### 2010 STANDARD SPECIFICATIONS for ROADS CONSTRUCTION

#### Updates from 2009 to 2010

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(The 2010 Standard Specifications for Road Construction can be downloaded for free from the ‘Contractors and Consultants’ section of The City of Calgary Roads website at [www.calgary.ca/roads](http://www.calgary.ca/roads))
UTILITY AND PIPELINE LOCATION NUMBERS

Prior to commencement of any work the Contractor shall contact the appropriate agencies listed below to locate existing underground utilities and pipelines in or adjacent to the construction work site. The utility or pipeline agencies shall be contacted two working days prior to commencement of work.

FIELD LOCATION SERVICE CALLS:

ATCO GAS ..........................................................
Enmax ..............................................................
TELUS ............................................................
WATERWORKS .............................................
WASTEWATER ............................................... ALBERTA 1st CALL
PETROGAS PROCESSING LIMITED ..............
HOME OIL COMPANY LTD ............................
PETRO-CANADA (ALBERTA PRODUCTS PIPELINE)......

SHAW CABLE ........................................................................ 1 866 344 7429 ( 1 866 DIG-SHAW)
PETRO-CANADA (VALLEY PIPELINE)......................... 933-4711

EXCAVATION PERMITS:

Excavation Permits shall be obtained from The City of Calgary, Transportation, ROADS, The Excavation Permit Office located at 2808 Spiller Rd SE, South Tower, Main Floor, prior to any excavation in public right of ways.

EMERGENCY SERVICE:

If you accidentally damage the coating, scrape, sever or rupture any underground line please call the appropriate emergency number immediately.

Watch for above ground structures such as utility pedestals, power lines and hydrants that are located in roadways, lanes and private property. If they are damaged please report the incident immediately.

EMERGENCY CALLS - 24 HRS SERVICE:

ATCO GAS .......................................................... 245-7222
Enmax .............................................................. 514-6100
WASTEWATER, WATERWORKS, ROADS (After Hours) 268-4066
WASTEWATER ................................................ 268-4910
WATERWORKS ................................................ 268-4355
ROADS .............................................................. 268-4066
TELUS ................................................................. DIAL 611
SHAW CABLE .................................................... 538 5206
PETRO-CANADA (ALTA. PRODUCTS PIPELINE EDMONTON).... 1-800-661-5642
(VALLEY PIPELINE STETTLER)..........................1-800-661-5642
HOME OIL CO. LTD. ............................................. 232-5000
PETROGAS PROCESSING ........................................ 226-0023
# Detailed Specifications

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300.00.00 GENERAL

There follows a list of required specifications and/or qualifications relevant to work carried out under these Specifications.

300.00.01 Application of Specifications

Notwithstanding any other specification, any deviation from these Specifications shall constitute non-compliance and may result in the rejection of the work.

300.00.02 Basis for Payments

Payment for work carried out under these Specifications shall be under either:

a) Lump Sum - no specific unit of payment for work in this category.

b) Unit Rate - work paid for by unit, such as tonne, cubic meter (m$^3$), square meter (m$^2$), etc.

Payment made under either mode of payment shall be considered full compensation for all labour, materials and equipment necessary to complete the work.

c) Force Account - When directed by the Engineer, additional work not covered by either Lump Sum or Unit Rate shall be paid for under the Schedule of Force Account Rates.

300.01.00 EXCAVATION PERMITS

Permits are required for all types of street construction. The Contractor acquires from the Excavation Permit Clerk, ROADS, one (1) excavation permit for each job undertaken under this Contract. All three pages of the permit shall be returned to the ROADS Excavation Permit Clerk upon completion of work covered by the permit. This permit shall be taken out at least forty eight (48) hours in advance of construction commencement. In the downtown area, an excavation permit shall be required for each individual block. The downtown area is defined as the area bounded by and including 14 Street S.W. on the West, 17 Avenue S.W. on the South, 6 Street S.E. on the East and the Bow River on the North.

If the work has not commenced within fourteen days, after the issuance of the Permit, please contact the Excavation Permit Office at 268 4936 for an extension.

The Excavation Permit Office is located at 2808 Spiller Rd SE, South Tower, Main Floor.
300.02.00 QUALIFICATIONS OF PRECAST CONCRETE MANUFACTURES

All precast concrete elements referred to in these specifications shall be fabricated in a manufacturing plant certified by the Canadian Standards Association in the appropriate category(ies) according to CSA Standard A251-M1982. The precast concrete manufacturer shall be certified prior to submitting the tender. Only precast concrete elements fabricated in such certified plants shall be acceptable to The City. Plant certification shall be maintained for the duration of the fabrication of the elements for the project.

300.03.00 WOOD PRODUCTS

Unless otherwise specified, all wood products referred to in these Specifications shall be pressure treated with either Copper Naphthenate or Penta Chlorophenol in accordance with CSA 080.1 and CSA PS-74 and shall be identified using certification marks authorized by the Canadian Wood Preservers Bureau (CWPB) and the National Lumber Grades Authority (NLGA).

NOTE: Workers should wear personal breathing filters when cutting wood treated with the above mentioned preservatives.

All panels, composed of laminated wood boards, shall be in accordance with CSA Standard CAN/CSA-0122-M. All glues shall be water resistant in accordance with CSA Standard 0112-M.

All nails and other fastening devices used with wood products shall be either hot dip galvanized steel, stainless steel or nonferrous.

300.04.00 COATINGS

All paints, stains and other coatings referred to in these Specifications shall be subject to certification by the supplier that the coating meets or exceeds the accelerated weathering test in accordance with the requirements of CGSB Standard 1-GP-71 Method 122.1 and ASTM Standard G23-81.

When prepared and tested as outlined, the coating shall, at the 2500 hour exposure evaluation, show no checking, blistering, loss of adhesion or other defects.

Chalking shall be seven or higher and the colour difference shall not exceed five units when measured in accordance to CGSB Standard 1-GP-71 Method 12.1.

Unless otherwise specified, stains shall be semi-transparent and shall meet or exceed the accelerated weathering requirements.

All coatings shall be free of lead.
300.05.00 REINFORCING STEEL

300.05.01 General

All reinforcing steel, referred to in these Specifications, when placed in the works shall be free from hardened mortar, dirt, rust, scale, paint, oil, or other foreign material that may destroy bond.

300.05.02 Cover

Concrete cover on reinforcing steel shall be a minimum of 50mm.

300.06.00 ALTERNATE CONSTRUCTION MATERIALS

Unless otherwise specified, all alternate construction materials including, but not limited to, recycled plastic, recycled concrete, recycled asphalt, etc., proposed as an alternate to materials specified in these specifications, shall be subject to the same or similar specifications as applicable to the already specified material. The use of any alternate material shall be at the sole discretion of the Engineer.

The Engineer may, at his sole discretion, request additional tests to ensure that the alternate material is suitable for the application intended.

Note: Recycled concrete shall not be used as a surface course or as pipe zone backfill.

Recycled asphalt shall not be used as an alternate for gravel under hot mix asphalt.

300.07.00 TESTING

300.07.01 General

Where reference is made to an ASTM designation or a CSA. Standard, the current standard applies.
DETAILED SPECIFICATIONS

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301.00.00 SITE PREPARATION

301.01.00 CLEARING

All work under this item shall be done in accordance with these Specifications and in conformity with the plans.

In developed and semi-developed areas where driveable streets exist and where the project calls for grading and/or paving, the limits of clearing include the area covered by the improvement including private property if accordingly staked by the Engineer.

Buildings, fences, lumber piles, trash, and obstructions, except utility poles, within the area to be cleared shall be removed and properly disposed of by the Contractor.

Trees, shrubbery, and flower beds designated by the Engineer are left in place and care shall be taken by the Contractor not to damage or injure such trees, shrubbery or flower beds by any of his operations. Where required by the Engineer, the Contractor shall construct temporary fencing to keep equipment away from tree roots.

The Contractor shall construct all temporary fences, gates, telephone lines, or other structures necessary to provide temporary service during the progress of the work. All buildings, fences, trees, curbs or other properties, which are not to be removed from the right-of-way, shall be protected during the progress of the work. The Contractor shall not cut or remove shrubs or trees without the prior approval of the Engineer. The Contractor shall water and fertilize existing trees and shrubs where these are affected by the Contractor's work.

The Contractor shall be responsible for all damages to existing improvements resulting from his operations.

301.02.00 GRUBBING

301.02.01 Protection of Existing Improvements

Where it is necessary to remove stumps, and where there are surface or subsurface improvements, the Contractor shall be responsible for determining which agencies, public or private, have underground or service utilities in the vicinity of the stump to be removed. Further, he shall notify each agency and request its assistance in locating its services.

Where sewer, water, electric, telephone, steam, gas and similar underground services into residences are imperiled by stump removal, the utility agency affected cuts the service and replaces same at no cost to the Contractor. Where telephone cable and/or ducts, watermains, gas mains, steam mains, and sewer trunks exist and are likely to be damaged, special care shall be taken and roots of stump are cut off in such a manner that the existing utility installations are not damaged in any way.
301.02.02 Contractor’s Responsibility

Regardless of the co-operation of affected agencies and utilities, the Contractor shall be responsible for any damage to service and utilities that are attributable to his operations, and he shall be responsible for the necessary repairs.

Any damage resulting from the Contractor’s operations to existing improvements within the area to be grubbed, but which are not required to be removed by the grubbing shall be repaired by the Contractor at his expense. He shall not be held responsible for damage to such improvements if the damage occurred previous to beginning of the Contract.

If the Contractor removes stumps for private property owners along the project, he shall be responsible for all damage resulting therefrom.

301.03.00 CONSTRUCTION DETAILS

All stumps, roots, foundations and planking embedded in the ground within the limits described herein or otherwise described in the special provisions, are removed and disposed of. Piling and butts of utility poles shall be removed to a minimum depth of 600mm below subgrade or 600mm below original ground, whichever is lower. Disposal requirements for grubbing are the same as those described for "Clearing".

Removal of sod and lawns that are not to be replaced shall be considered as incidental to other work of the project and no payment shall be made. Grubbing shall otherwise meet requirements previously outlined under "Clearing".

301.04.00 ORNAMENTAL AND DANGER TREES

301.04.01 Ornamental Trees

It shall be the responsibility of the Contractor to preserve any trees in accordance with provisions in G.C.4.35.6 in the Standard General Conditions; and as per the Tree Protection Bylaw.

301.04.02 Danger Trees

(Section Deleted)

301.05.00 STRIPPING

The Contractor shall be required to strip, stockpile and respread the material as directed by the Engineer.

The Contractor shall ensure that subsoils do not get mixed in with the topsoil. The Contractor shall notify Parks prior to commencing the stock piling operation.
DETAILED SPECIFICATIONS

302.00.00  EARTHWORK

302.01.00  Definitions
302.02.00  Grading General
303.03.00  Dust Control
302.04.00  Excavation
302.05.00  Embankment Construction
302.06.00  Subgrade Preparation
302.07.00  Quantity Measurement
302.00.00  EARTHWORK

302.01.00  DEFINITIONS

All materials excavated in accordance with these Specifications are classified as follows:

302.01.01  Common Excavation

This means the excavating, hauling, placing and compacting in embankments of materials which are not classified as “topsoil” and/or "rock excavation" within the limits of the Contract.

302.01.02  Waste Excavation

This means the excavating, hauling, disposing and leveling, within the limits of the Contract and at designated disposal areas, of materials which are surplus or unsuitable, but not of materials classified as “topsoil” and/or "rock excavation".

302.01.03  Rock Excavation

1) General

Rock excavation shall be paid for when the material encountered consists of mass or bed rock or a boulder of volume greater than 0.73 cubic meter. Such rock excavation is divided into two categories; (A) and (B), contingent upon its hardness and difficulty experienced in excavation. It shall be the Contractor's responsibility to demonstrate, to the Engineer's satisfaction that the material cannot be removed or that difficulty is being experienced through excavation by conventional means. In doing so, the Contractor may be required by the Engineer to seek and explore planes of weakness or layers that may ease the excavation process.

2) Type 'A' Rock

Type ‘A’ Rock refers to materials, such as fractured sandstone, shale or ledge rock, which can be removed by the minimum size of backhoe specified in the matrix on the following page for the depth of trench excavation and size of pipe being installed. For open excavation, it refers to materials which, in the opinion of the Engineer, result in:

- Substantial delay or decrease in the normal rate of excavation using conventional equipment.
- Significant damage or wear to the excavating equipment.

