work. Such work will be done at the Contractors cost. Notwithstanding the above, should the concrete remain in the work it will be subject to a reduction, as outlined below, for having a strength less than that specified.

Concrete of a specific class of repair and otherwise acceptable but having an average strength deficiency as tested of less than 5MPa compared with that specified, will be accepted but the bid price for **all concrete** in the predefined portion will be reduced according to the following procedure:

For concrete work where the Unit Price Table states the unit to be square metres or cubic metres the adjusted price shall be calculated as follows: $\$(\text{Adjusted Concrete Price}) = (\text{Tested Strength} / \text{Specified Strength}) \times \$(\text{Unit Bid Price})$

Division of the structure into predefined portions will be done by the Engineer when the concrete placement sequence is outlined by the Contractor at the pre-job meeting. A predefined portion shall generally be established as that concrete placed within one operation.

There will be no bonus payment under the contract when the average strength is in excess of the specified strength.

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SECTION 412**BEARINGS****412.01 SCOPE OF WORK**

The scope of this specification is to cover the supply, fabrication and installation of all plain and steel reinforced elastomeric bearings and pot bearings in structures. Pot bearings shall be defined as free sliding, constrained sliding and/or fixed structural bearings consisting of a metal piston supported by a single moulded disc of unreinforced elastomer that is confined within a metal cylinder.

Bearing materials, manufacture, fabrication and installation shall comply with the latest edition of CSA-S6 or OPSS 1202/1203 for elastomeric and pot bearing respectively. In the event of a conflict between the two, the more severe criteria shall control.

412.02 MATERIALS

All materials shall be new and unused with no reclaimed material incorporated in the finished bearing.

.01 Elastomeric Bearings

Bearings shall be fabricated from elastomeric materials. Virgin natural polyisoprene (natural rubber) or virgin polychloroprene (neoprene) shall be the only raw polymer permitted.

Internal steel plates shall be not less than 3mm thick nor greater than 5mm. Plates shall be mild steel and conform to CSA-G40.21.

The elastomer compound shall exhibit grade 5 low temperature behaviour. Both natural rubber and neoprene shall be either 50 ± 5 or 60 ± 5 durometer as stated on the contract drawings. The shop drawings shall indicate the low temperature behaviour grade and durometer number.

.02 Pot Bearings

The Contractor shall furnish a manufacturer's certification that materials proposed for use on the project have been pretested and will meet the requirements as set forth in the manufacturer's current literature.

Elastomer and rubber components shall meet Grade 5 classification as per CSA-S6.

Sliding pot bearings shall have a PTFE and stainless steel interface.

412.03 MANUFACTURE AND APPROVAL**.01 Elastomeric Bearings****.01 Manufacture**

All pads shall have a smooth finish. Any steel plates shall be free from burrs and sharp edges; all laminations shall have a uniform thickness.

Steel laminated bearings shall be moulded as a single unit under pressure and heat, steel plates shall be completely bonded on all surfaces.

.02 Approval

Bridge bearings shall be as designated in the contract or from an approved source. Bearings shall be approved by shop drawings or the manufacturer shall supply the Engineer with a catalogue.

Six (6) copies of drawings shall be forwarded for approval and three (3) weeks is necessary for this approval.

The following information is needed:

- (1) Dimensions
- (2) ULS/SLS Load capacity in compression
- (3) Compression stiffness
- (4) Maximum movement capacity in shear
- (5) Shear stiffness
- (6) Rotation capacity

.03 Identification

All bearings shall be indelibly marked with the name of the manufacturer, the part number, bearing identification number, elastomer type, elastomer grade and the date of manufacture on the side visible after erection.

.04 Quality Assurance

The manufacturer shall submit a certificate of compliance to the Engineer prior to installation. The certificate of compliance shall contain the material properties, grades and relevant standards of all bearing materials. The manufacturer shall certify the bearing(s) meet the design requirements.

.02 Pot Bearings**.01 Fabrication and Manufacture**

This work shall consist of the fabrication, manufacture and finishing of pot type structural bearing devices of the type shown on the plans for the locations as shown on the plans. These structural bearings shall adequately provide for all movements, loads, forces and rotations of structural members where applicable.

Bearings shall be factory set and clamped for equal expansion and contraction and plant assembled. Temporary connections shall not be removed until the bearings are set in their final positions.

The stainless steel sliding surface interface sheet shall conform to ASTM A167 Type 304 with a bright annealed mirror Number 8 finish on one side and continuously welded to the top plate.

All pot bearings shall have a minimum rotational capacity of ± 0.02 radians. All elements shall be capable of maintaining its initial uniform contact at ± 0.02 radians rotation. The coefficient of friction between the PTFE and stainless steel plates at maximum permissible bearing load shall be 0.03 or less. Pot bearings are to be lubricated and unfilled. Exposed steel surface shall be coated with cold galvanizing compound (2 coats).

The bearing device manufacturer shall be pre-qualified with a five year proven history of successful product manufacture.

All welding shall be in accordance with CSA W59-M. The company undertaking welding fabrication shall be certified in Division 1 or Division 2.1 of CSA W47.1.

Unidirectional or constrained sliding bearings should be manufactured with a gap tolerance at the guides of 0.5mm. All

bearing surfaces of steel plates shall be finished flat within 0.25mm. Overall manufacturing height tolerance shall be ± 3 mm.

Anchorage pins, studs and connections shall be designed and supplied by the fabricator for the maximum horizontal force and minimum/maximum vertical force indicated on the drawings.

.02 Approval

The pot bearing manufacturer shall be as designated in the contract documents or an approval equal. Bearings shall be approved by shop drawings and the manufacturer shall supply the Engineer with a catalogue.

Six (6) copies of drawings shall be forwarded for approval and three (3) weeks is necessary for this approval.

The following information is needed:

- (1) Dimensions of each component including: top plate, sliding surface, bearing surface, piston, elastomeric disc, base pot, anchor pins, anchor studs and welds and the overall dimensions of the finished bearing. Dimensions refer to length, width, diameter and thickness.
- (2) Minimum and maximum horizontal and vertical load capacity, both SLS and ULS.
- (3) Longitudinal and transverse movement capacity.
- (4) Bearing rotation capacity in radians.
- (5) Sketch indicating bearing locations, orientation and movement.
- (6) The shop drawings shall contain a detailed bill of materials.

.03 Identification

All bearings shall be indelibly marked with the name of the manufacturer, the part number, bearing identification number, elastomer type, elastomer grade and the date of manufacture on the side visible after erection.

.04 Quality Assurance

The manufacturer shall submit a certificate of compliance to the Engineer prior to installation. The certificate of compliance shall contain the material properties, grades and relevant standards of all bearing materials. The manufacturer shall certify the bearing(s) meet the design requirements.

412.04 INSTALLATION

All welding within three (3) metres of any bearing shall be specifically prohibited unless written approval is obtained from the Engineer. Such approval will require specific measures to protect the bearings where so required by the Engineer.

.01 Elastomeric Bearings

Bearings when received on site shall be stored in a location and under conditions approved by the Engineer.

The bearings shall be installed in the exact location as called for in the contract.

Tolerances of installation (including manufacturing tolerances) shall be ± 5 mm.

Variation from a parallel plane shall not exceed 1mm in 50mm.

Any abnormal appearance of the bearings shall be cause for rejection.

.02 Pot Bearings

The manufacturer shall ship each bearing fully assembled. The bearings are not to be disassembled prior to final installation without the knowledge of the design authority and manufacturer.

Bearings when received on site shall be unloaded and stored in accordance with the manufacturers recommendations. The Engineer shall approve the same.

The bearings shall be installed in the location and orientation as indicated on the contract drawings. Constrained sliding or unidirectional bearings shall be properly aligned to allow for the movement of the structure as indicated on the contract drawings. The bearings shall not be installed in the field prior to the Engineer's approval.

Where the bearings are of a guided or constrained type, the Contractor shall establish the bearing alignment using surveying instruments. The tolerance for variation in alignment, i.e. plan view, is ± 0.0067 radians (0.382 degrees) where the bearing is required to move 75mm or less. The bearings shall have dead level bearing surfaces, i.e. top and bottom plates. Dead level shall be defined as ± 0.001745 radians (0.10 degrees), i.e. ± 1.745 mm in 1000mm.

In positioning, the bearing centre of the base should correspond to the centre of the support. Rotation of the bearing should not be permitted to occur during concrete placing operations. The top plate shall be supported on all sides to prevent deflection of the same during the concrete placing operations.

The base plate shall be bedded by the Contractor on non-shrink grout. It is of extreme importance that the final bedding be free from high or hard spots, voids, etc. The Contractor shall supply durable load bearing wedges to support all bearings when they are placed on the non-shrink grout pad. Wooden wedges are not acceptable. The bearing base plate shall be set in position using a flowable non-shrink grout unless otherwise indicated on the shop drawings. For uni-directional and multi-directional bearings, adjust the upper plate to proper setting as instructed by the field Engineer prior to affixing to the structure. Ensure formwork is well sealed to prevent concrete from flowing onto the bearing prior to placing deck construction.

Installation requirements shall be written on the shop drawings. Bearings are to be installed as per the manufacturer's recommendations.

412.05 MEASUREMENT FOR PAYMENT

Each individual bearing fully assembled shall be considered as one (1) unit regardless of the bearing type, kind, size, capacity, function, location of installation in the structure or source of manufacture. Measurement for payment purposes shall be the total number of such units installed.

Bearings used against concrete creep blocks and concrete corbels shall not be included in measurement for payment and are incidental to the works.

412.06 PAYMENT

Payment at the contract price for "Bearings" shall be full compensation for all labour, equipment, materials, plant and services required to supply, fabricate, transport to the job site, store on site, handle and install the bearings in the specified locations. Any anchorages, grout and dowel pins required are considered incidental and no separate payments will be made.

The tendered price per each unit for "Bearings" shall be the average price per unit regardless of the bearing type, kind, size, capacity, function, location of installation in the structure or source of manufacture excluding bearings used against creep blocks and concrete corbels which are incidental to the works.

Any necessary engineering and adjustment shall be considered incidental to the work.

No payment will be made until a certificate of compliance has been received by the Engineer.

ITEM 422**ASPHALTIC PAVING OF BRIDGE DECKS****422.01 SCOPE OF WORK**

This specification applies to both existing or rehabilitated and new concrete bridge decks where asphaltic paving is being undertaken.

The scope of the work covers the requirements for the asphaltic paving of both treated and waterproofed new concrete bridge decks and concrete approach slabs with hot mix asphaltic surface course concrete. The paving of rehabilitated bridges and their approaches, in addition to the supply, transportation, placing and compaction of selected granular base course is also part of this work.

If paving items are contained in a current or ongoing road contract, the approaches including the approach slab where appropriate will be paved under the road contract. Otherwise, granular and paving operations up to 15 metres from the abutment backwall shall be included in the bridge contract.

Treating of rehabilitated bridge decks and some new bridge decks is also included. Waterproofing of all remaining bridge decks is provided for elsewhere.

The paving of bridge decks is not permitted without the specific approval of the Construction Division, Department of Engineering and Planning.

422.02 MATERIALS**.01 Tack Coat for Treated Bridge Decks**

Type SS-1h or RS-1k emulsion tack coat shall conform to Item 354 for Tack Coat.

.02 Selected Granular Base Course

Selected granular base course shall be of Granular "A" or Granular "B" gradation as required. This material shall conform to Item 323 Gravel for Streets.

.03 Hot Mix Asphaltic Concrete

Materials which comprise hot mix asphaltic concrete for paving bridge decks shall be of surface course gradation and quality. Item 351 Hot Mix Asphaltic Concrete shall govern.

.04 Joint Sealing Compound

Joint sealing compound shall conform to Item 414.03.06 Joint Sealing Compound.

.05 Hot Mix Asphaltic Concrete Sealant

This material shall conform to Item 414.03.07 Hot Mix Asphaltic Concrete Sealant.

422.03 EQUIPMENT

For treated bridge decks only, an approved pressure distributor may be utilized to place tack coat on the concrete deck. The distributor shall strictly conform to Item 354 Tack Coat. Overspray along curbs and expansion joint dams will not

be permitted, soil or gravel will not be tracked onto the bridge and approval is required from the Engineer stating the conditions of use. Alternatively, the following equipment must be utilized if so required by the Engineer.

Equipment for applying tack coat on bridge decks to be waterproofed shall be limited to a manually operated spray rod which shall produce a uniform fog-type spray. The lower part of the spray rod shall be bent 30 degrees to form a section of rod parallel to the deck. The pressurized container which holds the tack coat shall be equipped with a thermometer and pressure gauge.

All plant and equipment required to supply, produce, transport, place, spread and compact granulars shall conform to Item 323 Gravel for Streets.

All paving equipment and plant shall conform to Item 351 for Hot Mix Asphaltic Concrete.

The equipment used for filling the grooves and sealing the surface adjacent to the curbs and transverse joint filling with sealant at each expansion joint dam shall be approved by the Engineer.

422.04 CONSTRUCTION PROCEDURES

.01 General

All concrete surfaces shall be cured in accordance with Item 404.05 for "Curing" and be in a dry condition before the work as described herein may commence. Work shall not be performed during rainy or inclement weather or on wet, snow or frost covered surfaces.

.02 Treated Bridge Decks

Treated bridge deck construction procedures shall apply to all bridge decks where waterproofing is not carried out. The treatment procedure shall be as outlined herein. The process shall apply to both the suspended deck and the concrete approach slab.

.02.01 Deck Cleaning and Preparation

First, the Contractor shall sweep the bridge deck and approach slabs either manually or with a power broom. This shall be followed by a cleaning of the deck and approach slabs with oil-free compressed air. Tack coat shall be applied in accordance with Item 354 for Tack Coat.

Removal and disposal of old asphaltic pavement and deck rehabilitation shall be covered in Item 419 Rehabilitation of Concrete Structures.

.02.02 Granulars

Work under this classification is generally related to selected granular base course operations on rehabilitation type projects.