3) Type ‘B’ Rock

Type ‘B’ Rock requires drilling, blasting, wedging or jackhammering to remove, as determined by the Engineer.
## ROCK EXCAVATION

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<th>PIPE Diameter OR EQUIVALENT DUCT</th>
<th>0-300 mm</th>
<th>301-400 mm</th>
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<tr>
<td>350mm to 500mm</td>
<td>1½</td>
</tr>
<tr>
<td>550mm to 750mm</td>
<td>2</td>
</tr>
<tr>
<td>800mm to 1050mm</td>
<td>2½</td>
</tr>
<tr>
<td>1050mm to 1400mm</td>
<td>2½</td>
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<tr>
<td>1450mm to 1700mm</td>
<td>2½</td>
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<tr>
<td>1750mm to 2000mm</td>
<td>2½</td>
</tr>
<tr>
<td>2050mm to 2300mm</td>
<td>2½</td>
</tr>
<tr>
<td>Over 2300mm</td>
<td>2½</td>
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302.01.04 Stripping

Stripping is defined as the excavation, hauling and stockpiling (or immediate respreading) within the Contract limits of all organic material considered as topsoil or loam.

302.01.05 Respreading

Respreading is defined as the hauling and spreading of topsoil which has previously been stripped and stockpiled.

302.01.06 Benching

Where embankments are required on hillsides, or where a new fill must be applied on an existing embankment, the slopes of the original ground or embankment (except rock embankment) shall be terraced or stepped by approved means before filling shall commence.

302.02.00 GRADING GENERAL

The Contractor does all excavation of whatever substance is encountered to the depth and grades established by the Engineer. After excavation has been completed, the subgrade shall conform to design section and grade.

302.02.01 Ownership of Material

Under no circumstances shall any excavated material be sold or otherwise disposed of by the Contractor, Sub-Contractor, or any of their employees. The excavated materials remain the property of The City.

Suitable excavated material shall be used for the making of all required project embankments. The suitable portion of the excavated material shall be stored on or off the project, as the Contractor may elect, and used for backfilling of curbs, and dressing up the planting areas, the cost of which shall be considered as incidental to the excavation.

The Contractor does not dispose of any excavated material until he is certain there is sufficient material to complete all necessary project embankments and plantings. If an undue amount is wasted, the Contractor secures and furnishes the necessary material at his own expense.

302.02.02 Grading Tolerance

The excavation and fill shall be completed and trimmed to proper lines and grades with tolerance as follows:

Rock: 100mm vertically and 300mm horizontally to line or beyond.

Other Materials: 30mm vertically and 150mm horizontally to line or beyond.
Should the Contractor, through negligence or other fault, exceed these tolerances, he shall, at his own expense bring the grades and lines of all finished surfaces within the specified tolerances.

When excavation changes from one classification to another, the Contractor shall provide ample opportunity for the Engineer to take necessary cross-sections and measurements before proceeding.

For landscaped areas the maximum allowable slope shall be 3H:1V. The minimum allowable slopes shall be one percent, except for swales where the minimum allowable shall be two percent. Upon completion of rough grading, and prior to the inspection of the rough grading, grade stakes shall be provided on a 15m grid according to the approved grading plan. These grade stakes shall not be required for tot lots, roadways of a major classification or greater.

302.02.03 Haul Routes

Common and waste excavation haul routes are within the construction limits unless otherwise authorized by the Engineer.

Haul routes shall be maintained to permit free passage of construction traffic.

On completion of the Contract, haul routes are restored to their original condition, at the Contractor's expense.

302.03.00 DUST CONTROL

302.03.01 General

Dust around the work site and along haul routes, shall be controlled by the Contractor at all times.

Unless otherwise specified, payment for dust control shall be considered incidental to the contract.
302.04.00 EXCAVATION

302.04.01 General

Approaches to the project shall be excavated to the limits indicated on the plans. This excavation shall be made in conjunction with the street excavation and in such a manner as to provide for easy and safe access for local and emergency traffic at all times. Where existing streets are to be excavated and are presently surfaced with asphalt concrete or bituminous mats on earth or granular base, these surfaces are considered as part of the excavation unless otherwise specified in the special provisions. Where existing street pavements extend behind the new curb line, the Contractor shall also be required to neatly remove the pavement as part of the excavation.

302.04.02 Excavation Below Grade

Where the Engineer deems subgrade material unsatisfactory, excavation below grade shall be required to such depths as he may direct. Excavation below grade shall be of the same classification as that above it provided it is removed in the same operation as the normal excavation. The sides of extra depth excavation are sloped at a maximum slope of three units horizontal to one unit vertical.

The Engineer reserves the right to steepen the side-slopes of the sub-excavation in order to conserve material.

Material deposited and compacted in the subcut shall be considered as material deposited and compacted in an embankment.

Where the Contractor has completed the roadway excavation and is required to return to remove unsuitable material, or where the additional depth requires special equipment because of the presence of shallow utilities or other unforeseen conditions, the work shall be performed as directed and a payment for excavation below grade shall be made under the Schedule of Force Account Rates.

If the excavation below grade is required because of negligence on part of the Contractor, the necessary excavation below grade and the backfilling required to restore the surface satisfactorily shall be at the Contractor's expense.

302.04.03 Explosives and Blasting

When explosives are used the Contractor shall be responsible for their handling, storage and transportation in accordance with City By-laws, and with the provisions of the Explosives Act.
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(Canada) and the regulations made thereunder, and with the provisions of Alberta Regulation 272/76, the Explosives Safety Regulations and any amendments thereto or substitution therefore and with the applicable provisions respecting explosives and the transportation thereof found in the 1968 Calgary Fire Prevention Bylaw and any amendments thereto or substitutions therefore. In the event of any conflict or duplication of the provisions of Alberta Regulation 272/76 and the aforesaid bylaw, the Contractor shall comply with the more stringent provisions.

Notwithstanding the above, no blasting shall be carried out within 150 meters of any water storage reservoir, water storage tank or pumping station without the prior written approval of the Engineer. No blasting shall be carried out within three meters of any underground utility without the prior written approval of the Engineer.

At his sole discretion, the Engineer may require the Contractor to present him with a report by a competent consulting engineer containing sufficient information to show that any proposed blasting can be done judiciously and safely.

302.04.04 Slides

Side slopes in cuts and on embankments are constructed as staked or established by the Engineer. In the event that a slope that has been finished to the lines as staked or established by the Engineer slide back of the established slope onto the roadway prism, or out of an embankment, before final acceptance of the work, such slide material shall be removed by the Contractor from the roadway, or replaced in the embankment, at the Unit Rate for the class of excavation involved, and the slopes are to be refinished as directed by the Engineer. Materials to replace embankment slides shall be obtained from sources designated by the Engineer. Slopes undercut at the base or destroyed in any manner by an act of the Contractor are to be re-sloped parallel to the damaged slope, or as established by the Engineer, at the Contractor’s expense.

302.04.05 Ditches

All ditches shall be constructed as shown on the plans and are so graded as to the natural flow of the water to inlets, catch basins, culverts or channels. Ditches from cuts are located in such a manner as to bypass any part of the adjacent fill to prevent damage by running water.

302.04.06 Borrow

Borrow consists of the excavation and disposal of suitable and satisfactory material obtained from borrow pits designated and measured by the Engineer for the construction of embankments, subgrade, parking strips and sidewalk areas, or shoulders and other facilities. The widening of street cuts and ditches shall be considered as street excavation and not as borrow.

302.04.07 Disposal

All waste materials shall be properly disposed of at approved recycling sites, City of Calgary landfill sites or other approved Waste Management sites. At the direction of the Engineer suitable excess fill material may be stockpiled in designated areas for future use by The City.
302.04.08 **Excavation of Planting Beds**

Stake out the locations of all items requiring excavation and obtain the approval of Parks before commencing work.

Dispose of excavated material off site unless approved for use as fill material.

Excavate to the elevations and dimensions indicated or required for construction work.

Obtain the approval of Parks for all excavations.

Where bearing capacity of the subsoil appears to be insufficient, obtain the written approval of Parks to have soil investigations carried out.

Excavation, exceeding that shown on the drawings, if authorized in writing by the Engineer shall be paid Force Account Rates in accordance with the Standard General Conditions.

Do not disturb soil within the branch spread of trees that are to remain. If excavating through roots is required, inform Parks. The cutting of roots shall only be done by Parks or by an approved arborist.

302.04.09 **Excavation of Irrigation System Trenches**

Excavate trenches to lines and grades show to a minimum of 75mm below pipe invert where bedding is required. Provide recesses for bell and spigot pipe to ensure bearing will occur along barrel of pipe.

Cut trenches three times wider than maximum pipe diameter. Trim and shape trench bottoms and leave free of irregularities, lumps or projections.
302.05.00  EMBANKMENT CONSTRUCTION

302.05.01  General

Embankment construction shall be divided into two classes, rock embankments and earth embankments. Rock embankments are all, or any part of an embankment in which the material consists of 10 percent or more, by volume, of gravel or stone 100mm or greater in diameter. Embankments of all other material are considered as earth embankments.

The maximum density and optimum moisture content for each soil type shall be determined by ASTM D698.

302.05.02  Embankments on Soft, Wet or Swampy Ground

When embankments are constructed across wet or swampy ground which does not support the weight of heavy hauling and spreading equipment, the Contractor shall be required to choose such methods of embankment construction and to use such hauling and spreading equipment as will least disturb the soft foundation. When soft foundations are encountered, the lower part of the fill may be constructed by dumping and spreading successive vehicle loads in a uniformly distributed layer of thickness not greater than that necessary to support the vehicle while placing subsequent layers. The remainder of the embankment shall be constructed in layers and compacted as specified.

The Contractor will not be allowed to increase the planned depth of embankment material over soft, wet, or swampy ground for the sole purpose of providing support for heavy hauling and spreading equipment.

302.05.03  Materials

All materials used in embankments or for any other purpose are subject to the Engineer's approval. The use of frozen materials shall not be permitted for embankment construction. The materials composing the embankments shall be entirely imperishable. Wherever the natural surface upon which the embankment shall be placed is of such nature as, in the judgment of the Engineer, to impair the stability or usefulness of the street, the natural surface shall be stabilized or removed and disposed of as the Engineer may direct.

302.05.04  Compaction

Embankments are constructed in compacted layers of uniform thickness. The layers are carried up full width from the bottom of the embankment to avoid widening the edges after the centre is brought to grade.

Embankments are compacted with modern, efficient, compacting units capable of compacting each lift of the material to the specified density. The right shall be reserved for the Engineer to order the use of any particular compacting unit discontinued if it is not capable of compacting the material to the required density in a reasonable time.

Hauling equipment shall not be accepted in lieu of compaction equipment. Water added to the fill material for compaction purposes shall be free from deleterious materials.
302.05.05 **Maximum Lift Thickness and Minimum Compaction**

For materials classified as:

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum Lift Thickness</th>
<th>Moisture Content</th>
<th>Minimum Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>200mm</td>
<td>optimum to optimum +3%*density</td>
<td>97.0% of maximum</td>
</tr>
<tr>
<td>Granular</td>
<td>300mm</td>
<td>±3% of optimum</td>
<td>As specified in Chapter 305.</td>
</tr>
</tbody>
</table>

*Note: Subject to approval by the Engineer, the moisture content may be lowered if warranted by soil conditions to achieve stability requirements for proof rolling.

At all locations that are inaccessible to a roller, the embankment shall be brought up in horizontal layers and compacted thoroughly with mechanical tampers. The horizontal layers shall not exceed 200mm in loose thickness, except that the layers of the top 600mm shall not exceed 100mm in loose thickness.

302.05.06 **Embankment at Structures, Trestles and Bridge Ends**

The work of filling around structures and the ends of trestles and bridges and the constructing of embankments shall be undertaken and completed as soon as possible after each structure is completed, or when ordered by the Engineer.

In filling around the structure, trestle and bridge ends, the Contractor shall bring the fill up equally on all sides of the bracing and the columns of the ledge to prevent distortion of the bents and columns. This method shall be used as well in bringing up the fill on both sides of the bulkheads as shown on the plans, or as directed by the Engineer. The embankments are to be constructed under the bridge to the height and dimensions shown on the plans or as directed by the Engineer.

The embankment and backfill at both ends of all rigid frame concrete structures, which do not have provisions for expansion, are to be brought up and compacted simultaneously to prevent lateral displacement of the structure due to unbalanced earth loading.

All embankment and backfill within 30m of an existing or proposed structure, trestle or bridge end shall be compacted to a minimum of 100 percent of the maximum density as determined by ASTM Designation D 698 (Moisture Density Relationships of Soils).
302.06.00 SUBGRADE PREPARATION

302.06.01 General

The elevation of any given point shall not vary by more than 15mm from the design grades. The difference between the actual elevations and the design elevations shall not vary by more than 15mm in 20 meters.

In any area where fill is required, the fill shall be compacted to a minimum of 97.0 percent of its maximum density as determined by ASTM Designation D 698 (Moisture Density Relationships of Soils), and then fine graded.

In cut areas, prior to placing any gravel, the subgrade shall be scarified to the depth of 150mm and compacted to a minimum of 97.0 percent of its maximum density as determined by ASTM Designation D 698 (Moisture Density Relationships of Soils).

302.06.02 Proof Rolling

When required by the Engineer, the Contractor shall supply and operate a loaded test vehicle of 8200 kg axle load to test the subgrade for rutting, weaving and soft spots. Where proof rolling indicates areas that are defective, the Contractor shall remove and replace the material with suitable compacted material. Proof rolling shall be considered incidental to the grading work.

302.07.00 QUANTITY MEASUREMENT

302.07.01 Excavation

Quantity of common excavation, waste excavation and rock excavation shall be based on the calculated excavated volume as measured in place in the cut.

Where a disposal area for waste excavation is designated as being outside the common excavation fill area, The City reserves the right to dispose of surplus materials in the common excavation fill area without compaction and to make payment for this work at the Unit Rate for Common or Waste Excavation, whichever is less.

Volume of boulders shall be calculated by multiplying the greatest dimension of the boulder in each of three (3) directions at right angles. Measurement for mass or bedrock excavation shall be taken from the top of the rock strata to the depth below the pipe specified for "Bedding in Rock Excavation". The maximum width payable for rock excavation shall be the maximum allowable trench width as described under "Width of Trench".

302.07.02 Benching

Benching for embankments shall be measured and included as common excavation.
302.07.03 Embankments at Structures, Trestles and Bridge Ends

Embankments in connection with this work are considered as incidental to the construction of the improvement and are deemed to be incidental to the Unit Rate of the various units of work involved.

302.07.04 Overhaul

Where the disposal location is changed by The City, an overhaul adjustment shall be made for additional haul beyond the distance that would have been traveled to the specified disposal location using the overhaul Unit Rate.

302.07.05 Concrete or Asphalt Breakout

All edges of existing concrete and/or asphalt immediately adjacent to the breakout area shall be saw cut to a minimum depth of one third of the concrete and/or asphalt thickness in order to provide a smooth and even edge. All saw cutting shall be approved by the Engineer prior to proceeding.
DETAILED SPECIFICATIONS

303.00.00 GRANULAR MATERIAL

303.01.00 Pit Run Fill Gravel (Base Gravel)
303.02.00 Base Course Gravel (Crushed Gravel)
303.03.00 Drainage Gravel
303.00.00 GRANULAR MATERIAL

303.01.00 PIT RUN FILL GRAVEL (SUB - BASE GRAVEL)

303.01.01 Gradation

**TABLE I**

<table>
<thead>
<tr>
<th>METRIC SIEVE SIZES (Square Openings)</th>
<th>PERCENT PASSING BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>200mm</td>
<td>100 )</td>
</tr>
<tr>
<td>150mm</td>
<td>96 – 100 )</td>
</tr>
<tr>
<td>80mm</td>
<td>60 - 80 )</td>
</tr>
<tr>
<td></td>
<td>Total Sample</td>
</tr>
<tr>
<td>25mm</td>
<td>70 – 100 )</td>
</tr>
<tr>
<td>5.0mm</td>
<td>25 - 63 )</td>
</tr>
<tr>
<td>1.25mm</td>
<td>14 - 41 )</td>
</tr>
<tr>
<td>630μm</td>
<td>7 - 30 )</td>
</tr>
<tr>
<td>160μm</td>
<td>3 - 18 )</td>
</tr>
<tr>
<td>80μm</td>
<td>2 – 9 )</td>
</tr>
<tr>
<td></td>
<td>Material Passing 80mm Sieve</td>
</tr>
</tbody>
</table>

303.01.02 Properties

- No oversize material shall be tolerated.

  All grading curves submitted shall show:

  (A) Grading for the total sample

  (B) Grading for material passing the 80mm sieve

- % Passing 80 μm sieve - shall not exceed 2/3 of the material passing the 630 micron sieve.

- The material shall be free of harmful coating and any gravel containing loam or other unsuitable materials shall be promptly rejected.
### TABLE II

<table>
<thead>
<tr>
<th>Nominal Size (Square Openings)</th>
<th>METRIC SIEVE SIZES</th>
<th>PERCENT PASSING BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>100mm</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>80mm</td>
<td>95 - 100</td>
<td></td>
</tr>
<tr>
<td>50mm</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>40mm</td>
<td>60 - 80</td>
<td>95 - 100</td>
</tr>
<tr>
<td>25mm</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20mm</td>
<td>40 - 66</td>
<td>50 - 75</td>
</tr>
<tr>
<td>10mm</td>
<td>25 - 54</td>
<td>25 - 52</td>
</tr>
<tr>
<td>5.0mm</td>
<td>15 - 43</td>
<td>15 - 40</td>
</tr>
<tr>
<td>2.5mm</td>
<td>10 - 35</td>
<td>10 - 33</td>
</tr>
<tr>
<td>630μm</td>
<td>5 - 23</td>
<td>5 - 23</td>
</tr>
<tr>
<td>314μm</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>160μm</td>
<td>3 - 12</td>
<td>2 - 14</td>
</tr>
<tr>
<td>80μm</td>
<td>2 - 10</td>
<td>1 - 10</td>
</tr>
</tbody>
</table>
303.02.02  Properties

- Fracture Count

**80mm Base Course Gravel:** Of the particles retained on the plus 5.0mm sieves at least 13 weight percent shall have two or more fractured faces.

**40mm Base Course Gravel:** Of the particles retained on the plus 5.0mm sieves at least 25 weight percent shall have two or more fractured faces.

**25mm Base Course Gravel:** Of the particles retained on the plus 5.0mm sieves at least 50 weight percent shall have two or more fractured faces.

- Particles retained on the plus 5.0mm sieves shall consist of durable particles of crushed stone, gravel or slag capable of withstanding the effects of handling, spreading and compacting without degradation which produces deleterious fines.

- The material shall be free of harmful coating and any gravel containing loam or other unsuitable materials shall be rejected.

303.02.03  Other Properties (Optional)

- Liquid Limit – 25% maximum

- Plasticity Index – 6% maximum

- % Passing the 80 \( \mu \text{m} \) sieve - shall not exceed 2/3 of the material passing the 630 \( \mu \text{m} \) sieve.

- Los Angeles Abrasion, % loss (500 revolutions) – 50% maximum loss
303.03.00 DRAINAGE GRAVEL

303.03.01 Gradation

Coarse Aggregate

Coarse gravel for bedding and drainage shall conform to the following grading:

TABLE III

<table>
<thead>
<tr>
<th>Nominal Gravel Size</th>
<th>50mm</th>
<th>40mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Square Openings)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>METRIC SIEVE SIZE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PERCENT PASSING BY WEIGHT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric Sieve Sizes</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>50mm</td>
<td>100</td>
</tr>
<tr>
<td>40mm</td>
<td>90 - 100</td>
</tr>
<tr>
<td>25mm</td>
<td>-</td>
</tr>
<tr>
<td>20mm</td>
<td>35 - 70</td>
</tr>
<tr>
<td>16mm</td>
<td>-</td>
</tr>
<tr>
<td>10mm</td>
<td>10 - 30</td>
</tr>
<tr>
<td>5.0mm</td>
<td>0 - 5</td>
</tr>
<tr>
<td>2.5mm</td>
<td>-</td>
</tr>
</tbody>
</table>

Fine Aggregate

Sand for bedding and drainage shall conform to the following grading:

TABLE IV

<table>
<thead>
<tr>
<th>Metric Sieve Sizes</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>10mm</td>
<td>100</td>
</tr>
<tr>
<td>5.0mm</td>
<td>95 -100</td>
</tr>
<tr>
<td>2.5mm</td>
<td>80 -100</td>
</tr>
<tr>
<td>1.25mm</td>
<td>50 - 85</td>
</tr>
<tr>
<td>630μm</td>
<td>25 - 60</td>
</tr>
<tr>
<td>314μm</td>
<td>10 - 30</td>
</tr>
<tr>
<td>160μm</td>
<td>2 - 10</td>
</tr>
</tbody>
</table>
303.03.02  Properties

- **Coarse Aggregate:** Retained on the 5.0mm sieve shall consist of durable particles of crushed stone, gravel or slag capable of withstanding the effects of handling, spreading and compacting without degradation which produces deleterious fines. Of the particles retained on the plus 5.0mm sieves at least 50 percent shall have two or more fractured faces.

- **Fine Aggregate:** Shall consist of fines from crushing and natural sands.

- Drainage gravel shall not be used as trench backfill.

- The material shall be free of harmful coating and any gravel containing loam or other unsuitable materials shall be rejected.
### DETAILED SPECIFICATIONS

#### 304.00.00 UTILITY TRENCH BACKFILL REGULATIONS

| 304.01.00 | General |
| 304.02.00 | Moisture Requirements |
| 304.03.00 | Density Requirements |
| 304.04.00 | Non-Shrink Fill |
| 304.05.00 | Control Density Fill |
| 304.06.00 | Surface Rehabilitation of Trenches or Cuts |
| 304.07.00 | Excavation in Newly Re-Surfaced or Top Lifted Streets |
| 304.08.00 | Testing |
304.00.00  UTILITY TRENCH BACKFILL REGULATIONS

304.01.00  GENERAL

The following specifications apply to compaction of:

- all waterworks and sewer service cuts, repairs, replacements, main breaks, extensions etc.,
- all shallow cuts by utility companies, and
- all cuts for the installation of streetlight ducts and bases

on all existing or proposed streets, lanes or easements for the full width of the right-of-way where The City is responsible for maintenance.

A trench or cut shall be defined as that portion of any excavation extending from within 300mm below the pipe to the finished subgrade surface.

A trench or cut is further divided into the pipe zone and the street zone defined as follows:

1) Pipe Zone
   The pipe zone is defined as that area of a trench or cut from 300mm below the conduit to 300mm above the conduit.

   The method of bedding, backfill and compaction and type of equipment used in water and sewer installations shall comply with:

   - Standard Specifications Waterworks Construction
     504.03.00
   - Standard Specifications Sewer Construction
     403.04.00
     403.07.01
     403.08.02

2) Street Zone
   The street zone is defined as that area of a trench or cut from:
   - the top of the pipe zone to the finished subgrade surface, and/or
   - from 150mm below the streetlight duct and/or base to finished subgrade surface.

   The street zone shall be backfilled in uniform lifts with native material, and each lift shall be mechanically compacted. Thickness of lifts are determined by testing procedures during the construction process.

   When soils removed from any trench appear unsuitable for replacement in the trench due to moisture content or for other reasons, and suitable material is not available in the construction area, the street zone shall be backfilled with compacted crushed gravel. At the discretion of the Engineer and if trench width permits, base gravel or bank gravel (pitrun) may be used for backfill. Under no circumstances shall frozen material be used for backfill. Positive drainage to the storm sewer system shall be provided from all granular backfill material.
The use of Granulite, drainage gravel and/or other gap graded material as backfill material in the street zone is prohibited unless the material is enveloped in a drainage membrane (chapter 320) and positive drainage to the storm sewer system is provided.

304.02.00 MOISTURE REQUIREMENTS

Soil used for trench backfill shall be within optimum to +2% of its optimum moisture content. Subject to approval by the Engineer, the moisture content for the last metre of backfill may be lowered if warranted by soil conditions.

Granular material shall be within -3 percent to optimum moisture content.

304.03.00 DENSITY REQUIREMENTS

304.03.01 Summer Compaction

<table>
<thead>
<tr>
<th>Percent of Soils</th>
<th>Maximum Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Zone</td>
<td>Minimum 95.0</td>
</tr>
<tr>
<td>Street Zone</td>
<td>Minimum 97.0</td>
</tr>
</tbody>
</table>

(Unless otherwise specified)

Requirements apply to the full width of the right-of-way with the exception of the boundary area from the property line up to one (1) meter from the constructed or designed surface installation. In the boundary area the soil shall be compacted to a minimum of 90 percent of the soil's maximum density.

304.03.02 Winter Compaction

All settlements related to winter backfill operations shall be reworked and re-compacted by the utility to a minimum standard density of 97% of the maximum obtainable density by no later than the following May 31.
304.04.00 NON-SHRINK FILL

Specifications:

1. Compressive strength two (2) to five (5) MPa.

2. Aggregate Grading

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0mm</td>
<td>55 - 100</td>
</tr>
<tr>
<td>2.0mm</td>
<td>37 - 67</td>
</tr>
<tr>
<td>80μm</td>
<td>0 - 30</td>
</tr>
<tr>
<td>PI</td>
<td>10 maximum</td>
</tr>
</tbody>
</table>

3. Binder

Portland cement type 10 or Lime/Fly Ash.