Contaminated granular material shall be excavated and disposed of as directed by the Engineer.

Suitable existing selected granular base course shall be reshaped and recompact (one hundred percent (100%) maximum standard proctor dry density, ASTM D698) to grade as established by the Engineer.

Additional granular material shall be produced, supplied, transported, stored, placed, graded and compacted in accordance with Item 323 Gravel for Streets. The width and thickness of the granular base course and granular shoulders shall be in conformance with the bridge approaches and the standard of roadway to which it is being applied as per the typical cross section. The length shall be in accordance with the length of existing pavement removed and disposed of as determined by the Engineer, generally 15m from the abutment back wall.

02.03 Paving

All construction procedures related to paving shall conform to Item 351 for Hot Mix Asphalt Concrete except as outlined herein.

Paving shall proceed downgrade.

Paving shall commence as soon as practical when the tack coat has adequately cured.

Compaction using vibration is not permitted on bridge decks and approach slabs.

The deck, concrete approach slabs and bridge approaches where applicable on rehabilitation type projects shall be paved with hot mix, hot laid asphaltic surface course concrete.

On approaches to rehabilitation type projects, i.e., generally 15 m from the abutment backwalls, new asphaltic surface course concrete shall be placed in two 40mm lifts. The deck and concrete approach slabs shall be paved with one 50mm lift and the new asphalt grades shall match the elevations of the concrete expansion joint dams. The thickness of paving on new concrete decks and approach slabs shall be in accordance with the contract drawings.

The approaches to the bridge shall be paved first thus avoiding the transfer of foreign particles on the deck so as to preclude damage to the treated deck.

Prior to commencing deck paving operations the Contractor shall cover all deck drains to prevent the entry of hot mix asphalt. The covers shall be secured to the deck drains. After breakdown rolling is complete, covers shall be removed from all deck drains. In addition, the Contractor shall place a removable filler strip in each expansion joint gap and for the full length of each joint. The purpose of the expansion joint filler strip is to preclude the hot mix asphalt from entering the flexible expansion joint gap(s). After paving operations are complete, the filler strip shall be removed. The Contractor shall clean both the deck drains and expansion joints and dispose of waste material.

02.04 Forming and Filling Grooves with Joint Sealing Compound

This operation applies to the joints created adjacent to and for the full length of each curb. The work shall be carried out in accordance with Item 414.04.08 for Forming and filling Grooves with Joint Sealing Compound.

02.05 Sealing Surface of Asphaltic Concrete Adjacent to Curbs

This work shall be carried out in accordance with Item 414.04.09 of the Specifications Book, Sealing Surface of Asphaltic Concrete Adjacent to Curbs.

02.06 Transverse Joint Filling

The groove may be formed by placing a 10mm by 10mm vee shaped wooden strip across the width of the deck and against each concrete face at each expansion joint dam. The wooden strip shall be coated with an approved bond breaker. The strip shall be removed after the hot mix asphalt has been fully compacted. The vee groove shall be blown out with oil-free compressed air and filled with Cold Applied Sealant or Joint Sealing Compound.

The application of sealant or compound shall be carried out when the temperature is at or above 5°C and the joint is dry. Traffic shall be kept off the transverse joint until the Sealant is set-up which should take from two (2) to five (5) hours for the cold applied sealant.

.03 Waterproofed Bridge Decks**.03.01 Waterproofing**

The materials and treatment procedure for the concrete surface preparation, surface conditioner for asphaltic membrane, application of asphalt and rubber membranes, protection boards and protection board tack coat, the forming and filling of grooves with joint sealing compound and sealing of the asphaltic surface adjacent to the concrete curbs shall be as outlined in accordance with Item 414 "Bridge Deck Waterproofing".

Bridge decks that are waterproofed shall have their concrete approach slabs treated as per Item 422.04.02 "Treated Bridge Decks".

.03.02 Paving

All construction procedures relating to paving shall be as outlined in Item 422.04.02.03 for paving, except as outlined herein.

The thickness of paving on waterproofed decks and treated approach slabs shall be in accordance with the contract documents.

Paving of the bridge deck should commence as soon as practical after waterproofing operations described in Item 414 for Bridge Deck Waterproofing have been completed. Care should be taken so as to not damage the installed waterproofing system. Displacement or puncturing of the protection board is not acceptable. Turning of vehicles on the bridge deck is prohibited.

Paving operations shall be conducted downgrade in the direction of protection board overlap.

The trucks should dump part of their load into the paver and then move down the deck away from the paver, so that the paver does not have to push the truck. Care must be taken to remove any hot mix material from the deck that may have spilled in front of the paver tracks or tires so that it does not perforate the membrane.

The speed of the asphalt spreader should be kept down in the range of three (3) to four (4) metres per minute in order to provide maximum traction.

The temperature of the asphalt should cool to 115°C before breakdown rolling begins with a suitable static steel wheel roller. The protection boards may squirm under the roller and crack the hot mix around the protection board perimeter if breakdown rolling is attempted too soon. The breakdown roller should make only one pass over the mat. The mat should then be rolled with a rubber-tired roller. Starting and stopping on the newly paved deck is not permitted.

.03.03 Transverse Joint Filling

Transverse joint filling shall be carried out as described previously in this specification. However, only hot applied joint sealing compound is to be utilized.

422.05 MEASUREMENT FOR PAYMENT**.01 Treated Bridge Decks**

Measurement for payment for the asphaltic paving of bridge decks, shall be outlined in Item 351 for Hot Mix Asphaltic Concrete.

Measurement for payment for the asphaltic paving of new bridge decks shall be confined to the actual tonnage of hot mix asphaltic concrete actually placed on the bridge deck and concrete approach slabs as directed by the Engineer. On

rehabilitation type projects, measurement for payment shall include the actual tonnage placed on the deck, concrete approach slabs and approaches within the limits as directed by the Engineer.

Measurement for payment for bridge deck and concrete approach slab sweeping, cleaning, preparation, tack coating, forming and filling grooves with sealant or joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs, transverse joint forming and filling, the provision for deck drain cover plates and expansion joint filler strips will not be made.

Payment for the production, supply, storage, transportation, placing, grading and compaction of Selected Granular Base Course will not be made for rehabilitation type projects.

Measurement for payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course material on new construction projects shall be in accordance with Item 323 Gravel for Streets.

Payment for cutting existing asphaltic pavement, removal, transportation and disposal of old asphaltic pavement will be made in accordance with Item 419 "Rehabilitation of Concrete Structures".

.02 Waterproofed Bridge Decks

Measurement for payment for deck waterproofing shall be paid for under Item 414 "Bridge Deck Waterproofing".

Payment for concrete approach slab sweeping, cleaning, preparation, tack coating, forming and filling grooves with joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs, transverse joint forming and filling, the provision for deck drain cover plates and expansion joint filler strips will not be made.

Measurement for payment for the Asphaltic Paving of Bridge Decks shall be as outlined in Item 351 "Hot Mix Asphaltic Concrete".

Measurement for payment for the asphaltic paving of waterproofed bridge decks shall be confined to the actual tonnage of hot mix asphaltic concrete actually placed on the bridge deck and concrete approach slabs as directed by the Engineer. No separate payment will be made for liquid asphaltic cement or blending sand.

Measurement for payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course material on new construction projects shall be in accordance with Item 323 "Gravel for Streets".

422.06 PAYMENT

.01 General

The item in the Schedule of Quantity & Price for "Asphaltic Paving of Bridge Decks" shall contain either one of the following two phrases, (a) "**Treated Bridge Decks**" or (b) "**Waterproofed Bridge Decks**" whichever is applicable to the project being tendered.

The basis of payment for the asphaltic paving of bridge decks shall be as outlined in Item 351 "Hot Mix Asphaltic Concrete".

.02 Treated Bridge Decks

The basis of payment at the contract unit price for the asphaltic paving of bridge decks shall include full compensation for all equipment, labour, materials and plant necessary to prepare, sweep and clean the deck, supply and apply tack coat, pave the bridge deck, concrete approach slabs and approaches on rehabilitation type projects, form and fill grooves with joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs and transverse joint forming and filling as described above. Also included is the supply and transportation of all blending sand and asphaltic cement from the source to the mixing plant.

For rehabilitation type projects the excavation, removal transportation and disposal of contaminated granulars, the reshaping and recompact of suitable existing granulars and the production, supply, storage, transportation, placing, grading and compaction of additional selected granular base course shall be considered incidental to the work.

For new projects the production, supply, storage, transportation, placing, grading and compaction of selected granular base course shall be paid for separately under Item 323 Gravel for Streets.

The basis of payment for cutting existing asphalt, removal, transportation and disposal of old asphaltic pavement on rehabilitation type projects shall be made in accordance with terms outlined elsewhere in Item 419 "Rehabilitation of Concrete Structures".

The covering of deck drains and expansion joints to prevent the entry of hot mix asphaltic concrete, the removal of the cover plates and filler strips, clean up and disposal of waste material shall be considered incidental to the work.

.03 Waterproofed Bridge Decks

Payment for the waterproofing of bridge decks and all related work shall be as outlined in Item 414 "Bridge Deck Waterproofing".

The basis of payment at the contract unit price for the asphaltic paving of waterproofed bridge decks shall include full compensation for all equipment, labour, materials and plant necessary to prepare, sweep, clean and tack coat the concrete approach slabs, pave the bridge deck and concrete approach slabs. Included is the forming and filling of approach slab grooves with joint sealing compound and sealing the asphaltic surface adjacent to the concrete curbs, form and complete transverse joint filling as described above. Also included in the basis of payment is the supply and transportation of all blending sand and asphaltic cement from the source to the mixing plant.

The basis of payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course shall be provided for separately under Item 323 Gravel for Streets.

The covering of deck drains and expansion joints to prevent the entry of hot mix asphaltic concrete, the removal of the cover plates and filler strips, clean up and disposal of waste material shall be considered incidental to the work.

**DIVISION 5
SPECIFICATIONS FOR REINSTATEMENT**

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ITEM 511**TOPSOILING, SODDING AND/OR
HYDROSEEDING****511.01 SCOPE OF WORK**

The Contractor shall place topsoil and sod or place topsoil and hydroseed on areas designated by the Engineer in the field and in accordance with this specification.

Topsoil supplied and placed under this item shall be for sodding and hydroseeding application. Topsoil required for other applications such as trees, shrubs, flower beds, etc, shall conform to Item 512 "Topsoil and Finish Grading".

511.02 APPROVAL

The Contractor shall receive the approval of the Manager of Parks Services or his representative for all materials incorporated in the work (Topsoil, Lime, Fertilizer, Sod, Seed, etc.), as well as the approval of the finished product.

511.03 MATERIALS**Topsoil**

Topsoil shall be a "Loamy Sand" to "Sandy Loam" as classified by the Canadian System of Soil Classification. Topsoil shall be friable, fertile and free of subsoil, roots, vegetation, debris and stones greater than 40 mm in diameter. The pH range shall be such that not more than 0.5 kg/m² (110 lbs./1000 sq. ft.) of dolomite lime must be added to reach the required pH level of 6.8. The soil must have a 3-7% range in organic matter by dry weight. Prior to approval the contractor shall provide a soil test analysis of proposed topsoil. The Contractor shall guarantee that the soil submitted for laboratory testing is a representative sample taken from the soil that will be delivered to the site. The Contractor shall include in the tender price the cost of amending the soil to meet the required soil properties for the intended use.

Lime

Lime shall be dolomite lime, supplied on site in sealed manufacturers packaging. Rate of application shall be as recommended by the laboratory soil analysis for the intended use.

Fertilizer

- Fertilizers shall be standard commercial brands, meeting the requirements of the Canada Fertilizer Act.
- All fertilizers shall be granular, pelleted or pill form, and shall be dry and free flowing.
- The fertilizers shall have a guaranteed N-P-K analysis.
- Fertilizer shall be packed in standard waterproof packaging, clearly marked with the name of the manufacturer, weight and analysis.
- The types, formulations, and rates of application for fertilizers shall be as recommended by the laboratory soil analysis for the growing medium.
- Substitutions or variations in fertilizers and methods shall be made only upon pre-approval by the Parks Services Division Reviewer.
- Receipts and empty fertilizer bags should be retained until reviewed by the Parks Services Division Reviewer, as verification that the required fertilizer has been supplied.

Sod

This specification manual classifies sod into the following quality grades:

1. Cultivated Turfgrass Sod
 - Premium Grade #1
 - Standard Grade #2
 - Speciality Grade #3
2. Field Sod
 - Grade #4

Cultivated Turfgrass Sod

Shall be planted on cultivated agricultural land and grown specifically for sod purposes. It shall be mowed regularly and maintained to obtain reasonable quality and uniformity. The City has the authority to specify growing medium ie. mineral soil, peat or sand, etc.

Sod grade requirements:

Grade #1 & #3

Premium and Speciality Grade turfgrass shall contain only the species and varieties of grasses as specified in the tender document. Sod of this quality may contain 1 broadleaf weed per 40 m² and up to one percent (1%) native grasses. Sod should be of sufficient shoot density that no surface soil will be visible from a standing position when mowed to a height of 40 mm. Creeping bentgrass sod is exempted as mowing height is determined by end use.

Grade #2

At the time of sale, sod of this grade should be in healthy condition with no obvious patches of foreign grasses. Sod of this quality may contain up to five (5) broadleaf weeds per 40 m² and up to ten percent (10%) native grasses. Sod should be of sufficient shoot density so that no surface soil will be visible from a standing position when mowed to a height of 40 mm.

Field Sod**Grade #4**

Field sod is all sod that does not meet requirements of cultivated sod. It may consist of sod lifted from pastures or meadows. It may be composed of grasses from non-certified seed, or of unknown origin. Sod is suitable for erosion control, roadside and minimum maintenance areas.