304.04.01 Placing

Non-shrink Fill (N-S Fill) shall be cast on the compacted backfill from one meter below subgrade to base of asphalt. N-S Fill shall be rodded or vibrated to eliminate voids, rough areas, honeycombing, and to ensure contact with the sides of the trench.

304.05.00 CONTROL DENSITY FILL

304.05.01 General

A flowable fill with self leveling properties for trench backfill. It consists of fine aggregate, sand and cementacious content. The control density fill shall be resistant to settlement after hydration.

304.05.02 Materials

Portland cement shall conform to the requirements of CSA Standard CAN3-A5-M, Type 10 or Type 30.

Supplementary cementing materials, when permitted, shall conform to the requirements of CSA Standard CAN3-A23.5-M.

Both fine and coarse aggregate shall conform to the requirements of CSA Standard CAN3-A23.1-M. The gradation shall conform to Table 1 of the CSA Standard.

Mixing water used shall meet the requirement of CAN3-A23.1-M.

Air-entraining admixtures shall conform to the requirements of CSA Standard CAN 3-A266.1-M.
304.05.03 Mix Design

The supplier shall immediately after award of Tender and prior to any delivery of control density fill, submit to the Engineer for approval, the proposed mix design including source of proposed aggregates.

- Slump of the control density fill shall be between 150 to 250mm.

- Minimum performance values at one (1) day shall be a CBR of 15 and compressive strength of 0.10 Mpa.

- Maximum performance values at twenty eight days shall be a CBR of 60 and compressive strength of 0.60 Mpa.

304.05.04 Trench Restoration

The utility shall be bedded and protected prior to placing the control density fill. It shall be struck off at a level corresponding to 100mm below the pavement surface or to the bottom of the existing asphalt whichever is the greater.
304 - 5

304.06.00 SURFACE REHABILITATION OF TRENCHES OR CUTS

304.06.01 Paved Streets and Lanes

In the case of existing paved streets and lanes, compaction shall be carried out on all lifts, up to the level of the existing subgrade. The construction of the pavement structure shall match the existing asphalt thickness plus gravel. Gravel thickness, based on crushed gravels, shall be as per the following graph. If base gravel is used, add 50mm to the minimum gravel thickness.

To ensure a neat edge, the pavement shall be sawcut or routed to a depth of 100mm or one-half the pavement thickness, whichever is greater, for the full perimeter.

Patches greater than or equal to 100m² in area shall be placed with an asphalt spreader (Chapter 308).

Asphalt concrete lifts shall not exceed 110mm. Each lift shall be thoroughly compacted prior to placing an additional lift.

The final lift of the asphalt patch shall be the equivalent mix design of the wearing surface of the adjacent asphalt.
304.06.02 Graveled Streets

In the case of existing graveled streets, oiled or otherwise, compaction shall be carried out on all lifts, up to the level of the existing subgrade.

Surfacing shall be in accordance with Standard Drawing 454.1005.004 except that the 25mm crushed gravel shall be oiled in case of oiled streets.

304.07.00 EXCAVATION IN NEWLY RE-SURFACED OR TOP LIFTED STREETS

304.07.01 General

Utility excavations shall not be permitted on streets resurfaced or top lifted within the past two (2) years. Exceptions shall be granted only where it can be shown that the utility excavation was beyond the control of the utility involved. This shall include, but not be limited to, emergency work or redevelopment/development requiring service connections. All utility excavation permits applied for prior to the two (2) year period shall be reviewed by ROADS General Manager and shall be subject to the following rehabilitation standard of the street surface:

304.07.02 Edges

All excavations shall be sawed cleanly through the pavement prior to excavation.

304.07.03 Backfill

All trenches shall be backfilled in accordance with the Specifications. Where the trench width does not permit the use of conventional compaction equipment to meet the Specifications, other means acceptable to ROADS, shall be employed. This may include the use of non-shrink material for the top one (1) meter of the trench.

304.07.04 Surface Restoration

Surface restoration is required for any excavation made in a street with a Visual Condition Index (VCI) equal to or greater than 7.0. This includes streets listed in the PAVEMENT SURFACE RESTORATION LISTING FOR THE 2007 CONSTRUCTION SEASON document and streets located in areas that recently received a Final Acceptance Certificate (FAC). Some recently FAC’d streets may not be listed in this document. However, surface restoration requirements apply.

Surface restorations must include planing a minimum of 50 mm and placing new asphalt with a paver. Surface restoration must be completed by the end of the next construction season.

The final lift of the asphalt patch shall be the equivalent mix design of the wearing surface of the adjacent asphalt.

All patches greater than or equal to 100m² in area shall be machine laid.

Where the excavation runs longitudinally for some distance, such as in the case of a utility
installation, the width of the patch shall be the narrowest width that can be placed by a paving machine.

304.07.05 Maintenance

In all cases, the utility shall be responsible for maintenance of the trench backfill for the two (2) year period as specified in the Excavation Permit.

All costs shall be recovered against the excavation permit and charged to the utility involved.

All other requirements as stated in the Specifications shall be met.

304.08.00 TESTING

304.08.01 Testing Services and Reports

The following shall be the minimum acceptable standard for Testing Services and Reports.

Tests are taken within 24 hours of the backfill being placed in the trench or cut. Reports indicate date when the backfill was placed and testing completed.

Soil density and moisture content tests are taken on each 500mm of trench depth for a maximum of 75 meters.

Tests shall be so distributed that they are representative of the entire area of the backfill operations.

Service connector trenches shall be tested from pipe zone to finished sub-grade.

Such tests are taken adjacent to all manholes and valves from pipe zone to finished sub-grade.

304.08.02 Utility Mains - Testing Requirements

All sewer and water main installations within City right-of-way are subject to continuous testing and inspection to verify compliance with current backfill and compaction specifications. Testing Agencies shall send copies of all test results to ROADS.

All utility installations within City rights-of-way have sufficient tests taken to verify compliance with City backfill regulations.

304.08.03 Compaction Control

The maximum density and optimum moisture content for each soil type shall be determined by ASTM Designation D 698.

The field density of soils shall be determined by ASTM Designation D 2922.

For spot checks, the following methods are also acceptable:
ASTM Designation D 1556, ASTM Designation D 2167, and ASTM Designation D 2216.

Rapid drying of the soils to determine their field moisture content shall be permitted with a corresponding sample laboratory dried.

304.08.04 Backfill Compliance Certification

It shall be the responsibility of the consulting engineer engaged by the Contractor to certify that all City Backfill Regulations are met or exceeded. Copies of the soil moisture/density tests shall accompany the Letter of Certification.

In the event that the entire street serviced area is deficient or irregular in testing coverage or failed to maintain the design cross-section and/or grade at any period prior to the issuing of a F.A.C.; that portion of the right-of-way may be retested under observation by the Engineer or his representative prior to the issuing of a C.C.C. for the paving and surface concrete work. If such action is not undertaken, or the retests do not indicate compliance, the value of the surface improvements to be constructed in the affected area may be computed and a deposit in this amount may be required to serve as a guarantee against the failure of the surface improvement due to failures in the sub-base. The term of such a deposit shall be five years and the deposit shall be required prior to construction of surface improvements.
## DETAILED SPECIFICATIONS

<table>
<thead>
<tr>
<th>305.00.00</th>
<th>GRAVEL ROAD AND LANE CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>305.01.00</td>
<td>Base Gravel Base Course</td>
</tr>
<tr>
<td>305.02.00</td>
<td>Fine Grading of Base Course</td>
</tr>
<tr>
<td>305.03.00</td>
<td>Quantity Measurements</td>
</tr>
</tbody>
</table>
305.00.00 **GRAVEL ROAD AND LANE CONSTRUCTION**

305.00.01 General

The dimensions of all work shall be in accordance with the typical cross-sections shown on the Standard Drawings. The dimensions may be altered by the Engineer as conditions and circumstances require.

Where finished grade is less than 1400mm above the existing natural ground, all topsoil shall be removed before any fill material is placed.

The top 150mm of the subgrade through a cut section shall be scarified, and recompacted to a minimum 97.0 percent of Maximum Design Density in roadway sections and 95.0 percent of Maximum Design Density in lanes.

Culverts shall be installed at intersecting service streets, the size and type of culvert shall be determined by Wastewater.

The subgrade shall be trimmed during each phase of construction to conform to the proper grades and line.

No gravel shall be placed on any street or lane prior to the Engineer's acceptance of the grading work.

Swales shall not discharge into a graveled lane without the prior written approval of the Engineer.

305.00.02 Graveled Lane Construction

Generally lanes are constructed as shown on Standard Drawing 454.1011.003.

The lane at a catch basin location shall be constructed as shown on Standard Drawing 454.1011.002.

That portion of the lane from Back of Walk to a point 15m into the lane shall be constructed as shown on the Standard Drawing 454.1011.004.

Gravel lanes shall be deep based at intersections for five meters beyond intersection.

305.00.03 Materials

Base course gravel shall conform to the requirements set forth in Chapter 303.

25mm and 50mm crushed gravel shall conform to the requirements set forth in Chapter 303. The gravel shall be uniformly and thoroughly compacted throughout.

Recycled asphalt shall not be used in lieu of 25mm or 50mm crushed gravel.
305.00.04 Completion Requirements

To qualify for substantial completion, the following conditions shall be met:

- The lane or roadway grade conforms to the final approved grade.
- The right-of-way conforms to standard cross-section as shown on the Standard Drawings.
- All slopes are completed and trimmed.
- Catch basins are completely constructed as shown in the Standard Specifications Sewer Construction, Drawing 2-B-146.
- The minimum depth of compacted crushed gravel shall be in accordance with Standard Drawing 454.1005.004 for graveled streets and Standard Drawing 454.1011.003 for graveled lanes.

To qualify for Final Acceptance, the graveled street or lane shall meet the following conditions in addition to those listed under substantial completion.

- The full right-of-way shall be free from all foreign material, and properly maintained by the Developer, to the satisfaction of the Engineer.

305.01.00 BASE GRAVEL BASE COURSE

The Contractor shall supply approved Base Gravel (Sec. 303.01.00 Table I), and shall provide all material and labour necessary to load, haul, place and compact said gravel on the finished subgrade.

Base gravel may be placed in one (1) lift to a maximum of 300mm in depth. If the total thickness is greater than 300mm then that portion over the initial 300mm lift shall be placed in lifts not exceeding 200mm. Each lift shall be adequately consolidated by means of an approved vibratory compactor to a minimum of 97.0 percent of the gravel’s maximum design density. Steel drum or steel pad compactors may be used.

The surface of the final lift of base gravel shall be compacted to proper grade and cross-section.

When directed by the Engineer, the Contractor places and compacts approved crushed gravel in lieu of base course gravel. The crushed gravel shall conform to the gradation shown in Chapter 303, Table II.
305.02.00 FINE GRADING OF BASE COURSE

305.02.01 New Construction

Following the compaction of the base gravel, 25mm crushed gravel (Chapter 303, Table II) shall be placed. The 25mm crushed gravel shall be brought to proper grade and cross section and compacted, using approved vibratory compactors, to 98 percent of the Maximum Design Density. The crushed gravel shall be brought to moisture content at or below the optimum moisture content to achieve the required compaction.

Care shall be taken along gutters to leave exactly the specified depth for the subsequent placing of the final asphalt layer(s).

305.02.02 Base Gravel Base Course Previously Placed

Following the reshaping of the existing base course, the Contractor shall be required to place 25mm crushed gravel (Chapter 303, Table II) to bring the roadway to the desired cross-section. Grade alterations in excess of 100mm are brought to proper shape by the placing of 100mm crushed gravel (Chapter 303, Table II).

305.03.00 QUANTITY MEASUREMENTS

305.03.01 Base Course

Payment for base gravel shall be based on the actual tonnage incorporated in the work, unless this tonnage is in excess of the theoretical volume multiplied by 2.22 t/m³.

The Contractor shall not be compensated for material placed in excess of this tonnage unless authorized previously by a written change order.

The excavation area shall be used for base gravel calculation purposes, with each street or section being treated on an individual basis. Base gravel placed in authorized extra-depth areas shall be compensated for on the basis of a maximum 2.22t/m³.

305.03.02 Fine Grading

1) New Construction
Payment for crushed gravel shall be based on the actual tonnage incorporated in the work, unless this tonnage is in excess of the theoretical volume multiplied by 2.22 t/m³. Amounts in excess of the specified maximum shall be compensated for at established base gravel Unit Rate. For calculation purposes each street or section shall be treated on an individual basis.