Seed

Seed shall be packed and delivered in original containers clearly showing:

- Name of supplier
- Analysis of seed mixture
- Percentage of pure seed
- Year of production
- Net weight
- Date and location of bagging

Seed shall have a minimum germination rate of seventy-five percent (75%) and a minimum purity of ninety-seven percent (97%), except where otherwise required for a specialty mixture. Seed shall have proven track record for the Newfoundland climate and be Certified Canada No. 1 seed. Seed shall have the following seed mixture or similar unless otherwise specified in the tender document.

Kentucky Blue Grass	50-60%
Creeping Red Fescue	20-30%
Perennial Rye	10-20%

Hydraulic Mulch

Hydraulic mulch, when used, shall consist of fibre or other material designed for hydraulic seeding and dyed for ease of monitoring application. Hydraulic mulch shall be capable of dispersing rapidly in water to form a homogeneous slurry and remaining in such a state when agitated or mixed with other specified materials when applied, the mulch shall be capable of forming an absorptive mat, which will allow moisture to percolate into the underlying soil. It shall contain no growth or germination inhibiting factors. The mulch shall be dry, free of weeds and all other foreign material and shall be supplied in packages bearing the manufacturers label clearly indicating weight and product name.

The mulch may contain a colloidal polythacuride (or equivalent) tackifier, that shall be adhered to the mulch to prevent separation during shipment and to avoid chemical agglomeration during mixing in hydroseeding equipment.

Binder

Binder shall be capable of joining seeds mulch and soil particles together on slopes and erodible surfaces until plant growth has been established. The binder must not form an impervious seal which would prevent the penetration of moisture to the underlying soil.

511.04 PREPARATION

Prior to the placement of topsoil the ground shall be levelled, sloped and graded to the desired shape and grade. The surface shall be cleaned of stones, stumps or other objects larger than 100mm in thickness or diameter, and roots, brush, wire or other objects that might be a hindrance in placing the topsoil.

Grading shall be such as to prevent the ponding of water.

511.05 PLACING OF TOPSOIL

The topsoil shall be uniformly distributed on the designated areas and evenly spread to an average thickness of 150mm with a minimum thickness of 100mm. The spreading shall be performed in such a manner that planting can proceed requiring little additional soil preparation or tillage. Irregularities in the surface resulting from topsoiling or other operations shall be corrected so as to prevent the formation of depressions where water will stand. Topsoil shall not be placed where the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to the proposed planting or to proper grading.

After the topsoil has been spread and graded as required and lime added and roto tilled, then the surface shall be cleared of stone, stumps or other objects larger than 50mm in thickness or diameter, and of roots, brush, wire or other objects that might be a hindrance to placing or maintenance operations.

511.06 APPLICATION OF LIME

Prior to the placing of sod or hydroseed, lime shall be uniformly distributed over the topsoil at the rate specified in the laboratory soil sample analysis. The lime shall then be incorporated into the soil to a depth of at least 100mm by disking, harrowing or other acceptable methods. Lime may be placed up to three weeks ahead of the placing of sod or hydroseeding.

511.07 SODDING

Sod shall be laid on the prepared growing medium within 3 days after cutting. Sod may be stored in stacks or piles, grass to grass or roots to roots. Sod shall be protected against drying from sun or wind and from freezing as necessary. The moving and laying of sod shall, as far as possible, be done when weather conditions and soil moisture are favorable.

Sod shall be laid staggered, closely knit together in such a manner that no open joints wider than 2mm are visible, and no pieces are stretched or overlapped.

Sod shall be laid smooth and flush with adjoining grass and paving and top surface of curbs unless shown otherwise on the drawings.

On slopes with a slope angle of 20° or greater, sod shall be laid lengthwise up the slope and each sod shall be pegged at a spacing not exceeding 600 mm. All pegs shall be driven flush with the top of sod.

Prior to placing of sods, the soil shall be fertilized at the rate as specified in the soil test analysis. Fertilizers shall be spread evenly over the growing medium with a suitable mechanical spreader. Fertilizers shall be raked into the growing medium to a minimum depth of 25mm. There should be at least three weeks separation between application of lime and fertilizers. Following the placing of sods, sods shall be rolled with a 70 - 80 kg lawn roller and then thoroughly soaked with water. If conditions warrant, more water may be required from time to time to establish and maintain growth until the sod is established and accepted.

511.08 HYDROSEEDING

Two (2) operations shall be employed in the hydroseeding of designated areas. The first operation shall consist of the distribution of lime as specified in the soil sample analysis.

The second operation shall consist of the distribution of a slurry composed of mulch, seed, fertilizer plus binder. The rate of application of these ingredients shall be as follows:

Mulch (cellulose)	1250 kg/ha
Seed Mixture	225 kg/ha
Fertilizer	As per soil analysis
Binder	25 kg/ha

The Contractor shall measure the quantities of each of the materials to be charged into the seeder, either by mass or by a system of mass-calibrated volume measurements approved by the Engineer. The Contractor shall provide all equipment required for this purpose.

Both operations require that the ingredients be thoroughly mixed with water in a hydroseeding tank. The mix must be continuously agitated during the hydroseeding operation to ensure that a homogeneous slurry is produced.

The distribution of the slurry shall be by means of an approved hydroseeder and shall be applied uniformly and in such a manner as to prevent puddling and movement of the soil surface.

Work shall proceed only in calm weather and on ground free of frost, snow, ice or standing water and when weather and seasonal conditions are suitable. Hydroseeding shall not be carried out during periods of rainfall.

511.09 SECOND FERTILIZATION

The Contractor shall apply a maintenance application of fertilizer to areas sodded or hydroseeded. Fertilizer shall have an N-P-K analysis ratio of 8-2-1. The fertilizer shall be applied at a ratio of 0.5 kg of actual nitrogen per 100 m² and shall be applied approximately two (2) months after the initial placing.

511.10 PROTECTION AND REPAIR

The area shall be protected against traffic or other use by erecting barricades immediately after sodding or hydroseeding is completed and by placing warning signs of an approved type on the various areas. If at any time before completion and acceptance of the entire work covered by this contract, any portion of the surface becomes gullied or otherwise damaged following sodding or hydroseeding, or the seedlings or grass have been winter-killed or otherwise destroyed, the affected portion shall be repaired to re-establish the condition and grade of the soil prior to sodding or hydroseeding and shall then be re-sodded or hydroseeded.

511.11 ACCEPTANCE

Sods and hydroseeding placed in the FALL will not be accepted until the following June.

511.12 CUT OFF DATES

No topsoil, sod or seed shall be placed before May 1st or after November 1st of any year.

511.13 MEASUREMENT FOR PAYMENT

The quantity to be measured shall be the area in square metres, measured to one decimal place, between the limits set by the Engineer that has been landscaped in accordance with this specification.

511.14 PAYMENT

Payment shall be at the unit price bid for each square metre of topsoil, seed, sod and/or hydroseed placed in accordance with this specification. Such payment shall be full compensation for the cost of all labour, materials, tools and equipment necessary to supply and place topsoil, sod, and/or hydroseed.

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ITEM 512**TOPSOIL AND FINISH GRADING****512.01 SCOPE OF WORK**

The Contractor shall prepare the existing grade, supply and place topsoil and perform finish grading as detailed on the drawings and specified as follows.

Topsoil supplied and placed under this item shall be for trees, shrubs, flower beds, etc. Topsoil required for sodding and hydroseeding application shall conform to Item 511 "Topsoiling, Sodding and/or Hydroseeding".

512.02 SOURCE QUALITY CONTROL

Inform Engineer of proposed source of topsoil to be supplied and provide access for sampling. Acceptance of topsoil subject to inspection and/or soil analysis test results. Do not commence work until topsoil is accepted by the Engineer.

Inspection and testing of topsoil will be carried out by testing laboratory designated by Engineer. The Contractor will pay for costs of tests.

Test topsoil from source prior to stripping and stockpiling, for clay, sand and silt, NPK, Mg, soluble salt content, pH value, growth inhibitors and soil sterilants.

Use 25mm diameter sampling tube or spade and in presence of Engineer take twenty-five (25) samples per hectare to full depth of topsoil at random across entire area to be stripped. Mix samples together thoroughly before submitting for testing.

Submit 0.5 kg sample of topsoil to testing laboratory and indicate present use, intended use, type of subsoil and quality of drainage. Prepare and ship sample in accordance with provincial regulations and testing laboratory requirements.

Determine required limestone treatment to bring pH value of soil as recommended by soil testing laboratory.

Submit two (2) copies of soil analysis and recommendations for corrections to Engineer.

512.03 APPROVAL

The Contractor shall receive the approval of the Manager of Parks Services or his representative for all materials incorporated in the work (Topsoil, Lime, Fertilizer, etc.), as well as the approval of the finished product.

512.04 SCHEDULING OF WORK

Schedule placing of topsoil and finish grading to permit planting under optimum conditions.

512.05 MATERIALS**Planting soil for planting of trees, shrubs and ground covers**

Mix 9 parts topsoil with 1 part peatmoss. Incorporate bonemeal into planting soil at rate of 3 kg/m³ of soil mixture.

Peatmoss

Derived from partially decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses.

Elastic and homogeneous, brown in colour.

Free of wood and deleterious material which could prohibit growth.

Shredded particle minimum size: 5mm.

Fertilizer

Complete commercial synthetic fertilizer with minimum sixty-five percent (65%) insoluble nitrogen.

Formulation ratio: as determined by soil testing laboratory.

Bonemeal

Finely ground with a minimum analysis of twenty percent (20%) phosphoric acid.

Limestone

Ground horticultural limestone containing minimum eighty-five percent (85%) of total carbonates.

Gradation requirements: percentage passing by weight, ninety percent (90%) passing 1.0mm sieve, fifty percent (50%) passing 0.125mm sieve.

512.06 PREPARATION OF EXISTING GRADE

Prevent damage to existing buildings, curbs, sidewalks, and utilities. Make good any damage.

Grade subsoil, eliminating uneven areas and low spots, ensuring positive drainage. Remove soil contaminated with toxic materials. Dispose of removed materials as directed by Engineer.

Cultivate entire area which is to receive topsoil to depth of 100mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.

Remove surface debris, roots, vegetation branches and stones in excess of 50mm diameter.

Cultivate soil to depth of minimum 25mm.

512.07 SPREADING OF PLANTING SOIL

Spread topsoil after Engineer has inspected and approved subgrade.

Spread topsoil with adequate moisture in uniform layers over approved, unfrozen subgrade, where planting is indicated.

Apply planting soil as indicated.

Manually spread planting soil around trees, shrubs and obstacles.

512.08 SOIL AMENDMENTS

Apply soil amendments at rate as specified and as determined from soil sample test.

Mix soil amendments into full depth of topsoil prior to application of fertilizer.

512.09 APPLICATION OF FERTILIZER

Apply fertilizer at least one week after limestone application.

Spread fertilizer uniformly over entire area of topsoil at rate determined on basis of soil sample test.

Mix fertilizer thoroughly to full depth of topsoil.

512.10 FINISH GRADING

Fine grade and loosen topsoil. Eliminate rough spots and low areas to ensure positive drainage. Prepare loose friable bed by means of cultivation and subsequent raking.

512.11 SURPLUS MATERIAL

Dispose of materials not required off site.

512.12 CUT OFF DATES

No topsoil shall be placed or finish graded before May 1st or after November 1st of any year.

512.13 MEASUREMENT FOR PAYMENT

Supply and placing topsoil shall be included in the lump sum price and shall include preparation of subgrade and all material specified herein.

512.14 PAYMENT

Payment shall be on a lump sum basis for all subsurface preparation, supply and installation of drainage material, fabrics, topsoil, etc. The price bid shall include all labour, equipment and materials necessary to complete the work in accordance with this specification and the contract drawings.

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ITEM 513**TREES, SHRUBS AND GROUND COVERS****513.01 SCOPE OF WORK**

The Contractor shall supply and install trees, shrubs and ground covers as detailed on the drawings and specified as follows.

513.02 MUNICIPAL ARBORIST

Prior to the ordering of any trees, shrubs and/or ground cover, the contractor, in addition to the meeting of the requirements of the contract, shall obtain a permit from the Municipal Arborist and receive his approval of the final plant selection, placement, and final acceptance.

513.03 SOURCE QUALITY CONTROL

Obtain approval of plant material at source.

Notify Engineer of source of material at least seven (7) days in advance of shipment. No work under this Item is to proceed without approval.

Acceptance of plant material at its source does not prevent rejection on site prior to or after planting operations.

Imported plant material must be accompanied with necessary permits and import licences. Conform to federal and provincial regulations.

All plant material shall be nursery stock unless otherwise approved by the Municipal Arborist.

513.04 SHIPMENT AND PRE-PLANTING CARE

Co-ordinate shipping of plants and excavation of holes to ensure minimum time lapse between digging and planting.

Tie branches of trees and shrubs securely and protect plant material against abrasion, exposure and extreme temperature change during transit. Avoid binding of planting stock with rope or wire which would damage bark, break branches or destroy natural shape of plant. Give full support to root ball of large trees during lifting.

Cover plant foliage with tarpaulin, and protect bare roots by means of dampened straw, peatmoss, saw dust or other acceptable material to prevent loss of moisture during transit and storage.

Remove broken and damaged roots with sharp pruning shears. Make a clean cut.

Keep roots moist and protected from sun and wind. Heel-in trees and shrubs, which cannot be planted immediately, in shaded areas and water wells.

513.05 GUARANTEE

The Contractor hereby warrants that plant material as itemized on plant list will remain free of defects in accordance with GC24, but for 2 full growth seasons.

End-of-warranty inspection will be conducted.

Engineer reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

513.06 REPLACEMENTS

During warranty period, remove from site any plant material that has died or failed to grow satisfactorily as determined by Engineer.

Replace plant material in next planting season.

Extend warranty on replacement plant material for a period equal to the original warranty period.

Continue such replacement and warranty until plant material is acceptable.

513.07 MATERIALS

Water - Potable and free of minerals which may be detrimental to plant growth.

Stakes - T-bar steel stakes 40 x 40 x 5 x 2440mm.

Tree Rings - Fabricated from 3mm galvanized wire encased in two ply reinforced 12mm dia rubber garden hose or equivalent.

Fibreglass fabric - Tight woven, min 2.5 kg/m² mass, 1m wide.

Root ball burlap - 150 g Hessian burlap.

Chip mulch - Chips from deciduous or coniferous trees, varying in size from 25mm to 50mm dia.

Anti-desiccant - Wax-like emulsion to provide film over plant surfaces reducing evaporation but permeable enough to permit transpiration.

513.08 PLANT MATERIAL

Quality and source

Comply with Guide Specification for Nursery Stock, 1994 Edition of Canadian Nursery Trades Association referring to size and development of plant materials and root ball. Measure plants when branches are in their natural position. Height and spread dimensions refer to main body of plant and not from branch tip to branch tip. Use trees and shrubs of No. 1 grade.

Additional plant material qualifications

Plant material obtained from areas with milder climatic conditions from those of site acceptable only when moved to site prior to the breaking of buds in their original location and heeled-in, in a protected area until conditions suitable for planting.

Use trees and shrubs with strong fibrous root system free of disease, insects, defects or injuries and structurally sound. Use trees with straight trunks, well and characteristically branched for species. Plants must have been root pruned regularly, but not later than one growing season prior to arrival on site.

Large trees must have been half root pruned during each of two (2) successive growing seasons, the latter at least one (1) growing season prior to arrival on site.

Plant material that has come out of dormant stage and is too far advanced will not be accepted unless prior approval obtained.

Cold Storage

Approval required for plant material which has been held in cold storage.

Container-grown stock

Acceptable if containers large enough for root development. Trees and shrubs must have grown in container for minimum of one growing season but not longer than two. Root system must be able to "hold" soil when removed from container.

Plants that have become root bound are not acceptable. Container stock must have been fertilized with slow releasing fertilizer.

Balled and burlapped

Coniferous and broad-leaved evergreens over 500mm tall must be dug with soil ball. Deciduous trees in excess of 3 metre height must have been dug with large firm ball. Root balls must include seventy-five percent (75%) of fibrous and feeder root system.

Substitutions to plant material as indicated on planting plan are not permitted unless written approval has been obtained as to type, variety and size. Plant substitutions must be of similar species and of equal size as those originally specified.

513.09 WORKMANSHIP

Stake out location of trees and planting beds as per planting plan. Obtain approval prior to excavating.

Apply anti-desiccant in accordance with material manufacturer's instructions.

Co-ordinate operations. Keep site clean and planting holes drained. Immediately remove soil or debris spilled onto pavement. Do not leave open holes on site over night, unless covered with suitable coverings.

513.10 PLANTING TIME

Plant deciduous plant material during dormant period before buds have broken. Plant material noted for spring planting only, must be planted in dormant period.

Plant material imported from region with warmer climatic conditions may only be planted in early spring.

When permission has been obtained to plant deciduous plant material after buds have broken, spray plants with anti-desiccant to slow down transpiration prior to transplanting.

Plant evergreens in spring before bud break.

When permission has been obtained, trees, shrubs and ground covers growing in containers may be planted throughout growing season.

Plant only under conditions that are conducive to health and physical conditions of plants.

Provide planting schedule. Extending planting operations over long period using limited crew will not be acceptable.

513.11 EXCAVATION**Shrub beds**

Excavate to minimum depth of 500mm.

Individual shrubs

Excavate planting holes 500mm deep and at least 500mm wide.

Small trees (up to 3.0 metres)

Excavate holes 600mm deep with diameter of 300mm greater than root spread or root ball.

Large trees

Excavate to depth of rootball, with width of 750 mm greater than diameter of rootball.

The transition of the tree planting area to shallower growing medium shall have a shallow angle.

Excavation of the subgrade below the rootballs of trees shall only be necessary to permit the bottom of the rootball to sit on undisturbed material or compacted fill such that the top of the rootball remains at the proper finished grade. Disturbed subgrade below the rootball shall be compacted to prevent settlement of the tree after planting. Excess excavated material shall be removed from the site.

Planting pits or areas excavated in fine soils or by mechanical means shall have all bottoms and sides scarified to ensure that they do not have glazed surfaces. Where the growing medium in a planting pit or area is different in texture, structure or organic content from the surrounding soil (such as when the pit is filled with imported prepared growing medium) the sides and bottom shall be scarified and the two material thoroughly mixed to avoid an abrupt interface. Growing medium shall be free from interfaces or textural differences that could impede root development.

513.12 PLANTING

Planting shall be such that after settlement the level of the adjacent growing medium surface matches the level of the original growing medium surface in the nursery. The soil mark on the stem is an indication of this, and it shall be maintained on the finished level, allowing for settling of the growing medium after planting. Total depth of rootballs shall be planted in growing medium.

- Plants shall be set plumb in the planting beds or in the center of the pits, except where the plant's character requires variation from this. Orientate plant material to give best appearance in relation to structure, roads or walkways.
- Growing medium shall be placed in layers around the roots or ball, preferably by hand. Each layer shall be carefully tamped so as to avoid injuring the roots or ball, or disturbing the position of the plant.
- When growing medium is at two-thirds of the rootball height, ties shall be cut and the top one-third of burlap on B & B plants shall be folded back carefully, not disturbing the rootball integrity. No burlap shall show above grade. In addition, wire baskets if present should be cut back to this level without disturbing rootball.
- Growing medium should be moist in tree pits and beds at this stage, and allowed to settle around the roots. After the water has been absorbed, the backfilling shall be completed and tamped lightly. Any settling shall be brought up to the intended grade with growing medium.

513.13 TREE SUPPORT

Immediately following planting, trees shall be stabilized using appropriate methods such that the crown of each tree is permitted free movement but normal forces such as wind, snow loading or forces applied by human hands will not disturb the buttress root system or cause the rootball to shift in the growing medium. Securing methods include staking, guying, soil anchors and deadmen.

A tree may not need to be stabilized if the subsoil and growing medium are stable and can hold the rootball in place and if the rootball is solid, contained in a wire basket, and shaped such that it can be expected to resist shifting.

All tree stabilization methods shall be such that they do not damage the tree.

Attachment to the tree shall be no higher than necessary to stabilize the rootball while permitting free movement of the tree's crown.

Ties shall be secured to the stakes or placed in the tree such that they will not slide down or otherwise be displaced.

Stakes, anchors, etc. shall be set deep enough that they will not move in the soil when subjected to wind and other normal forces.

Stakes or anchors for guy wires shall be set below or flush with the soil surface so that they do not present a hazard, and guy wires shall be used only where they do not present a hazard. Guy wires shall be marked with flagging tape for visibility.

Stakes shall not be driven through the rootball.

513.14 PRUNING

Pruning at the time of planting shall be limited to the minimum necessary to remove dead or injured branches. Pruning shall be done in such a manner as to preserve the natural character of the plants. Only clean, sharp tools shall be used. Tools should be sterilized between cuts of different plants. All cuts shall be clean and cut to the branch collar, leaving no stubs. Cuts, bruises or scars on the bark shall be traced back to living tissue and removed. The affected areas shall be shaped so as not to retain water.

513.15 MULCHING

Obtain approval of planting before mulching material is applied. Loosen soil in planting beds and pits and remove debris and weeds. Spread mulch to minimum thickness of 50mm. Mulch material susceptible to blowing must be moistened and mixed with topsoil before applying. When mulching is placed in fall, place immediately after planting. When mulch is placed in spring, wait until soil has warmed up.

513.16 MAINTENANCE

Water once a week for first four (4) weeks and then sufficiently thereafter to maintain optimum growing conditions. Ensure adequate moisture in root zone at freeze-up.

Keep soil within confines of planting saucer around trees and planting beds, shallowly cultivated and free from weeds.

Keep tree stakes in proper repair.

Provide adequate protection against winter damage.

Maintain plant material from date of planting up to end of warranty period.

Remove tree stakes at end of warranty.

513.17 CUT OFF DATES

No trees, shrubs or ground cover shall be placed before May 1st or after November 1st of any year.

513.18 MEASUREMENT FOR PAYMENT

Measurement for payment shall be the number of each plant type supplied and installed.

513.19 PAYMENT

The Contractor shall be paid at the respective unit price bid for each plant type supplied and installed. The unit price shall constitute full compensation for all labour, equipment and materials required to complete the work as specified.

DIVISION 7

SPECIFICATIONS FOR TEMPORARY SIGNS & DEVICES

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ITEM 704

TEMPORARY CONDITION SIGNS

704.01 GENERAL

All Temporary Condition Signs must meet the standards shown in this Division and the Manual of Uniform Traffic Control Devices for Canada, Part D – Temporary Conditions, for appearance, size, shape, colour, and level of reflectivity. The minimum level of reflectivity for orange sheeting used on temporary condition signs is ASTM Type 111 (high intensity).

704.02 SIGN DIMENSIONS

Signs must be placed on or by the edge of the road where they do not pose a hazard to traffic. Signs must be aimed and their alignment maintained so that they have the best viewing angle for oncoming traffic. For post mounting, the distances from the road surface to the bottom of the signs are:

- For 900 x 900 mm signs or larger, the sign must be installed so that their bottom edge is 1.0 to 2.5 m above the traveled portion of the roadway.
- For smaller signs, such as 750 x 750 mm signs, the sign must be installed so that their bottom edge is 1.5 to 2.5 m above the traveled portion of the roadway

The minimum sizes that should be maintained for all temporary condition signs, unless otherwise stated under the sign description, is as follows:

Road Type	Signs in Advance Warning Area	Signs Elsewhere in Work Zone
Freeway	1200mm x 1200mm	900mm x 900mm
Rural Roads	900mm x 900mm	750mm x 750mm
Urban Streets	750mm x 750mm	750mm x 750mm

704.03 SIGN DESCRIPTIONS

TC-1 Construction Ahead is used to provide advance warning of a major work area. This sign is generally used on long- term construction projects where drivers may encounter construction activities.



TC-1A Construction Ahead Advance (with distance) is used to provide additional advance warning of construction projects. The distance shown on the sign is to be changed to show the actual distance to the work area by placing overlays or tabs in 500 m increments on the face of the sign.



TC-2 Road Work is used to indicate that work area activities are occurring on or near the traveled portion of the road and that workers or equipment may be at risk or may pose a risk to the driver.

TC-2



TC-4 Construction Ends is used to indicate to drivers that they have reached the end of a work zone and that they can expect normal roadway conditions on the remainder of the roadway.

TC-4



TC-5 Lane Closed Ahead is used to indicate that a lane is closed for road work. TC-5 must only be used on a multi-lane highway or street or on a highway or street with a multi-lane approach to the work area. The appropriate TC-5L (Left Lane) or TC-5R (Right Lane) version of the sign must be used.

TC-5R



TC-5L



TC-6 Lane Closure Taper is erected at the beginning of a taper on Multi-Lane highways as a final warning to drivers that a lane change is necessary.

TC-6



TC-7 Lane Closure Arrow is used to indicate that traffic must pass to the Left or Right of the temporarily closed lane. The TC-7 sign is not used for Detours. Minimum size for TC-7 on Urban Residential Streets - 600mm x 1200mm

TC-7



TC-10 Detour Ahead is used to indicate that traffic will be required to follow another road to detour around the work area. TC-10 is erected in advance of detours on all streets and highways.

TC-10



TC-10A Detour Ahead Advance (with distance) is used provide additional advance warning of detours. The distance shown on the sign is to be changed to show the actual distance to the beginning of the detour by placing overlays or tabs in 500 m increments on the face of the sign.

TC-10A



TC-11 Detour Direction Markers are used to indicate an alternate route for traffic to follow where work zone activities require the total closure of a roadway. The Detour Direction Markers should be installed in advance of and at intersections where the driver is required to follow the detour. The appropriate advanced turn arrow or direction arrow is used to show the direction of the detour route. TC-11 is available in Straight Through (TC-11), Right Turn (TC-11R), and Left Turn (TC-11L). The appropriate arrow must be used. Detour Direction Markers may be installed at intermediate locations along the detour route as confirmation to the driver. Minimum size for TC-11 on Urban Residential Streets - 600mm x 600mm. Minimum size for TC-11L and TC-11R on Urban Residential Streets- 600mm x 450mm.

TC-11



TC-11R



TC-11L



TC-12S End Detour should be used to indicate that motorists have reached the end of the detour and are resuming travel on their original route. Minimum size for TC-12S on Urban Residential Streets - 450mm x 300mm.

TC-12S



TC-13 Road Diversion is used to indicate a minor deviation to the right, "TC-13R" or left, "TC-13L" from the normal road alignment, TC-13 is used when the minor deviation is 200 meters or less in length.

TC-13R



TC-13L



TC-14 Road Diversion is used to indicate a minor deviation of two or more lanes to the right, "TC-14R" or left, "TC-14L" from the normal road alignment. TC-14 is used when the minor deviation is 200 meters or less in length.

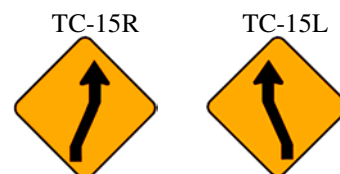
TC-14R



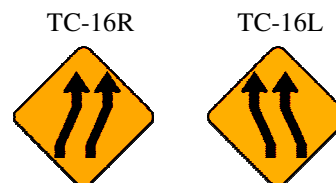
TC-14L



TC-15 Road Realignment is used to indicate a realignment of the roadway. A Right, “TC-15R” or Left, “TC-15L” is used as appropriate to indicate the deviation from the normal road alignment. TC-15 is used when the roadway realignment is greater than 200 meters in length.



TC-16 Road Realignment is used to indicate a realignment of two or more lanes. A Right, “TC-16R” or Left, “TC-16L” is used as appropriate to indicate the deviation from the normal road alignment. TC-15 is used when the roadway realignment is greater than 200 meters in length.