2) Base Gravel Base Course Previously Placed
The reshaping of the existing base course and the placing and compaction of the additional crushed gravel shall be paid for under the Schedule of Force Account Rates. Payment for the crushed gravel shall be based on the actual tonnage incorporated in the work, and includes only the hauling and placing of material at the proper location.
<table>
<thead>
<tr>
<th>306.00.00</th>
<th>BASE STABILIZATION</th>
</tr>
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<tbody>
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<td>Soil Cement Base Course</td>
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<tr>
<td>306.02.00</td>
<td>Lime Stabilization</td>
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<td>306.03.00</td>
<td>Asphalt Stabilization</td>
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<td>306.04.00</td>
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</tr>
</tbody>
</table>
306.00.00 **BASE STABILIZATION**

306.01.00 **SOIL CEMENT BASE COURSE**

306.01.01 **Description**

Soil cement base course consists of soil and Portland Cement uniformly mixed, moistened, compacted, finished and cured in accordance with these Specifications, and it conforms to lines, grades, thickness and typical cross-section shown or as directed by the Engineer.

306.01.02 **Materials**

1) **Portland Cement**

Portland Cement shall meet the requirements of CAN3-A5-M77.

2) **Water**

Water shall be free from substances deleterious to the hardening of soil cement, and be subject to the approval of the Engineer.

3) **Curing Seal**

Curing seal shall be an emulsified asphalt, type RS-1H or RC-70.

4) **Soil**

Soil consists of the material existing in the street to be paved, in an approved borrow pit, or a combination of these materials in a definite controlled proportion. The soil shall not contain gravel or stone retained on a 50mm sieve or more than 45 percent retained on a 5.0mm sieve.

306.01.03 **Preliminary Testing**

An approved testing firm in accordance with recommendations of the Portland Cement Association shall conduct testing and interpretation of results to determine minimum cement contents. The "Short Cut" test procedure shall not be acceptable for determination of cement contents, but may be used for confirmation tests only. The "Rapid Test" procedure is not acceptable to The City.

The design cement content, A.A.S.H.O. soil classification and results of the following tests shall be submitted to The City for approval:


2. Grain size analysis of soil including hydrometer analysis. ASTM Designation D-442.


5. Wetting and drying tests of compacted soil-cement mixtures. ASTM Designation D-559. Minimum of one (1) cylinder per test at the recommended cement content.


7. Compressive strength tests on soil-cement mixtures. Minimum of three cylinders per test at varied cement contents to be broken at seven days.

Frequency of tests shall be as follows where in place material is to be stabilized:

Test No. 1 - Minimum of one (1) test per 150m of street to be paved.

Test No. 2 and Test No. 4 - Minimum of one (1) test per 300m of street to be paved.

Test No. 5 to Test No. 7 - Minimum of one (1) test per 600m of street to be paved provided that previous tests show uniformity of soil in the area, otherwise frequency of tests are determined by The City.

The above lengths of street per test apply only to continuous or adjacent streets in any one area. Short isolated streets to be paved require at least one (1) full set of tests on each.

Where material to be stabilized, is to be taken from a borrow pit, frequency of tests shall be determined by The City.

306.01.04 Equipment

Soil-cement shall be constructed by any machine, combination of machines or equipment that will produce results meeting the requirements for soil pulverization, cement application, mixing, water application, incorporation of materials, compaction, finishing and curing as controlled by these Specifications. All equipment necessary for the proper construction of the base course shall be on the project and in satisfactory condition before construction begins.

306.01.05 Construction Methods

1) Preparation
Before other construction operations are begun, the areas to be paved are graded and shaped as required to construct the base course in conformance with grades, lines and typical cross-section shown on the plans. Unsuitable or excess material shall be removed, disposed of and leveled at a designated disposal area.

The subgrade shall be firm and able to support, without displacement, the construction equipment and compaction hereinafter specified. Soft or yielding subgrade shall be made stable before construction proceeds.

Where a central plant mix operation is used, material shall be excavated to subgrade level across the full width of the street. The top 150mm of subgrade shall be scarified, brought to within two (2) percentage points of optimum moisture content and compacted to a minimum density of 100 percent of the soils' Maximum Design Density as determined by a moisture density test, ASTM Designation D-558.
2) Pulverization
The soil shall be so pulverized that at the completion of moist mixing, 100 percent by dry weight passes a 25mm sieve, and a minimum of 80 percent passes a 5.0mm sieve, exclusive of gravel or stone retained on these sieves.

3) Application of Cement
No cement shall be spread or added to the soil when the subgrade is frozen or when the air temperature is less than 4 degree Celsius. At the time of cement application, the percentage of moisture in the soil shall not exceed by more than two (2) percentage points the optimum moisture content for the soil-cement mixture. Cement shall be applied or added only to that material which can be mixed, spread and compacted within six (6) hours. The specified quantity of Portland Cement shall be uniformly distributed through the soil during the mixing operation. The amount of cement in any sample of mixture shall not vary by more than five (5) percent from the theoretical design quantity.

4) Mixing and Spreading

- Road Mix Operation
  Soil shall be scarified and pulverized prior to the application of cement. Where required by the Engineer, the loosened material shall be bladed into one or more windrows of uniform cross-section, and of size such that all material in one windrow can be passed through the mixing machine in one operation. Immediately after the cement has been spread, it shall be mixed with the soil until they have been sufficiently blended to prevent the formation of cement balls when water is applied. Water shall then be incorporated into the mixture until it has reached the required moisture content for compaction purposes. The water shall be applied by pressure distributing equipment or other approved means, in such a manner that excessive concentrations of water are avoided. After all mixing water has been applied, mixing continues until a uniform and intimate mixture of soil, cement and water is obtained.

- Central Plant-Mix Operation
  The soil material, cement and water are mixed at a central mixing plant of the pugmill or rotary drum type using a batch or continuous feed. If a batch feed is used, the materials are proportioned by weight, and if a continuous feed is used, the materials are proportioned by volume. If the Contractor employs a continuous type mixer and feed, the soil shall be drawn from storage bins or areas through adjustable calibrated gates or fixed gate feeder with adjustable speed control. The mixer shall be equipped with metering devices of an approved type which introduce the cement and water into the mixer in desired proportions. The metering devices and soil feeder shall be interlocked and so synchronized as to maintain a constant ratio between soil, cement and water. Where the Engineer deems it necessary for the accurate control of cement feed, the Contractor equips the cement storage hoppers with a compressed air system to eliminate the possibility of arching of the cement. The plant shall be equipped with facilities satisfactory to the Engineer for calibrating gate opening or rate of feed, by weighing check samples.
The weight of charge in a batch mixer or the rate of feed to a continuous type mixer shall not exceed that which permits complete mixing of all material. Dead areas in the mixer, in which material does not move or is not sufficiently agitated, are corrected either by reduction in volume of material or by other adjustments. Mixing of the materials shall be continued until the cement and water are evenly distributed through the mass and a uniform mixture of unchanging appearance is obtained. In no case shall the period of mixing be less than thirty (30) seconds from the time all materials are in the mixer. Sufficient mixing capacity shall be provided to produce a minimum of 150t of soil-cement mixture per hour. The City reserves the right to order the use of any proportioning or mixing equipment discontinued, where in the opinion of the Engineer it fails to produce a satisfactory mixture.

Immediately prior to spreading soil-cement base course material, the surface of the prepared subgrade shall be moistened and kept moist until covered by the mixture. Materials are transported from the central mixing plant to the street by means of suitable vehicles, equipped with protective covers, and deposited by employing approved spreading equipment. Dumping in piles on the subgrade shall not be permitted. The mixture shall be spread in one layer of uniform density and of such thickness that after compacting, the finished soil-cement base conforms to the required grade and cross-section. The spreading progresses continuously without breaks and shall be organized so that not more than thirty (30) minutes elapses between the time of placing the material in adjacent lanes at any location.

After a part width section is completed, the longitudinal joint against which additional material is to be placed shall be trimmed in a neat line parallel to the curb and with a vertical edge. Material cut away from the edge shall be spread uniformly over the adjacent subgrade and compacted or otherwise disposed of as directed by the Engineer. Transverse construction joints are treated in a similar manner.

5) **Compaction**

The mixture shall be compacted within two (2) hours after the addition of water. Any soil and cement mixture which is not compacted and finished shall not remain undisturbed for more than thirty (30) minutes. At the start of compaction, moisture in the mixture shall be within two (2) percentage points of the specified optimum moisture content. This shall be determined by a moisture density test, ASTM Designation D-558, on representative samples of the soil-cement mixture.

Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. Compaction shall be carried out on the loose material until it has attained a uniform density of one hundred (100) percent of the Maximum Design Density as determined by a moisture density test, ASTM Designation D-558.

Compaction may be obtained by steel wheel, grid or pneumatic rollers, vibratory or sheepsfoot packers or any other means approved by the Engineer. Following initial compaction, the mixture shall be shaped to the required grade and cross-section. Where necessary the surface shall then be scratched to remove compaction planes which may have developed during
compaction. Final compaction to the specified density shall be done with steel wheel or pneumatic rollers, or vibratory packers. If the specified density is not attained, the Contractor, at his own expense, shall complete one of the following operations as instructed by the Engineer.

- Reprocess the same soil-cement material within twenty-four (24) hours of the original application of cement and water, with the addition of seventy-five (75) percent of the original cement content.

- Reprocess the same soil-cement material after the elapse of twenty-four (24) hours with the addition of one hundred (100) percent of the original cement content.

- Remove the soil-cement base and replace it with new approved material processed in accordance with these Specifications.

- Complete the surfacing operation in two (2) lifts, applying a total average depth of 75mm of asphaltic concrete.

6) Finishing
After final compaction, the surface shall be smooth and free from cracks, ridges and loose material. Any ridges or undulations are removed by planing with a motor grader, and the resulting loose material removed from the area. The finishing and construction operations shall be completed before six (6) hours has elapsed from the time of addition of water to the mix.

The surface of the compacted base course shall be kept moist until a curing seal has been applied. Water shall be applied in a fine spray which does not segregate the cement from the soil particles.

7) Curing
A curing seal of emulsified asphalt, type SS-1H shall be applied to the dampened surface at a temperature of 20°C - 50°C, and at a uniform rate of 2.5 litres per square meter. The seal covers the full width of the roadway and shall be allowed to cure thoroughly before the Engineer grants permission to pave.

306.01.06 Alternative Method of Construction
The Contractor may use any equipment which is capable of carrying out two or more of the following operations simultaneously:

Scarification, pulverization, application of cement, mixing, addition of water, spreading and compaction.

Any such combination of operations shall comply in every respect with conditions as set out under the various sections of Construction Methods in these Specifications.
306.01.07 Maintenance

The Contractor shall, within the Limits of Contract, maintain the soil-cement base course in good condition. Faulty areas are replaced for the full depth of the base course with fresh soil-cement mixture or concrete. Surface depressions are brought up to proper grade by patching with asphaltic concrete prior to the application of the asphaltic surface course. Areas where the curing seal is removed by traffic or otherwise, shall be resealed immediately, at the Contractor's expense.

306.02.00 LIME STABILIZATION

306.02.01 Description

Lime stabilized base course shall consist of soil and lime uniformly mixed, moistened, compacted, finished and cured in accordance with these Specifications, and it shall conform to lines, grades, thickness and typical cross-sections shown or as directed by the Engineer.

306.02.02 Temperature

Lime stabilization should not be carried out when the temperature falls below 5° Celsius.

306.02.03 Materials

1) Lime
Lime shall be of an approved brand and shall conform to the requirements of ASTM Designation C110. Project Specification shall govern lime grade and classification.

2) Water
Water shall be free from substances deleterious to the hardening of the lime, soil mixture, and be subject to the approval of the Engineer.

3) Soil
Soil shall consist of the material existing in the street to be paved, or approved borrow material.

306.02.04 Equipment

Lime stabilized or modified base may be constructed by any machine, combination of machines or equipment that produces results meeting the requirements for soil pulverization, lime application, mixing, water application, compaction, finishing and curing as controlled by these Specifications. All equipment necessary for the proper construction of the base course shall be on the project and in satisfactory condition before construction begins.
306.02.05 Construction Methods

1) Preparation
Before other construction operations are begun, the area shall be graded and shaped as required to construct the base course in conformance with grade, line and typical cross-section shown on the plans. Unsuitable or excess material are removed, disposed and leveled at a designated disposal area. All work shall meet the requirements set forth in Chapter 302.

2) Scarification and Pulverization
The soil shall be scarified to a minimum of 150mm over the full road width and then partially pulverized. All deleterious materials and aggregates larger than 75mm are removed.

3) Lime Spreading
Lime shall be uniformly spread, using either dry or slurry methods.

Dry lime should be sprinkled lightly to reduce dusting. To prevent wind loss and minimize lime carbonation, the lime shall be mixed into the soil within six (6) hours after application. Percentage of lime applied shall be specified by the Engineer after laboratory testing.

4) Preliminary Mixing and Watering
The lime shall be uniformly distributed throughout the soil to the minimum depth of 150mm and the full road width. Mixing shall continue until all soil is pulverized to minus 50mm. The moisture of the soil-lime mixture shall be at least five (5) percent above optimum moisture content throughout the mixing operation.

After initial mixing, the lime-treated layer shall be shaped to section and lightly compacted.

5) Final Mixing and Pulverization
Mixing and pulverization shall continue until all of the soil clods are broken down to pass a 25mm sieve and at least 60 percent pass a 5.0mm sieve. The lime-treated layer shall be at optimum moisture prior to compaction.

6) Compaction
The lime-soil mixture shall be compacted to a minimum 97.0 percent of maximum density of lime-soil mixture determined by ASTM Designation D698. Compaction begins immediately after final mixing.

The 97.0 percent compaction requirement may be waived by the Engineer, with proof rolling required instead.

7) Finishing
After final compaction, the surface shall be smooth and free from cracks, ridges and loose material.
8) Curing
After compaction and finishing the stabilized soil shall be carried for three to seven days prior to placing the subsequent layer of base course. Curing shall be by either:

- Moist curing - maintain surface in a moist condition by light sprinkling and rolling as required.
- Membrane curing - seal the compacted layer with a bituminous prime coat.

306.03.00 ASPHALT STABILIZATION

306.03.01 Description
Asphalt stabilized base course consists of soil, crushed aggregate and emulsified asphalt uniformly mixed, moistened, compacted and finished in accordance with these Specifications, and it conforms to line, grade, thickness and typical cross-section shown or as directed by the Engineer.

306.03.02 Materials

1) Emulsified Asphalt
SS-1 emulsified asphalt shall conform to the requirements of the Canadian Specifications Board Specification for Emulsified Asphalt (16-GP-2).

2) Water
Water shall be free from substances deleterious to the hardening of the asphalt, soil mixture, and shall be subject to the approval of the Engineer.

3) Soil
Soil shall consist of the material existing in the street to be paved or approved borrow material.

4) Aggregates
Aggregates shall conform to the gradation specified in Chapter 303.

306.03.03 Mix Design
The amount of emulsified asphalt and soil/aggregate blends shall be established by the following tests:

ASTM Designation D915 Method of Testing Soil Bituminous Mixtures.


ASTM Designation D1561 Preparation of Test Specimens of Bituminous Mixtures by Means of California Kneading Compactor.
306.03.04 Equipment

Mixing and spreading shall be accomplished through the use of a rotary type mixer with transverse shafts that mix emulsified asphalt and soil/aggregate by revolving tines under a hood, preferably with an internal spray system which applies the emulsified asphalt while mixing. All equipment necessary for the proper construction of the base course shall be on the project and in satisfactory condition before construction begins.

306.03.05 Construction Methods

1) Preparation
Before other construction operations are begun, the area shall be graded and shaped as required to construct the base course in conformance with grade, line and typical cross-section shown on the plans. Unsuitable or excess material shall be removed, disposed of and leveled at a designated disposal area. All work shall meet the requirements set forth in Chapter 302. Construction occurs only when the temperature is in excess of 4° Celsius, and during daylight hours.

2) Scarification and Pulverization
The soil shall be scarified to a minimum of 150mm over the full road width and then partially pulverized. All deleterious materials and aggregates larger than 75mm are removed.

3) Mixing
Rotary mixing of the emulsion and soil/aggregate shall be used, unless other means of mixing are approved by the Engineer.

Emulsified asphalt shall be applied in increments of three litres per square meter until the total required amount is achieved and is uniformly distributed throughout the soil to the minimum depth of 150mm and the full road width. Mixing shall continue until all soil is pulverized to minus 50mm. The moisture of the soil-emulsified asphalt moisture shall be above optimum moisture content throughout the mixing operation.

Mixing and pulverization shall continue until all of the soil clods are broken down to pass a 25mm sieve and at least 60 percent pass a 5.0mm sieve.

4) Compaction
The emulsified asphalt soil mixture shall be compacted to a minimum 97.0 percent of maximum density. Compaction begins as soon after mixing as the mat bears the weight of the compaction equipment. The 97.0 percent compaction requirement may be waived by the Engineer, with proof rolling required instead.

5) Finishing
After final compaction, the surface shall be smooth and free from cracks, ridges and loose material, and conform to design cross-section.
306.04.00 CHEMICAL STABILIZATION

Chemical stabilization takes place only with the approval of the Engineer. Application and construction methods shall be in accordance with the manufacturer’s specifications. Prior to application, the manufacturer shall prove to the City that the application of the chemical(s) is effective for the in-situ soils. All pre-application testing shall be done within the City of Calgary at a City approved testing firm at no cost to the City.
DETAILED SPECIFICATIONS

307.00.00 ASPHALTIC CONCRETE

307.01.00 Classifications
307.02.00 Materials
307.03.00 Design Properties
307.04.00 Design Mix Formula
307.00.00 ASPHALTIC CONCRETE

307.00.01 Description

Asphaltic concrete consists of a hot mixed combination of coarse aggregate and fine aggregate, with or without mineral filler, uniformly coated and mixed with asphalt cement, in an approved mixing plant.

307.01.00 CLASSIFICATIONS

307.01.01 Conventional Mixes

1) Mix “A” Asphalt
   Mix “A” shall be used for base course asphalt.

2) Mix “B” Asphalt
   (i) Mix “B-50” shall be used for surface course and overlay asphalt where DTN< 500.
   (ii) Mix “B-75” shall be used for surface course and overlay asphalt where DTN> 500.

307.01.02 Maintenance Mixes

1) Sheet Asphalt
   Sheet Asphalt shall only be used as a temporary repair for concrete sidewalks and walkways.

2) Mix “M” Asphalt
   Mix “M” may be used to crown residential streets in subdivisions due for final acceptance. The crowning shall be less than 25mm in depth and less than 100m² in area.

307.01.03 Modified Mixes

Polymer Modified Asphalt Cement can be used as a binder in Mix “A” and Mix “B” asphalt and must be used in Bridge Mastic asphalt.

307.01.04 SuperPave Mixes

At the discretion of the Engineer, SuperPave mixes can be used.

307.02.00 MATERIALS

307.02.01 Aggregates

1) Coarse Aggregate
   Coarse aggregate shall consist of crushed stone, crushed gravel, or combinations thereof, or material naturally occurring in a fractured condition or a highly angular natural aggregate with pitted or rough surface texture. It shall be clean, free from coatings of clay, silt or elongated flat fragments and foreign matter. This material shall conform to the requirements for Crushed Stone, Gravel or Bituminous Concrete Base and Surface Courses of Pavements ASTM Designation D692, with the following modifications:
The percentage wear of the aggregate as measured in the Los Angeles Abrasion Test (ASTM Designation C131) shall not exceed 35 percent for the surface course material or 40 percent for the base course material.

Min Fracture:  
20mm to 4.75mm 70 weight % on two (2) faces  
40mm to 20mm 50 weight % on two (2) faces

2) Fine Aggregate  
Fine aggregate shall conform to the requirements of ASTM Designation D1073 Fine Aggregate for Bituminous Paving Mixtures with the following modifications.

Fine aggregate shall pass the 5.0mm sieve. It shall be a blend of manufactured sand and natural sand. Manufactured sand shall be fine aggregate produced by crushing rock, gravel or slag. Fine aggregate shall consist of hard, tough grains, free of clay, loam or other deleterious substances.

All asphaltic hot mixes shall incorporate fine aggregate with fracture evident on a minimum of 65 percent of the grains.

3) Mineral Filler  
Mineral filler shall consist of finely ground particles of limestone, hydrated lime, Portland cement or other approved non-plastic mineral matter. It shall be thoroughly dry and free from lumps. When tested by ASTM Designation D546, it shall meet the following minimum graduation requirements:

<table>
<thead>
<tr>
<th>Size</th>
<th>Percent Passing By Dry Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>160(\mu m)</td>
<td>90</td>
</tr>
<tr>
<td>80(\mu m)</td>
<td>65</td>
</tr>
</tbody>
</table>

For that portion of mineral filler which washes through a 80 micron sieve, more than 50 percent shall pass through the 80 micron sieve by dry sieving.

4) SuperPave Aggregate  
Properties of aggregates used in SuperPave mixes shall be in within the requirements of the Asphalt Institute’s SuperPave Level 1 Mix Design, SuperPave Series No. 2 (SP-2).
307.02.02 **Asphalt Cement**

The asphalt cement shall be prepared by the refining of petroleum. It shall be uniform in character and not foam when heated to 174° Celsius.

The tolerance allowed by ASTM for testing precision shall be applied for acceptance of asphalt cement.

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<tr>
<th>Characteristics</th>
<th>ASTM Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
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<td>Kinematic Viscosity at 135°C, mm²/s</td>
<td>D2170</td>
<td>200 min</td>
</tr>
<tr>
<td>Absolute Viscosity at 60°C, 300mm Hg Vacuum, Pa.s</td>
<td>D2171</td>
<td>60 min</td>
</tr>
<tr>
<td>Penetration at 0°C, 200 g., 60 secs., dmm</td>
<td>D5</td>
<td>30 min</td>
</tr>
<tr>
<td>Flash Point (Cleveland Open Cup) °Celsius</td>
<td>D92</td>
<td>205 min</td>
</tr>
<tr>
<td>Thin film oven test Penetration after test 25°C, 100 g., 5 secs., percent of original</td>
<td>D5</td>
<td>50 min</td>
</tr>
<tr>
<td>Ductility at 25°C mm, 5 cm/min, cm</td>
<td>D113</td>
<td>100 min</td>
</tr>
<tr>
<td>Solubility in Trichloroethylene, % by mass</td>
<td>D2042</td>
<td>99.5 min</td>
</tr>
</tbody>
</table>
307.02.03 SS-1 Emulsified Asphalt

This standard applies to liquid asphaltic materials in the form of aqueous emulsions of the anionic type.

Anionic emulsified asphalt according to this standard shall be Type 3 - Slow setting (SS).

Anionic emulsified asphalt shall show no separation of asphalt within 30 days after delivery and be homogeneous after thorough mixing.

The asphalt shall comply with the requirements given in the following table

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<thead>
<tr>
<th>REQUIREMENTS</th>
<th>ASTM TEST METHOD</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tests on Emulsion</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Viscosity Saybolt Furol Seconds at 25°C, s</td>
<td>D244</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>Residue by Distillation, % by mass</td>
<td>D244</td>
<td>55</td>
<td>-</td>
</tr>
<tr>
<td>Settlement in five days, % difference by mass</td>
<td>D244</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Sieve Test, % retained on a 850μm sieve, by mass</td>
<td>D244</td>
<td>-</td>
<td>0.10</td>
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<tr>
<td>Cement Mixing Test, % by mass</td>
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<td>2.0</td>
</tr>
<tr>
<td>Tests on Residue</td>
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<tr>
<td>Penetration at 25°C, 100 g., 5 sec., dmm</td>
<td>D5</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Ductility at 25°C, cm (CGSB Can 16-2-M77)</td>
<td>D113</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>Solubility in Trichloroethylene, % by mass</td>
<td>D2042</td>
<td>97.5</td>
<td>-</td>
</tr>
</tbody>
</table>

The methods of testing shall be as specified with each requirement.
307.02.04 High Float Emulsified Asphalt

(Section Deleted)

307.02.05 Polymer Modified Asphalt Cement

1) Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM No.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration @ 25°C, 100g/5s</td>
<td>D5</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Penetration @ 0°C, 200g/60s</td>
<td>D5</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Softening Point, °C</td>
<td>D36</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Absolute Viscosity @ 60°C,</td>
<td>D2171</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>300mm Hg Vacuum, Pa.s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kinematic Viscosity @ 135°C, mm²/s</td>
<td>D2170</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Thin Film Oven Test, % loss</td>
<td>D1754</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

2) Test after TFOT

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM No.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration @ 25°C, 100g/5s</td>
<td>D5</td>
<td></td>
</tr>
<tr>
<td>Aging Index</td>
<td></td>
<td>4.0</td>
</tr>
</tbody>
</table>

Aging Index = Viscosity @ 60°C after TFOT
Aging Index = Viscosity @ 60°C before TFOT

307.02.06 Polymer Modified Bridge Mastic Cement

1) Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>ASTM No.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration @ 0°C, 200g/60s</td>
<td>D5</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Viscosity @ 60°C,</td>
<td>D2171</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>300mm Hg Vacuum, Pa.s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Shear rate 5 x 10⁻² s⁻¹)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kinematic Viscosity @ 135°C, mm²/s</td>
<td>D2170</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>Flash Point, °C</td>
<td>D92</td>
<td>230</td>
<td></td>
</tr>
</tbody>
</table>
2) Test after TFOT