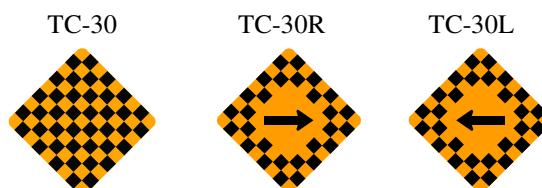
TC-17S Yield To Oncoming Traffic is used to indicate which direction has the right of way where only one lane is available for two-way traffic. The Yield sign (RA-2) with the To Oncoming Traffic tab sign (TC-17S) is installed in the direction of the closed lane only. The RA-2 sign with the accompanying TC-17S tab sign should only be used in situations where the one lane operation is short and where visibility is available in both directions beyond the one-lane section. Minimum size for TC-17S on Urban Residential Streets - 300mm x 600mm



TC-21 Traffic Control Person is used to indicate the presence of Traffic Control Persons directing traffic using a stop/slow paddle. Motorists are required to follow the direction of the Traffic Control Person. TC-21 is displayed only when traffic control persons are actively directing traffic; otherwise the TC-21 sign must be removed or covered. Minimum size for TC-21 on Urban Residential Streets - 600mm x 600mm.



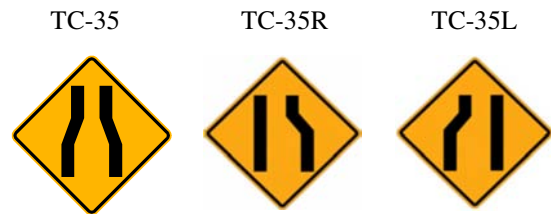
TC-30 Checkerboard is used to indicate the termination of a road. It is applied where a driver cannot proceed either straight ahead or to the left or right. The sign should be installed at the point at which the road terminates. TC-30L and TC-30R are used to indicate an abrupt change in the roadway alignment at a turn or curve. The arrow indicates the direction taken by the turn or curve and should be installed at the turn or curve in the roadway.



TC-31 Chevron Alignment is used to provide additional guidance to drivers where there is a change in the horizontal alignment of the roadway. The signs are installed on the outside of a curve or sharp turn and located at right angles to oncoming traffic. Minimum size for TC-31 on Urban Residential Streets - 450mm x 600mm



TC-35 Road Narrows is used to indicate a reduction in the width of the roadway. The TC-35 sign only applies when there is no reduction in the number of traffic lanes. The Road Narrows Right “TC-35R” and Road Narrows Left “TC-35L” versions of the sign are used where only the width of the respective lane is reduced.



704.04 SITE CONDITIONS

The typical Traffic Control Diagrams located in this Division illustrate the standard signs required to notify motorists and pedestrians of the upcoming temporary traffic control conditions and lane configurations. Special attention must be paid to site conditions to warn motorists and pedestrians of any changes or specific hazards to the road surface and surrounding area. The following will illustrate the common signs and typical applications for which the specific sign must be displayed to identify a hazard.

TC-47 Grooved Pavement is used to warn motorists of road surface conditions which require extra care and attention by cyclists and motorcyclists. The sign must be erected in advance of a section of roadway where construction procedures such as milling, grinding, scarifying or cold planning create a surface condition which may affect the control and stability of motorcycles and similar vehicles. The sign must remain in place until re-surfacing is completed and the hazard is removed.



TC-48 Soft Shoulder is used to warn motorists of possible hazards due to soft shoulder conditions along the roadway. The sign must be erected at 300 meters intervals for up to 1.0km and 900 meters intervals for sections longer than 1.0km where hazards exist due to soft shoulders. The sign must remain in place until the shoulders have been thoroughly compacted such that the hazard is no longer present.



TC-49 Pavement Drop-Off is used to warn motorists approaching a section of roadway that due to construction activities the adjacent lane and or shoulder may be higher or lower than the current roadway surface the motorists is traveling on. The Pavement Drop-Off sign must be erected in advance of the hazard and every 1.0km throughout a section of roadway where the hazard is present. The sign must remain in place until the roadway is restored to its normal condition. Additional Hazard Markers are required to be erected along the section or roadway to delineate the hazard. Please see Drawing 704-1 for further information.

TC-49



TC-50 Pavement Ends is used to warn motorists that a hard-packed road (i.e. asphalt or concrete) is about to end, and that the roadway will continue as a gravel surface.

TC-50



TC-51 Bump is used to warn motorists of a change in the profile of the roadway which is sufficient enough to cause discomfort to passengers or a deflection of the vehicle from its course. The Bump sign must be erected in advance of every isolated “bump” caused by construction procedures. The sign may also be used to indicate that a section of road has numerous “bumps” by using the supplementary tab sign TC-36S indicating the length of the rough section. The sign must remain in place until the roadway is restored to its normal condition.

TC-51



TC-54 Truck Entrance is used to indicate a location where trucks are entering, exiting, or crossing the road and where there is no other construction activity in the area, such as entrances to gravel pits or asphalt mix plants. TC-54 should not be used at locations where construction activities are in progress as this information would be conveyed by TC-2. TC-54 must be displayed only when trucks are working; otherwise the sign must be removed or covered. TC-54 is available in R (Right Entrance), and L (Left Entrance). The appropriate version of the sign must be used..

TC-54R



TC-54L



CSJ -RM Raised Manholes sign is used to warn motorists that the following section of roadway will contain obstructions in the form of raised manholes which will create a change in the profile of the roadway sufficient enough to cause discomfort to passengers or a deflection of the vehicle from its course. The Raised Manholes sign must be erected in advance of every raised manhole caused by construction procedures. The sign may also be used to indicate that a section of road has numerous raised manholes by using the supplementary tab sign TC-36S indicating the length of the rough section. The sign must remain in place until the obstructions are removed and the roadway restored to its normal condition.

CSJ-RM



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ITEM 705**TEMPORARY CONDITION DEVICES****705.01 APPLICATION**

Delineation devices must be used to channelize traffic when the traffic flow is impeded as a result of obstructions, work area or a narrowing of the street. They form part of the general category called Temporary Condition Devices and must be used as a supplement to temporary condition signs. Temporary Condition Devices have three functions for drivers and pedestrians:

- They warn that construction, maintenance or utility work is being carried out on or near the road immediately ahead.
- They advise of the appropriate response.
- They guide passage through the Temporary Workplace.

All Temporary Condition Devices must be removed or covered immediately after they are no longer applicable.

Where the temporary condition will exist during the hours of darkness, delineation must be achieved by the use of construction markers, traffic barrels, barricades, chevron markers, flashing beacons or similar devices. In all cases, markers and barricades used to achieve delineation during the hours of darkness must be reflectorized or illuminated to show the same colour and shape by night as by day (Fluorescent paint must not be used as a reflectorized substitute).

Delineator posts may be used to a maximum of five (5) days, not extending over the weekend period. Extended use is possible only with the approval of the Traffic Division.

Traffic cones may be used where the temporary condition will exist during daylight hours only and where the street will be in its normal operating condition throughout the hours of darkness.

705.02 LOCATION OF DELINEATION DEVICES

Any construction or maintenance activity on or within 1 m of a street must be marked by delineators along the work site and the approaches to the work site or obstruction, the angle at which the delineations are placed across the closed portion of the street is called the taper and should vary according to the maximum regulatory speed and must be as follows:

Regulatory Speed Limit	Minimum Taper
50 km/h and less	30 m
60 km/h	40 m
70 km/h	60 m
80 km/h	80 m
90 km/h	105 m
100 km/h	125 m

In 50, 60, or 70 km/h speed zones, taper lengths as noted above may be reduced to twenty-five percent (25%) of the minimum table value for utility truck operations where there is an approved flashing arrow board in operation on the utility vehicle.

If the work area affects more than one (1) traffic lane width, each traffic lane must be closed separately and a tangent section provided between the two (2) tapers. The minimum length of the tangent section must be as follows:

Regulatory Speed Limit	Minimum Tangent Between Tapers
50 km/h and less	30 m
60 km/h	40 m
70 km/h	60 m
80 km/h	80 m
90 km/h	105 m
100 km/h	125 m

705.03 SPACING OF DELINEATORS

The centre to centre distance between delineators varies with the regulatory speed limit and must be established as follows:

Regulatory Speed Limit	Maximum Centre to Centre Spacing
50 km/h and less	8 m
60 km/h	12 m
70 – 80 km/h	15 m
90 – 100 km/h	18 m

705.04 DESIGN AND COLOUR

Delineators, with the exception of traffic cones and delineator posts, must be designed with alternating striped orange and black colour placed in a horizontal position. Traffic cones must be solid orange in colour. Delineator posts must be orange in colour with two (2) reflectorized white 75mm strips per post.

705.05 FORMS OF DELINEATORS

A number of forms of delineation may be used, as outlined in the following:

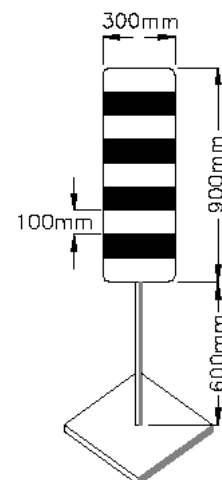
1. Construction Markers

Construction markers must be of the dimension indicated. They must be retro-reflectorized with high intensity grade orange reflective sheeting to indicate the same colour and shape by night as by day. Construction Markers must be marked with 100mm reflectorized horizontal orange stripes alternating with 100mm non-reflectorized horizontal black stripes.

Size – Construction Markers must be 300 X 900mm.

Spacing - The maximum hazard marker spacing is 50 metres.

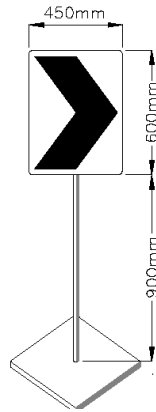
Some markers may require a weight to keep them from being knocked down or blown over. Only approved sand bags will be permitted and the use of rocks or boulders will not be considered.



CONSTRUCTION MARKER

2. Chevron Markers

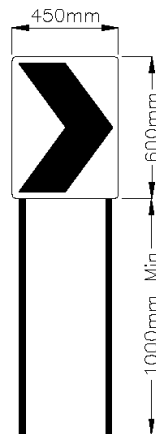
Chevron markers must be used on tapers for detours and diversions. They must replace the normal construction marker at a spacing of 30 metres. The arrowhead must point in the direction of the turn. They must be retro-reflectorized using high intensity grade orange reflective sheeting to indicate the same color and shape by night as by day. Some markers may require a weight to keep them from being knocked down or blown over. Only approved sand bags will be permitted and the use of rocks or boulders will not be considered.



Where traffic has to be diverted or channelized to cross multi-lanes of paved surfaces, delineator devices, such as hazard markers and chevrons, must be installed as outlined in this Division.

Signs 300mm or less in width, must be erected on a single piece of 25mm rebar to a height of 1 metre to 2 metres above the traveled portion of the roadway to the bottom edge of the sign.

Signs greater than 300mm in width, must be erected on two (2) pieces of 25mm rebar to a height of 1 metre to 2 metres above the traveled portion of the roadway to the bottom edge of the sign.



3. Drums

Drums are normally of 200 liters capacity set on end and used as delineators. Drums must be reflectorized to indicate the same colour and shape by night as by day. Drums are to be predominantly bright orange with a minimum of two (2) white reflectorized strips (100mm width minimum) per drum required.

Flexible drums may be used as an alternative method to channelize or delineate traffic and must be a minimum of 1000mm in height and a minimum of 550mm in diameter at the base. The markings on the flexible drums must be horizontal,

circumferential alternating black and reflectorized orange strips each being 100mm in width.

Use - Drums must be used as shown on the Application Guides. They are a higher standard and may be substituted for cones, or high delineators. Orange and black drums must not be used on the same project as orange and white drums. Different types of delineators must not be mixed, for the same purpose, on the same job, even when a higher standard delineator is used.

Drum stability - Drums must have bases heavy enough to keep them upright and in position during all conditions of use. Drums must not be weighted on top and Drum weighting must not be a hazard if the drum is struck. Drums that are tipped, should not roll or migrate, causing a traffic hazard.

Continuing Effectiveness - Drums that lose effectiveness through reduced reflectivity, or general appearance, must be removed from service.

5. Traffic Cones

Traffic Cones must be made from light weight, solidly coloured, bright orange material. Traffic Cones may be used to delineate work, buffer, transition and termination area tapers where their use is indicated on an Application Guide. Where Traffic Cones are specified by an Application Guide, high mounted Delineators may be used instead of the cones. Different types of delineators must not be mixed, for the same purpose, on the same job, even when a higher standard delineator is used.

Night Use - The use of traffic cones is only permitted during the hours of daylight. The use of traffic cones during the hours of darkness will only be permitted for emergency situations and longitudinal pavement marking applications. During these situations, all traffic cones in use for the hours of darkness must be reflectorized.

Cone Stability - Traffic Cones must have bases heavy enough to keep them upright and in position during all conditions of use. Their weight must not present a hazard if the cone is struck by a vehicle. Cones that are tipped, should not roll or migrate, causing a traffic hazard.

Continuing Effectiveness - Traffic Cones that lose effectiveness through reduced reflectivity, or general appearance, must not be used.

The dimensions of traffic cones should be related to the maximum speed on the street and their height comply with the following minimum requirements.

Maximum Speed km/h	Minimum Height (mm)
60 or less	450
70 or more	700

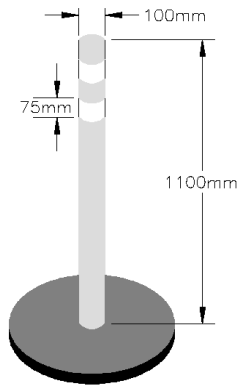
For longitudinal pavement marking applications, 450mm traffic cones may be used for speeds of 70km/h or greater.

6. DELINEATOR POSTS

Delineator posts used to channelize or delineate traffic must be 1100mm in height and 100mm in diameter. The markings must consist of two (2) high intensity reflective white horizontal, circumferential strips, 75mm in width. The unit is weighed down with a standard 7 Kg. rubber base. Extra 7 Kg. base inserts can be used when required by wind conditions.

High Delineators must be made from light weight, solidly coloured, bright orange material. Where Traffic Cones are specified by an Application Guide, High Delineators may be used instead of the cones. Different types of delineators must not be mixed, for the same purpose, on the same job, even when a higher standard delineator is used. (For example: Do not intermix cones and high delineators in an Approach Transition Taper, or drums and cones in a Buffer Area.)

Continuing Effectiveness - High Delineators that lose effectiveness through reduced reflectivity, or general appearance, must be removed from service.



705.06 FORMS OF WARNING DEVICES

A number of forms of warning devices may be used, as outlined in the following:

1. Flashing Arrow Light Units – TC-8 / TC-9

Flashing Arrow Boards are traffic control devices which provide an illuminated flashing display in the form of a left arrow, right arrow or a caution bar to inform drivers to change lanes or proceed with caution. There are two types of flashing arrow boards in common use:

TC-8 – displays a black arrow or bar on a reflectorized orange background. Both ends of the sign are hinged such that the board displays either a left or right arrow so that only one arrow head is visible. The board may also display a bar (arrow shaft only) with no arrow heads. The black arrow and bar modes are enhanced by the flashing lights contained in the black area of the board.

TC-9 – has a black background and displays a symbol only when the lights are activated. Depending on the light arrangement, several symbols and patterns may be displayed including left and right arrows and bars.

Arterials with a speed limit of 90 km/h or higher and detours and diversions that are anticipated to be in place longer than fifteen (15) days must have a flashing arrow light unit (TC-8 or TC-9) located within each taper length where either of the following conditions exist:

1. Lane drop situation.
2. Speed limit reduction of more than 20 km/h from the existing posted speed limit.

The arrow board must be a minimum of 1200mm long by 600mm high, and must be of a type and design as approved by the Engineer.

Flashing Arrow Light Units may be vehicle or trailer mounted. The height from the pavement to the centreline of the unit must be approximately 2.2 metres when it is in the upright position.

Approved Displays - Flashing Arrow Light Units have a group of lights capable of flashing a horizontal bar (Bar Mode) or a directional arrow(s) (Arrow Mode). The approved displays are:

- Left Arrow



- Right Arrow



- Left and Right Arrow



- Warning Bar.



The displays must have a minimum of:

- Six (6) working lights in Warning Bar mode.
- Nine (9) working lights in Left or Right Arrow mode (one arrowhead lit).
- Twelve (12) working lights in Left and Right Arrow mode (both arrowheads lit).

Use - When required by an Application Guide:

- A Flashing Arrow Light Unit must display a bar (caution) to draw motorist's attention to a hazard.
- A Flashing Arrow Light Unit must display an arrow only when it blocks a lane on a Multi-Lane Road and it is safe for traffic to change lanes in the direction of the arrow.
- Where a single lane is closed on a multi-lane road and more than one Flashing Arrow Light Unit is used, the first, Flashing Arrow Light Unit displays an arrow, second and subsequent units in the same lane display a bar (caution). (The arrow is normally used to indicate the need for a forced lane change on a multi-lane road.)

Position - Flashing Arrow Light Units must be positioned to obtain optimum motorist visibility. For a lane closure, Flashing Light Units must be positioned in the middle of the closed lane. For partial lane closures they should encroach into the roadway approximately the same amount as the work.

Flash Rate – Flashing Arrow Light Units must maintain a flash rate of 25 - 40 flashes per minute. The lights must be lit for approximately fifty percent (50%) of the cycle. For each Flashing Arrow Light Unit, all bulbs must show the same yellow or amber colour, and all must display the same light intensity. The Flashing Arrow Light Unit must be capable of automatically dimming at night or under low light conditions to a minimum of 50% of the normal daytime light output in order to not impair driver's vision.

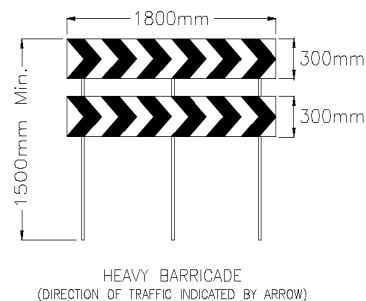
2. Barricades

For reasons of traffic safety and for the protection of workers, barricades must be used to define the work area and to close streets and roads in the area where work is being carried out. Barricades are always placed immediately preceding the work area on the approach side and act as a physical barrier between the street user and the obstruction or activity.

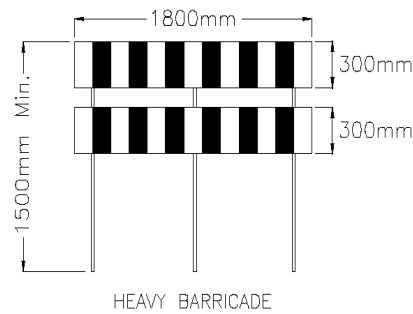
These barricades must be reflectorized or illuminated to indicate the same colour and shape by night as by day. All barricades must be marked with 100mm reflectorized orange stripes alternating with 100 mm non-reflectORIZED black stripes. The orange stripes must be reflectORIZED with ASTM Type 111 (high intensity) sheeting. The use of fluorescent paint on barricades will not be considered for use.

Heavy Barricades

Heavy barricades must be used to provide complete closure of a street or lane for an extended period of longer than five (5) days. Their supports must consist of posts set in the ground with two (2) TC-64C heavy barricade faces attached as shown below:

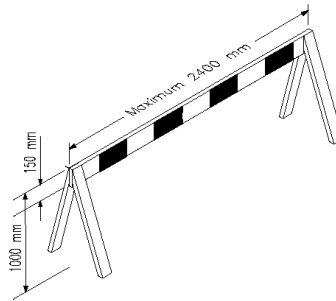


Where no direction is required barricade TC-64B must be used, as shown below:



Light Barricades

Light barricades must be used for work of short duration to provide closure of a traffic lane or roadways or to provide protection around road excavation sites or other work site hazards. Light barricades must not be used as a channelized device. The use of fluorescent paint on light barricades will not be considered for use (TC-64A sign is required on each light barricade).



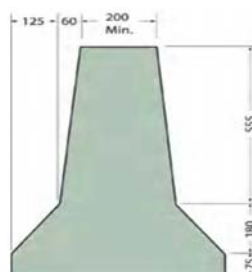
F-Shaped Barrier (New Jersey style Barrier)

For long duration work, the function of preventing errant vehicles from entering the work area may be accomplished through the use of New Jersey style barriers. When the 'New Jersey style' name is used, it refers to a barrier conforming to F-shape Barrier standards, as tested by FHWA.

F-shape Barriers (New Jersey style Barriers) have four uses:

- Provide scaffolding protection.
- Provide worker protection by preventing errant vehicles from entering a work area.
- Separate two-way traffic, particularly when a section of a multi-lane highway is operated as two way.
- Provide protection from an exposed object or excavation.

F-shape Barrier sections must be securely fastened together, in accordance with design provisions, so that the barriers acts as a unit under impact. Any break in the barrier should be avoided. Errant vehicles must be protected from the exposed ends of an F-shape Barrier by the use of impact Attenuators or by flaring the Barrier away from approaching traffic. Approved reflective devices must be attached to the barrier ends so that they are identifiable during day and night conditions.



All dimensions are in mm

705.07 MISCELLANEOUS WARNING DEVICES

Under certain conditions, as outlined in the following sections, a number of other warning devices, including the following, may be used to augment the standard devices outlined in the preceding sections.

1. TRUCKS WITH FLASHERS

Trucks with flashers may be used as a replacement for normal signing, in some cases, where the work site is of a very temporary nature and its location changes on a continuing basis. In such instances, the truck must be equipped with a rotating amber flasher mounted on its roof, or approved equal, and standard four way flashers. This vehicle must display a bumper, a minimum of 250mm wide, with alternate orange and black stripes at a 45° angle and must be equipped with the appropriate sign to properly guide vehicles approaching from the rear. The bumper and the sign must be reflectorized to indicate the same shape and colour by night as by day.

2 MISCELLANEOUS

Other miscellaneous traffic control devices, such as flares, flashlights, floodlights, lanterns, etc. may be used, as required, to supplement the signs and other devices described in this section. In all cases, the approval of the Engineer is required.

705.08 PORTABLE LANE CONTROL SIGNALS

With the authorization of the City, portable lane control signals may be used to alternate traffic past a work area, in lieu of flagpersons. The Traffic Engineering Division must be advised in each case of the intent to use this device, at least four weeks before application.

Portable lane control signals must meet the standards set by the Traffic Engineering Division and must be designed based on standards contained in, Part “B”, “Traffic Control Signals”, of the Manual of Uniform Traffic Control Devices for Canada. Portable signals must be installed so that the signal heads remain in position and properly aligned under all conditions of use. Portable signals must be used only under conditions where the lights are clearly visible to an approaching motorist such that the vehicle can be brought to a safe stop at any approach speed. Intensity of the signal lamps must be maintained in such a manner that the lights are clearly visible for a distance of at least 500 metres. The user will be required to adjust the timing to the approval of the Traffic Engineer.

Proper action must be taken to ensure that the signals are inspected regularly to verify correct operation and a plan in place to ensure safe movement of traffic should a failure occur. The plan must include keeping equipped and mobile Traffic Control Persons available, in the area of the installation, should a failure occur.

It is essential that these devices be removed immediately when conditions no longer require their use.

705.09 PORTABLE VARIABLE MESSAGE SIGNS

Portable Variable Message Signs are traffic control devices capable of displaying a variety of messages. The messages can be changed manually, by remote control, or by automatic control. Variable Message Signs help to warn motorists of construction activities or operations that are outside their normal expectations, such as lane closures associated with special operations. Messages displayed using Variable Message Signs must provide motorists with a legible, concise message directly relevant to the roadway condition they are approaching. The Variable Message Sign must have adjustable lighting levels such that under low light conditions the message will be legible while not impairing the driver’s vision.

ITEM 814**GROUNDING - SECONDARY****814.01 SCOPE OF WORK**

The work covered by this specification shall cover all grounding - secondary necessary to furnish operating traffic control stations, traffic control equipment and street lighting.

814.02 PRODUCTS**Materials**

Grounding equipment: to CSA C22.2 No.41

Copper grounding conductors: to ASA G7.1

Equipment

Clamps for grounding of conductor shall be suitable for direct bury; size for conductor and secured to ground.

Rod electrodes, galvanized steel 19mm diameter by 3 metres long.

System and circuit, equipment, grounding conductors, bare stranded copper, untinned, soft annealed, unarmoured, size as indicated.

Insulated grounding conductors: type TW

Manufacturers

Acceptable manufacturers: Burndy Corp. Erico Inc., Cadweld Division or approved equal.

814.03 EXECUTION**Installation General**

Install complete permanent, continuous, system and circuit, equipment, grounding system including electrodes, conductors, connectors, accessories as indicated to conform to requirements of Engineer and local authority having jurisdiction over installation. Where EMT is used, run grounding wire in conduit.

Electrodes

Install rod, electrodes and making grounding connections as indicated.

Bond separate, multiple electrodes together.

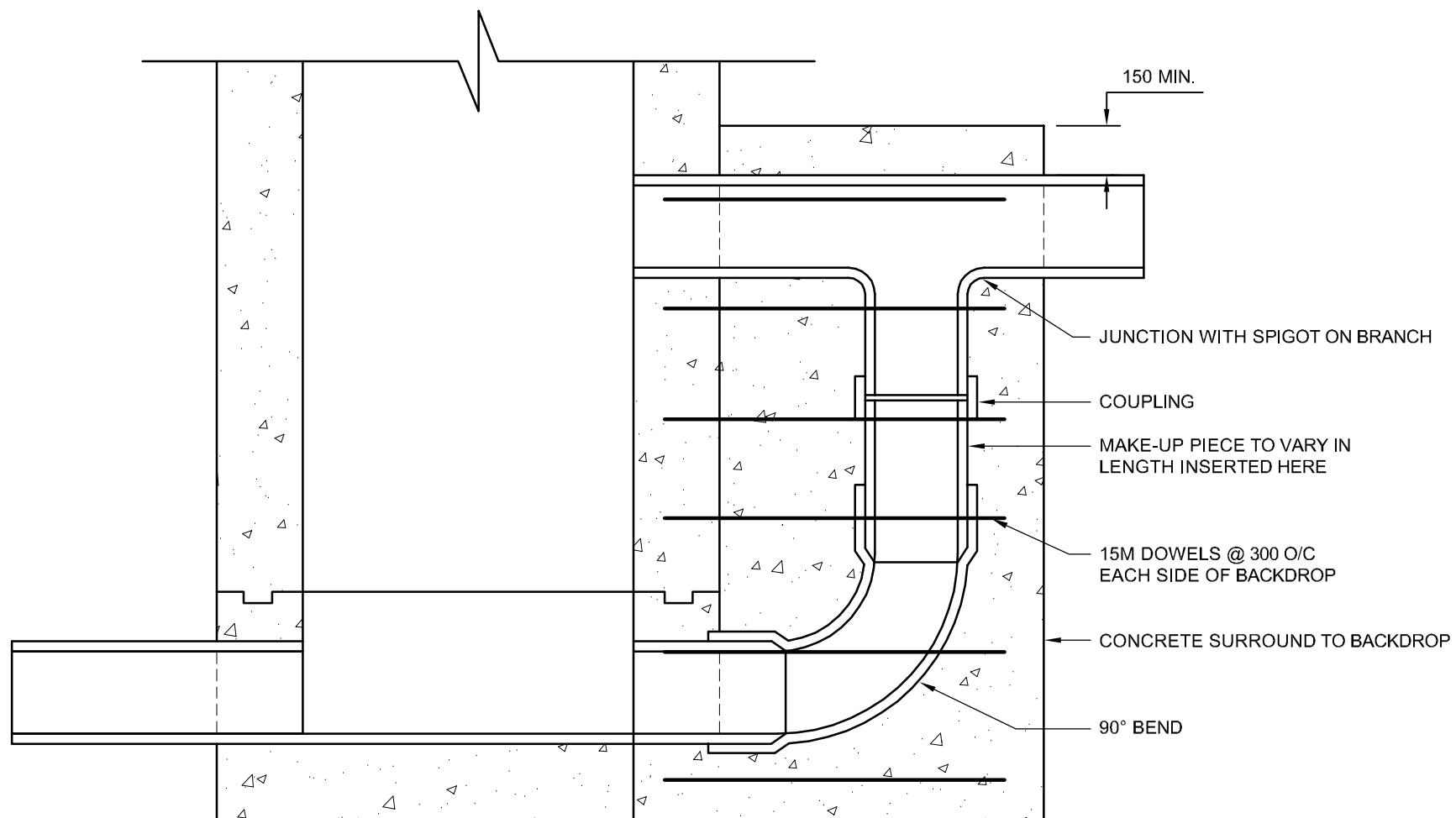
Use size 3/0 AWG copper conductors for connections to electrodes.