Weight Loss, % D1754 1.0
Aging Index 4.0

Aging Index = Viscosity @ 60°C after TFOT
Viscosity @ 60°C before TFOT

307.02.07 SuperPave Grade Asphalt Cement

Notwithstanding any other Specification, where asphalt cement is required to be PG graded, the minimum required grading shall be:

For Base Course PG58-31

Top Lift PG58-31 on Local Roads
PG58-31 or PG64-31 on Collector Roads
PG64-34 on Major Roads

For Surface Overlay PG58-31 on Local Roads
PG58-31 or PG64-31 on Collector Roads
PG70-31 or PG76-31 on Major Roads

307.02.08 Recycled Asphalt Pavement

Recycled asphalt pavement (RAP) may be used. Prior to its use, a proposed mix design shall be submitted to the Engineer for approval. In no instance shall the design incorporate in excess of 20% RAP.
### Design Properties

#### Proportions of Materials

1) Conventional Mixes

<table>
<thead>
<tr>
<th>Sieve Sizes (Square Openings)</th>
<th>Mix “A” Base Course</th>
<th>Mix “B-50” Surface mix DTN &lt; 500</th>
<th>Mix “B-75” Surface Mix DTN &gt; 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marshall Blows</td>
<td>50</td>
<td>50</td>
<td>75</td>
</tr>
</tbody>
</table>

Percent Passing by weight

<table>
<thead>
<tr>
<th></th>
<th>40mm</th>
<th>25 mm</th>
<th>20 mm</th>
<th>16 mm</th>
<th>10 mm</th>
<th>5 mm</th>
<th>80 micron</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>90-100</td>
<td>100</td>
<td>100</td>
<td>85-95</td>
<td>57-80</td>
<td>2-7</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>85-100</td>
<td>100</td>
<td>57-70</td>
<td>4-8</td>
</tr>
</tbody>
</table>

2) Maintenance Mixes

<table>
<thead>
<tr>
<th>SIEVE SIZES (Square Openings)</th>
<th>Sheet Asphalt</th>
<th>Mix “M” Maintenance Thin Overlay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Passing by Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10mm</td>
<td>100</td>
<td>65 - 80</td>
</tr>
<tr>
<td>5mm</td>
<td>100</td>
<td>50 - 70</td>
</tr>
<tr>
<td>2.5mm</td>
<td>95 - 100</td>
<td>-</td>
</tr>
<tr>
<td>630μm</td>
<td>70 - 95</td>
<td>-</td>
</tr>
<tr>
<td>80μm</td>
<td>8 - 16</td>
<td>3 - 8</td>
</tr>
</tbody>
</table>

3) Bridge Mastic Mixes

<table>
<thead>
<tr>
<th>SIEVE SIZES (Square Openings)</th>
<th>Single and Rehabilitation Lifts</th>
<th>Multiple Lifts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Passing by Weight</td>
<td>Membrane</td>
<td>Overlay</td>
</tr>
<tr>
<td>12.5mm</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>10mm</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>5mm</td>
<td>90 - 95</td>
<td>50 - 70</td>
</tr>
<tr>
<td>2.5mm</td>
<td>70 - 76</td>
<td>-</td>
</tr>
<tr>
<td>160μm</td>
<td>8 - 16</td>
<td>-</td>
</tr>
<tr>
<td>80μm</td>
<td>4 - 8</td>
<td>6 - 8</td>
</tr>
</tbody>
</table>

Fine Aggregate: Of the particles passing the 5mm sieve at least 80% shall have two or more fractured faces.

Coarse Aggregate: Of the particles retained on the 5mm sieve at least 70% shall have two or more fractured faces.
### 307.03.02 Properties of Laboratory Compacted Plant Mix

#### 1) Conventional Mixes

<table>
<thead>
<tr>
<th>Mix “A”</th>
<th>Mix “B”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BASE COURSE</strong></td>
<td><strong>SURFACE AND OVERLAY</strong></td>
</tr>
<tr>
<td>V.M.A., %</td>
<td>12 min</td>
</tr>
<tr>
<td>Plant Mix Moisture, %</td>
<td>0.2 max</td>
</tr>
<tr>
<td>Marshall Stability, N</td>
<td>5400 min</td>
</tr>
<tr>
<td>Flow (0.25mm units)</td>
<td>9 - 15</td>
</tr>
<tr>
<td>Air Voids, %</td>
<td>3 - 6</td>
</tr>
</tbody>
</table>

#### 2) Maintenance Mixes

<table>
<thead>
<tr>
<th>Sheet</th>
<th>Mix “M”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>Maintenance Thin Overlay</td>
</tr>
<tr>
<td>VMA, %</td>
<td>-</td>
</tr>
<tr>
<td>Plant Mix Moisture, %</td>
<td>-</td>
</tr>
<tr>
<td>Marshall Stability, N</td>
<td>2250 min</td>
</tr>
<tr>
<td>Flow (0.25mm units)</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Air Voids %</td>
<td>3 - 8</td>
</tr>
<tr>
<td>Marshall Blows</td>
<td>35 - 50</td>
</tr>
</tbody>
</table>

#### 3) Polymer Modified Mixes

<table>
<thead>
<tr>
<th>Mix “A-PM”</th>
<th>Mix “B-PM”</th>
</tr>
</thead>
<tbody>
<tr>
<td>V.M.A., %</td>
<td>12 min</td>
</tr>
<tr>
<td>Plant Mix Moisture, %</td>
<td>0.2 max</td>
</tr>
<tr>
<td>Marshall stability, N</td>
<td>6150 min</td>
</tr>
<tr>
<td>Flow, (0.25mm units)</td>
<td>9 - 15</td>
</tr>
<tr>
<td>Air Voids</td>
<td>3 - 6</td>
</tr>
</tbody>
</table>

**NOTE:** Fine aggregate shall conform to Section 307.02.01

#### 4) SuperPave Mixes

The properties of the laboratory compacted plant mix shall be within the requirements of the Asphalt Institute’s SuperPave Level 1 Mix Design, Superpave Series No. 2 (SP-2).
5) Polymer Modified Bridge Mastic Mixes

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>LIMIT Single lift and Rehabilitation</th>
<th>LIMIT Membrane</th>
<th>LIMIT Overlay</th>
<th>TEST ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binder Content (%)</td>
<td>8.5 min</td>
<td>9.5 min</td>
<td>6.5 min ± 0.3%</td>
<td>D2172/ ATT-12 Part II</td>
</tr>
<tr>
<td>Marshall Stability (N)</td>
<td>6,000 min</td>
<td>5,200 min</td>
<td>7,000 min</td>
<td>D 1559</td>
</tr>
<tr>
<td>Flow (250 μm)</td>
<td>20 max</td>
<td>20 max</td>
<td>20 max</td>
<td>D 1559</td>
</tr>
<tr>
<td>VMA (%)</td>
<td>14 min</td>
<td>18 min</td>
<td>14 min</td>
<td></td>
</tr>
<tr>
<td>Air Voids (%)</td>
<td>2 - 4</td>
<td>3 max</td>
<td>3 - 5</td>
<td></td>
</tr>
<tr>
<td>Permeability @ 70 kPa (cm/s)</td>
<td>10⁻⁷ max</td>
<td>10⁻⁷ max</td>
<td>10⁻⁷ max</td>
<td>D 5084-90</td>
</tr>
<tr>
<td>Film Thickness (μm)</td>
<td>8.0 min</td>
<td>8.0 min</td>
<td>7.0 min</td>
<td></td>
</tr>
</tbody>
</table>

6) Test Standards
- Percent V.M.A. - minimum compaction 50 blows each face (mechanical compactor).
- Marshall Stability, N - at 60° Celsius, compaction 50 blows each face (mechanical compactor).
- Flow - measured at point where the load just begins to decrease.
- Percent Air Voids - that portion of asphalt cement absorbed into the aggregate shall be compensated for in the calculation.

307.03.03 Design Asphalt Cement Content

1) General

The design asphalt cement content shall be a minimum of 4.5 percent for Mix A and a minimum of 6.0 percent for Mix B-50. Alternate designs may be considered at the sole discretion of the Material & Research Engineer. No design of conventional and SuperPave mixes will be approved having a film thickness less than those specified below.

The design asphalt cement contents shall meet the minimum specified film thickness on both the fine and coarse sides of the mix gradation envelope.
2) Minimum Film Thickness
Mix "A" 6.0μm
Mix "B" 7.0μm
Mix “M” 7.0μm
Mix "A-PM" 6.0μm
Mix “B-PM” 7.0μm

3) Surface Area Calculations
Surface area shall be calculated as set out in the most recent edition of the Asphalt Institute Manual MS-4 except that the total surface area shall be corrected to a common aggregate relative density of 2.65 as per the following calculation:

Corrected Surface Area = Total S.A. × 2.65

Where: A = Bulk Relative Density of Aggregate.

4) Film Thickness Calculations
Film thickness shall be calculated as follows:

\[ 10 \times \frac{C - D}{E \times F} \text{μm} \]

Where:
C = Percent Binder by Mass of Dry Aggregate
\[ C = \frac{100}{100-B} \times B \]

Where:
B = Percent Binder by Mass of Total Mix
D = Percent Absorbed Binder
E = Corrected Surface Area
F = Binder Relative Density
307.04.00 DESIGN MIX FORMULA

307.04.01 General

Before any mix shall be used a laboratory design mix formula for each class of asphalt hot mix to be placed on work covered by these Specifications shall be developed. A compliance design mix formula consists of an envelope gradation within the range of values of Conventional Mixes. At no time shall the filler content (passing 80 micron) exceed 20 percent of the fine aggregate fraction (passing 2.36mm). For Conventional mixes design density values shall be established by the Marshall Method – 50 or 75 blows with mechanical compaction. Bulk specific gravity shall be determined using oven dried aggregate.

The percentages of aggregate include mineral filler, when used, and refer to the complete dry mix. The percentages of asphalt cement refer to the complete asphalt concrete mixture. All percentages are by weight.

At least 48 hours prior to the use of any mix on work covered by these Specifications the Contractor shall make available to the Materials & Research Engineer a sample minimum weight of 60kg, of the mix to be used, for confirmation of compliance to all Specifications. If compliant, the test results shall constitute the design mix formula for the mix for purposes of determining deviations and variations.

The use of any mix on work covered by these Specifications without the approval of the Materials & Research Engineer shall be done solely at the risk of the Contractor.

Any deviation from any standard shall be cause for refusal.

Notwithstanding any of the above, all materials used on work governed by these Specifications shall be compliant to those Specifications.

**Note:** *SuperPave PG grading shall be supplied for each asphalt cement used.*

307.04.02 Tolerances

1) Conventional Mixes

The job mix gradation shall be maintained within the requirements of Conventional Mixes, which are the master range of tolerances and shall govern over any other tolerances prescribed.

Allowable variations in aggregate gradation:

±3 percent on material retained on the 160 micron and coarser

±1 percent on material retained on the 80 micron sieve.

Maximum allowable variations in asphalt cement content:

±0.3 percent of the design mix within a test lot.
2) SuperPave Mixes
The job mix gradation shall be maintained within the requirements of the Asphalt Institute’s SuperPave Level 1 Mix Design, SuperPave Series No. 2 (SP-2) and such that the gradation falls below the “Restricted Zone Boundary”.

Allowable variations in aggregate gradation:
±3 percent on material retained on the 160 micron and coarser
±1 percent on material retained on the 80 micron sieve.

Maximum allowable variations in asphalt cement content shall be within -01% and +0.3% of the design mix within a test lot.

307.04.03 Determination of Value of Non-Compliant Asphalt

1) Conventional Mixes
Project average asphalt cement content deviating from design value shall result in the following value adjustment.

<table>
<thead>
<tr>
<th>Deviation of</th>
<th>Payment Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 0.2</td>
<td>70% value</td>
</tr>
<tr>
<td>0.2 to 0.3</td>
<td>50% value</td>
</tr>
<tr>
<td>0.3</td>
<td>No payment</td>
</tr>
</tbody>
</table>

2) SuperPave mixes
The average asphalt cement content deviating from design value within a test lot shall result in the following value adjustment.

<table>
<thead>
<tr>
<th>Asphalt Cement Content Deviation from Design</th>
<th>Payment Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.2%</td>
<td>70%</td>
</tr>
<tr>
<td>-0.3%</td>
<td>50%</td>
</tr>
<tr>
<td>&gt; ±0.3%</td>
<td>Remove &amp; replace</td>
</tr>
</tbody>
</table>
DETAILED SPECIFICATIONS

308.00.00 ASPHALTIC CONCRETE PAVEMENTS

308.01.00 Pavement Design
308.02.00 General Equipment Requirements
308.03.00 Preparations for Paving
308.04.00 Paving Operations
308.05.00 Payment Adjustments
308.06.00 Road Planing
308.07.00 Hot In-Place Recycling
Prior to constructing surface improvements a pavement design shall be submitted, under cover letter, by the developer, City Project Manager or his consulting engineer to The City of Calgary, Transportation, ROADS, Materials & Research for approval.