System and Circuit Grounding

Install system and circuit grounding connections to neutral of primary and secondary systems as indicated.

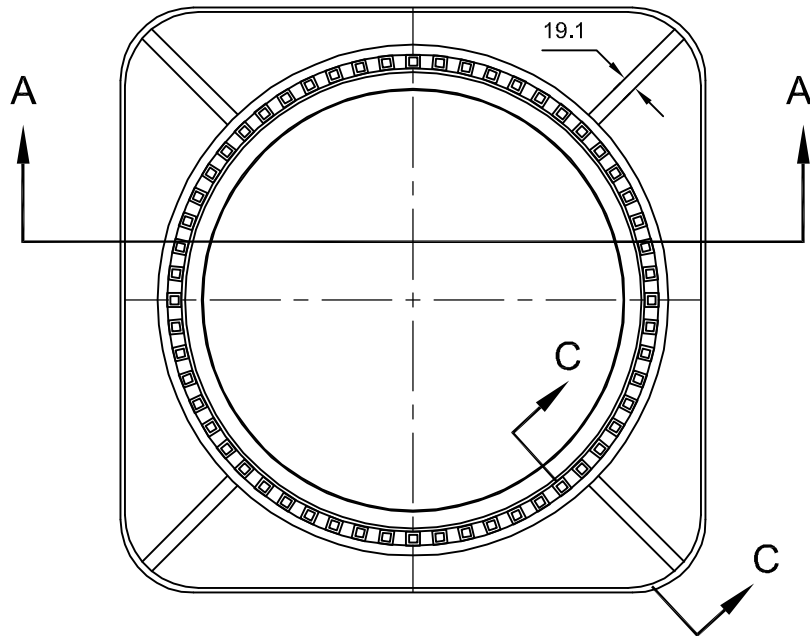
814.04 PAYMENT

All labour, equipment and material costs associated with Grounding - Secondary shall be appropriately spread over the items bid in the unit price table for related work specified under this division. No specific pay item for Grounding - Secondary will be provided.

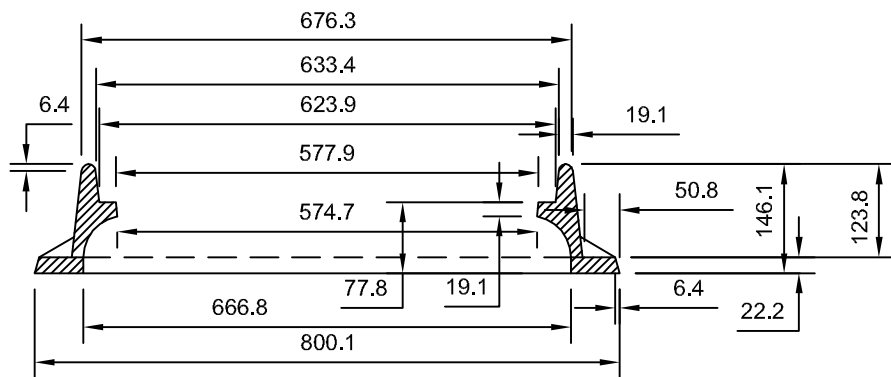


BACKDROP GREATER THAN 1000

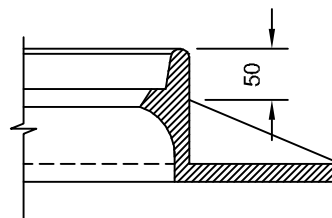
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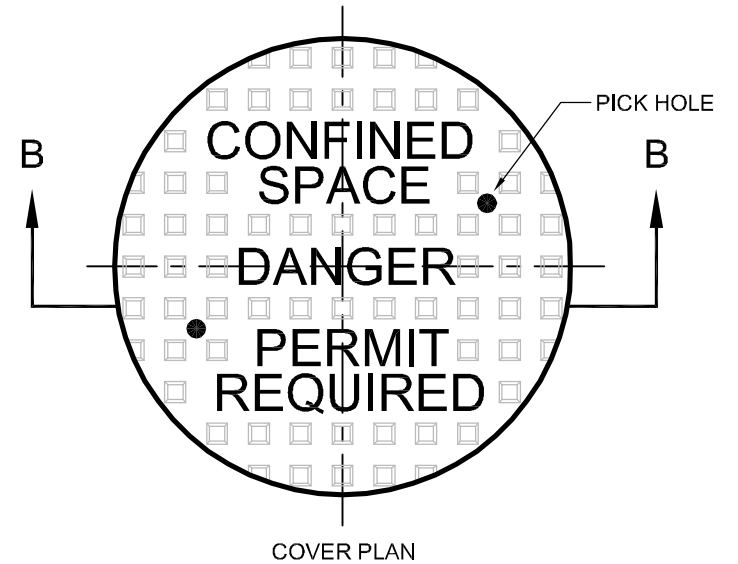
FRAME PLAN



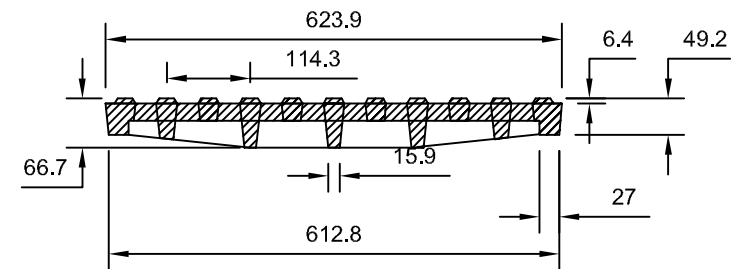
SECTION A - A



SECTION C - C



COVER PLAN

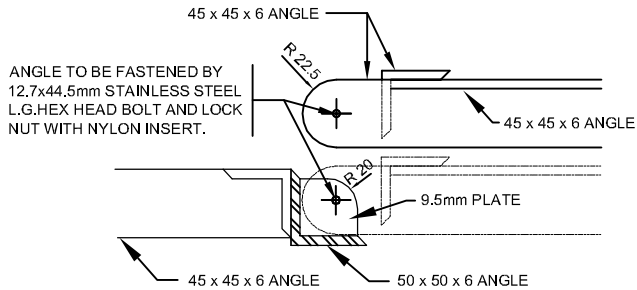
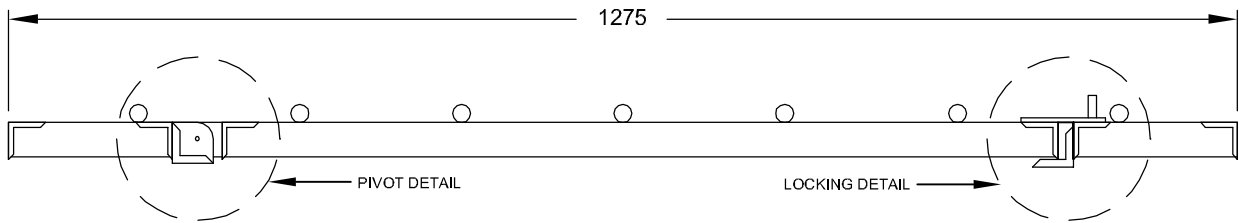


SECTION B - B

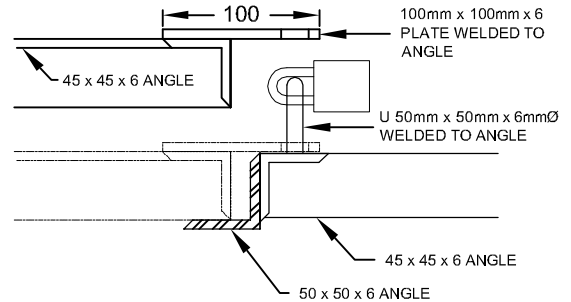
NOTES:

ALLOWABLE TOLERANCES DIMENSIONS 300mm OR LESS 3mm± DIMENSIONS 300mm UP TO AND INCLUDING 900mm 6mm±.
SEAT BETWEEN FRAME & COVER TO BE MACHINE LATHED - BOTH SIDES
IN ASPHALT STREETS, PARKING LOTS, ETC.
FRAMES SHALL BE MUELLER ADJUSTABLE OR APPROVED EQUAL.

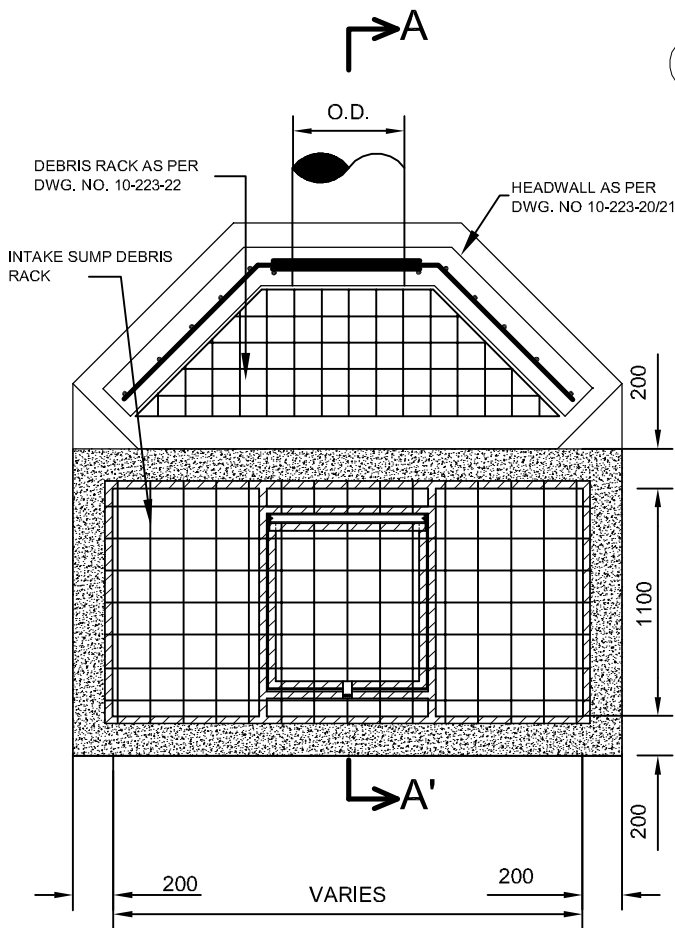
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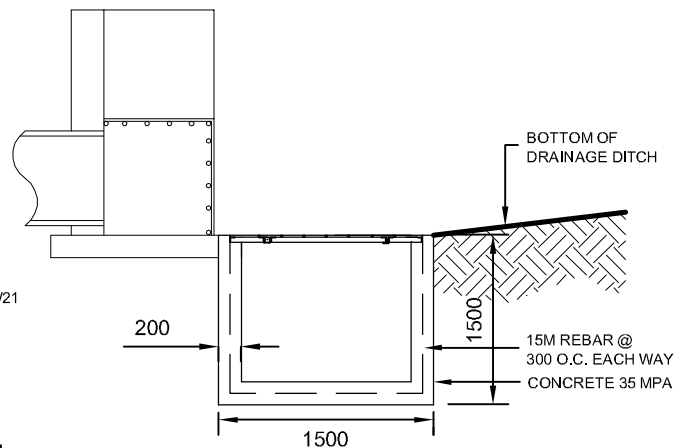
PIVOT DETAILS



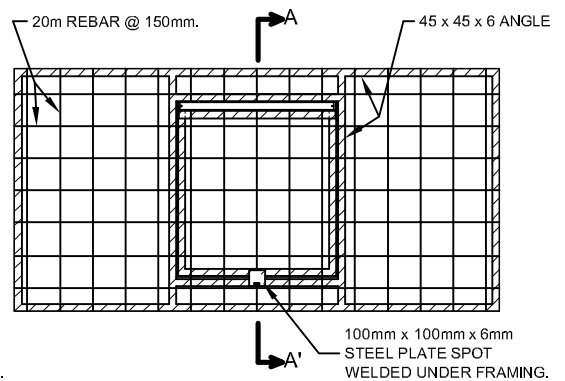
LOCKING DETAILS



PLAN VIEW



SECTION A - A'

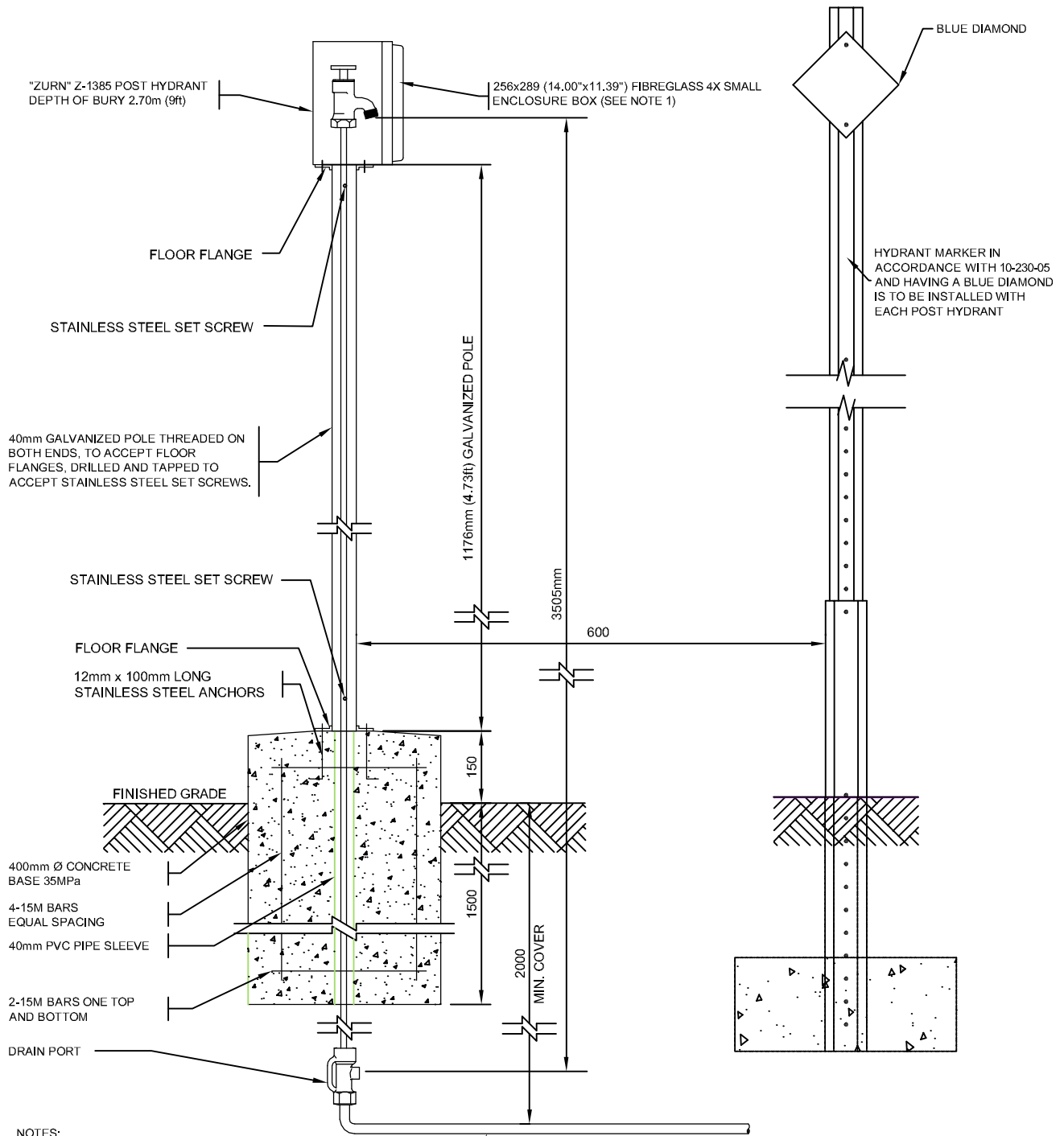


PLAN VIEW

NOTES:

1. ALL JUNCTIONS TO BE SPOT WELDED.
2. USE 100mm x 100mm STEEL HINGES (6mm THICK) SPOT WELDED TO ANGLE.
3. ALL EXPOSED METAL TO BE HOT DIPPED GALVANIZED.
4. RACK TO BE ATTACHED USING 16mm ANCHORS & BOLTS AT 300mm SPACING.

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NOTES:

1. FIBREGLASS BOX BY HOFFMAN TYPE 4X SMALL ENCLOSURE SOLID COVER WITH QUICK RELEASE LATCHES & PAD LOCK (BEST LOCK) - ACTUAL SIZE 256x289 (14.00"x11.39").
2. "ZURN" Z-1385 POST HYDRANT DEPTH OF BURY 2.70m (9ft).
3. TAP WATERMAIN WITH 20mm CORPORATION COCK AND PROVIDE 20mm COPPER TYPE "K".

ST. JOHN'S
DEPARTMENT OF ENGINEERING

**POST HYDRANT/
WATER SAMPLING STATION**

DRAWN BY: R.W.

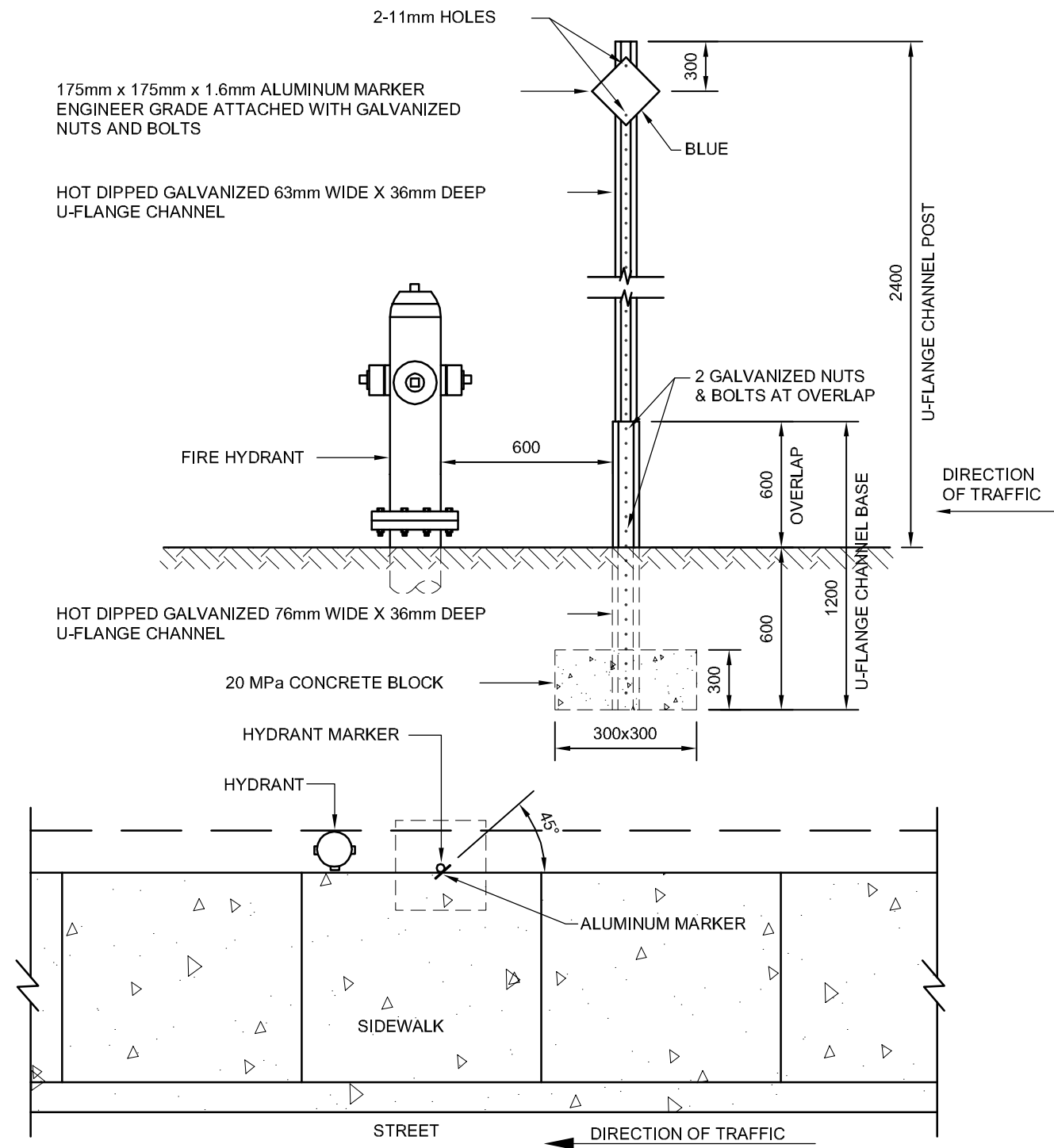
DATE: MARCH 2011

SCALE:

N.T.S.

DRAWING No. 10-230-10

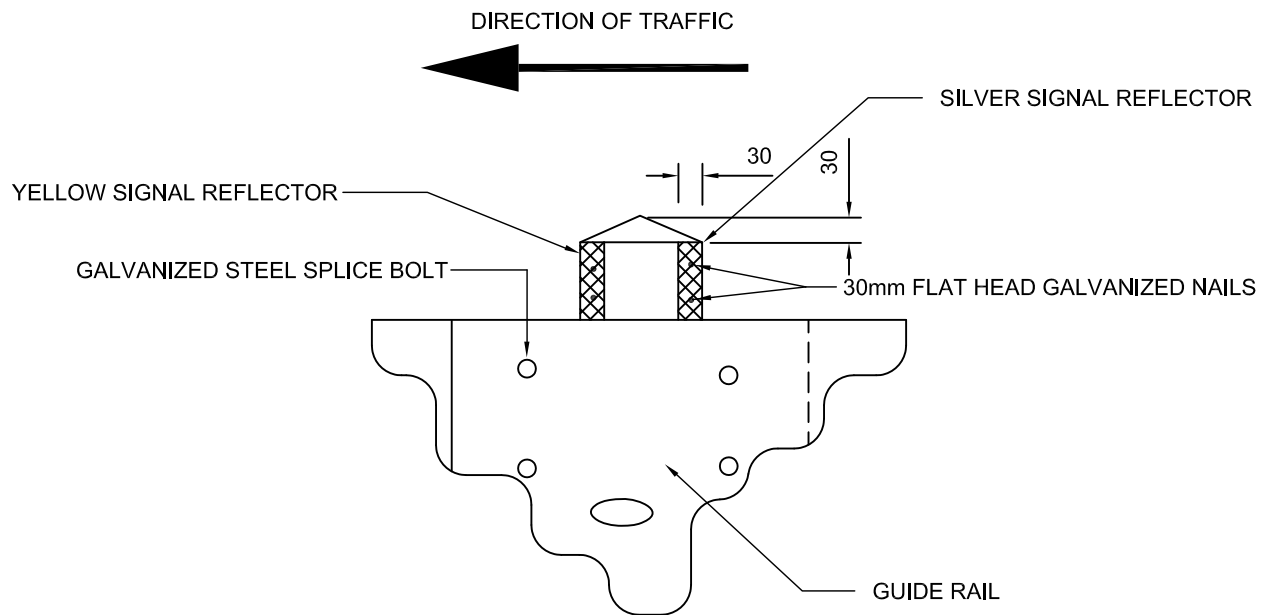
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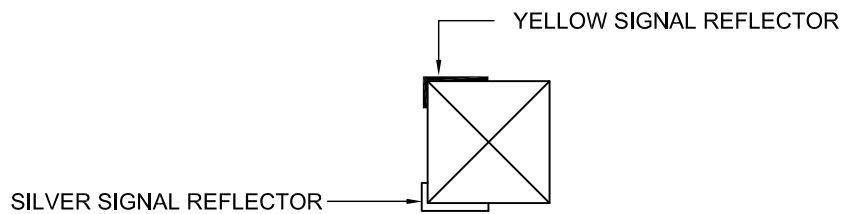
NOTES:

1. HYDRANTS THAT ARE TO BE TURNED OVER TO THE CITY FOR MAINTENANCE TO BE PAINTED SAFETY YELLOW (COLOUR YOUR WORLD #8413-METALCLAD SERIES ALKYD GLOSS) OR EQUIVALENT. ALL OTHER HYDRANTS SHOULD BE PAINTED SAFETY RED.
2. U-FLANGE CHANNEL - FINISH TO BE HOT DIPPED GALVANIZED TO CSA-G164 SPECIFICATIONS AND APPLIED AFTER PUNCHING TO PREVENT RUSTING OF THE EXPOSED METAL AROUND THE HOLES.
3. POSTS AND BASES TO HAVE 11mm DIAMETER HOLES ON 50mm CENTERS.
4. APPROXIMATE WEIGHT FOR:
POSTS=3.0kg/m
BASES=3.7kg/m

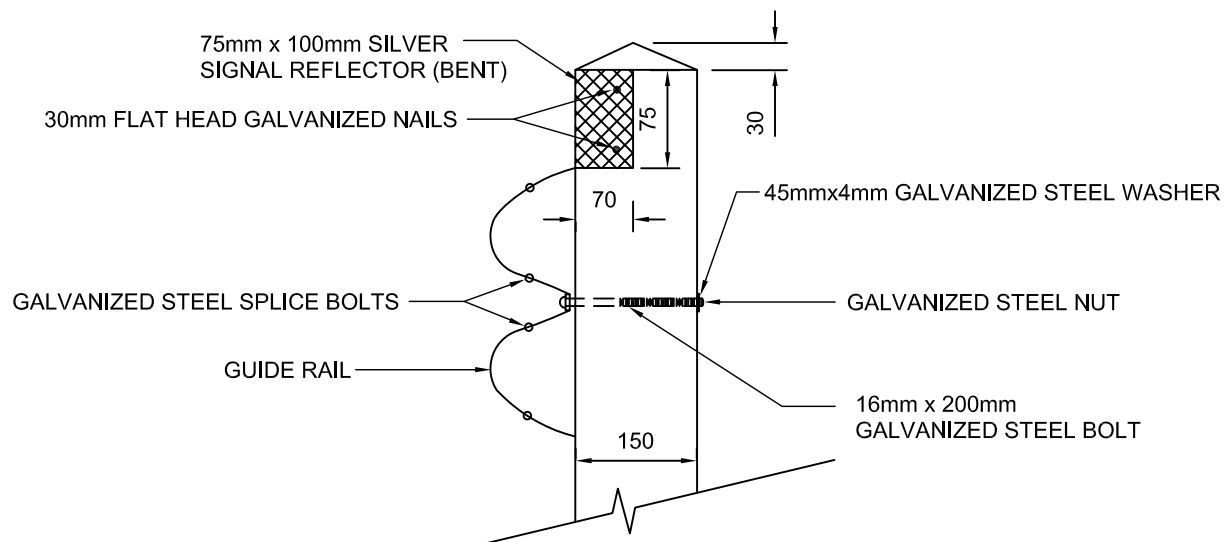
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FRONT VIEW



TOP VIEW



RIGHT SIDE VIEW

NOTE:

1. YELLOW SIGNAL REFLECTORS ARE OMITTED ON DIVIDED HIGHWAY.