All pavement designs shall conform to the requirements of the relevant Standard Drawings.

Where exceptions to the Standard Drawings are requested to accommodate cold weather construction, the lift of 25 mm crushed gravel may be replaced by an equivalent thickness of asphalt concrete, subject to the approval of the Materials & Research Engineer. For Major or Collector Roads with already approved designs and where the design asphalt thickness is a minimum of 20mm greater than the thickness specified in our Standard Drawings 454.1005.002 and 454.1005.009, the lift of 25 mm Crushed Gravel may be replaced by 80mm Base Course Gravel.

All pavement designs shall be gravel based. Pavement designs shall be prepared by a qualified professional engineer such that the pavement structure has the same bearing value as the full depth pavement shown on Standard Drawing 454.1005.013.

Pavement designs shall include a review of subgrade drainage and/or water table concerns and shall provide recommendations for the use of continuous subdrains and separation membranes.

Note: A transverse subdrain, connected to the storm sewer system, shall be installed at the joint wherever a gravel based road with a downhill grade joins a road constructed with full depth pavement.

The subgrade shall be graded without a quarter-crown, to provide positive drainage from the center of the roadway to the curb and gutter. On super-elevated roadways the subgrade shall conform to the super-elevated grades.

Placing and compaction of gravel shall be carried out in accordance with Chapter 305.

Minimum design shall be based on the actual soaked CBR values of the representative soils compacted to a density equal to the density recommended for the subdivision. Samples shall be selected by qualified personnel from a testing agency to confirm that they are representative of site conditions and tested according to ASTM Standards.

If no soaked CBR tests were done on the representative soils, a soaked CBR value of One(1) shall be used for the minimum design.

Pavement design shall be based on the predicted traffic patterns or on the following minimum traffic patterns for the designated streets, whichever is the greater.
308 - 2

For roadways having a predicted DTN greater than 500, the full-depth equivalent pavement structure can be determined using Standard Drawing 454.1005.014 or AASHTO Guide for the Design of Pavement Structures (1993).

Design Traffic Number (DTN) is defined as the average daily number of equivalent 80 kN single axle loads (ESALs) for the design lane during the design period. The design period shall be a minimum of 15 years.

The determination of the Design Traffic Number (DTN) or total ESALs over Design Life shall be based on the predicted Average Annual Daily Traffic AADT per day per direction. The following Load equivalency factors shall be used for the following vehicles:

- Single Unit Trucks (SUT) 0.881
- Tractor Trailer Combinations (TTC) 2.073
- Transit buses (BUS) 2.000
- Passenger (CAR) 0.0004

308.01.03 Minimum Asphalt Thickness

The following minimum asphalt thickness shall be incorporated into all granular based pavement designs.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Base Lift (mm)</th>
<th>Final Lift (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>Residential Collector</td>
<td>110</td>
<td>40</td>
</tr>
<tr>
<td>Industrial</td>
<td>110</td>
<td>40</td>
</tr>
<tr>
<td>Major and Arterial</td>
<td>160</td>
<td>40</td>
</tr>
</tbody>
</table>

Positive drainage to the storm sewer system by means of catch basin or storm manhole weeper holes shall be provided from all granular bases.

308.01.04 Allowable Deflections

All design roadways constructed under these Specifications shall demonstrate an average deflection at or below the following maximum allowable deflections:

<table>
<thead>
<tr>
<th>Road Classification</th>
<th>Maximum Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>50 mils</td>
</tr>
<tr>
<td>Residential Collector</td>
<td>35 mils</td>
</tr>
<tr>
<td>Industrial</td>
<td>35 mils</td>
</tr>
<tr>
<td>Major and Arterial</td>
<td>25 mils</td>
</tr>
</tbody>
</table>
The average deflection shall be based on a minimum of ten Benkelman Beam tests. Interval between testing points shall not be greater than 50 meters.

308.01.05 Deflection Testing

Deflections are to be determined using the procedure known as the "CGRA Benkelman Beam Rebound Procedure" as set out in the "Guide to the Structural Design of Flexible and Rigid Pavement in Canada" published by the Roads and Transportation Association of Canada (April 1971) except that the points on the pavement to be tested shall be alternating on the wheel paths.
308.02.00 GENERAL EQUIPMENT REQUIREMENTS

308.02.01 General

All equipment furnished by the Contractor shall be of approved design and be maintained in its best mechanical condition. Units that drip fuel, oil or grease shall be removed from the project until such leakage is corrected to the satisfaction of the Engineer.

308.02.02 Asphalt Mixing Plant

All asphalt mixing plants shall be registered with Alberta Environment and shall be operated in accordance with the "Code of Practice for Asphalt Paving Plants.

The plant used by the Contractor for the preparation of the asphalt paving mix shall have the following features.

1) Asphalt Storage Tanks:
Tanks for storage of asphalt shall be capable of heating the material, under effective and positive control at all times, to temperature requirements set forth in the specifications. Heating shall be accomplished so that no flame comes in contact with the heating tank. A circulating system for the asphalt shall be provided of a size adequate to ensure the proper and continuous circulation between storage tank and mixer during the entire operating period. All pipes and fittings shall be properly insulated to prevent heat loss. The discharge end of the asphalt circulation system shall be maintained below the surface of the asphalt in the storage tank to prevent discharging hot asphalt into open air.

2) Cold Feed Control:
For control of the cold aggregates each size designation or grading separation of the cold aggregates, as well as blending sand, shall be fed onto the cold stone belt or elevator by separate mechanical feeders. A mechanical feeder may have one or more vertical divider plates for feeding two (2) or more size designations through a single feeder if the feeder is equipped with individual gates that can be operated separately for each aggregate size.

3) Pollution Control:
Asphalt plants shall meet all Government regulations regarding pollution control and pollution control equipment.

4) Sampling Facilities:
Batch asphalt plants shall be equipped with devices for safely sampling hot aggregate in the bins. These may be sampling "gates" or "windows" in sides of the bins, or devices for diverting the flow of aggregate from the bins into sample containers.

Drain cocks shall be installed on the side of the asphalt storage tank for the purpose of easily and safely obtaining a representative sample of the asphalt cement.

A ladder or platform, shall be so located at the truck loading space to permit easy and safe inspection or sampling of the mix as it is discharged into the truck.
5) Temperature Measuring Equipment:
A temperature measuring instrument reading from 50° Celsius to 200° Celsius shall be fixed in the asphalt feed line at a suitable location near the discharge valve at the mix unit.

The plant shall be equipped with a temperature measuring instrument placed at the discharge chute of the dryer so as to register automatically or indicate the temperature of the heated aggregate.

The plant shall meet the Specification for automatic recording of batching and maintenance of records.

The Engineer reserves the right to judge the efficiency of the above instruments; and for better regulation of temperature of the aggregates, he may direct the replacement of the instrument by some approved temperature recording apparatus; and may further require daily charts of the regulator to be filed with the Engineer.

6) Asphaltic Hot Mix Silos
Prior to use, the specifications of proposed asphaltic hot mix silos shall be submitted for written approval. The Engineer reserves the right to withdraw approval if asphaltic hot mix shows evidence of segregation, loss of temperature or oxidation after storage.

308.02.03 Spreading Equipment

1) Asphalt Spreaders
Track mounted spreading machines shall be self-propelled and capable of placing a uniform layer of asphalt mix to the depth shown on the plans or ordered by the Engineer.

Rubber tired spreaders with equivalent placing specifications may be used for placing multi-lift asphalt pavements, surface over concrete base, or for placing multi-lift asphalt pavement in lanes six meters and under in width.

The design of the spreader shall meet the following minimum requirements:

- Track length or wheel base of at least 2m.
- Track width of at least 250mm.
- Placing depth variable from 15mm to 150mm.
- Standard mat width not less than 3m.
- Mat width shall be variable in 150mm and 300mm increments by use of equipment supplied by the manufacturer of the spreader.
- The screed shall include a tamping bar or vibratory strike-off device and a controlled heating device for use when required. The screed shall strike-off the mix to the depth and cross-section specified and produce a finished surface of uniform texture.

Control of the screed shall be by automatic sensing devices. Longitudinal control shall be accomplished by a sensor which follows a string line, ski, or other reference. The grade sensor shall be moveable and mounts provided so that grade control can be established on either side of the paver. A slope control sensor shall also be provided to maintain the proper transverse slope of the screed.
If at any time a breakdown of automatic controls occurs, the Contractor may continue operation of the equipment using manually operated controls for a maximum period of three working days, to allow time for repair of the automatic control system.

- Infrared heaters with automatic heat control shall be mounted for joint heating during spreader operation.

2) Spreader Boxes
Spreader boxes towed by a dump truck, shall be supported on their own wheels, and have a screed or strike-off edge which shall be adjustable for depth of course and crown.

308.02.04 Compaction Equipment

1) General
The Contractor shall supply sufficient compaction equipment to:

(1) provide a compaction rate that equals or exceeds the placing rate of the spreader.
(2) ensure full compaction of the asphaltic concrete before the temperature of the mat falls below 77° Celsius.

2) Pneumatic - Tired Roller - Variable Pressure
Pneumatic - tired roller shall meet the following Specifications:

- minimum 10mm overlap in the tracks made by front and rear wheels.
- the wheels shall not wobble.
- minimum tire size shall be 900 x 20.
- shall have a self contained tire inflation/deflation system, adjustable from 250 kPa to 850 kPa.
- shall be equipped with a gauge indicating tire pressures, the gauge mounted in a position where it may be readily checked by the Engineer.
- minimum ground contact pressure of 600 kPa when tires are inflated to 850 kPa.
- shall be equipped with tire scrapers and some method of reducing the loss of tire heat, approved by the Engineer.

When used in areas of less than 100 m² the pneumatic-tired roller shall meet the following specifications:

- effective 10mm overlap in the tracks by front and rear wheels.
- the wheels shall not wobble.
- the tires shall be of equal size and diameter, and be smooth.
- minimum tire pressure of 400 kPa with minimum operating weight of 450 kg/m of tire width.
- shall be equipped with an efficient means of keeping the tires wet to prevent adhesion of the mix to the tires.
3) **Steel Wheel Roller**
Steel rollers shall meet the following Specifications:

- two axle, tandem steel wheels, self propelled.
- Provide a minimum compression in the driving wheels of 450 kg/m of wheel width.
- the rolls shall be free of flat areas, openings, or projections that mar the surface of the pavement.
- shall be equipped with roll scrapers and some method of wetting the rolls to prevent adhesion of the mix to the rolls.

4) **Vibratory Steel Roller**
Vibratory steel rollers shall meet the following Specifications:

- self-propelled.
- shall have a split steering roll
- minimum dead weight of 2,000 kg including ballast.
- shall be equipped with roll scrapers and some method of wetting the rolls to prevent adhesion of the mix to the rolls.

5) **Tamping Irons**
Tamping irons shall meet the following Specifications:

- shall be of sufficient weight to compact the edges to the same degree as the main body of the pavement.
- tamping irons used to consolidate material along curbs, gutters and other structures inaccessible to the roller shall:

- weigh no less than 10 kg.
- have no side longer than 200mm.

Mechanical compaction equipment, satisfactory to the Engineer, may be used instead of tamping irons.

308.03.01 **Pressure Distributor**

The pressure distributor used for applying the liquid asphalt shall be so designed and operated as to distribute the asphalt in a uniform spray, without atomization. The spray patterns made by alternate nozzles shall meet with no overlap, to avoid streaking. Nozzles should be of the same manufacture, size, and type, and should be set in the spray bar so that all nozzle slots make the same angle with the longitudinal axis of the spray bar.

The distributor shall be equipped with:

- A speed indicator registering meters per minute,
- A meter registering liters per minute passing through the nozzles. Both of these gauges shall be readily visible to the operator of the distributor.
- Equipment suitable for accurately indicating the temperature of the asphalt.
If equipped with heating attachments, the distributor shall also be equipped to circulate or agitate the asphalt during the heating process.

308.03.00 PREPARATION FOR PAVING

308.03.01 General

The hot asphaltic mixture shall be laid upon a dry firm base, true to grade and cross-section and free from all screenings or other loose or foreign material. No hot mix shall be spread while the sub-base is wet or when other conditions prevent proper spreading, finishing or compaction.

Existing asphalt surfaces and gutter areas shall be thoroughly cleaned of all loose or deleterious materials or objects prior to commencing either the leveling course or top lift paving operations.

Cleaning prior to paving shall be considered as incidental to the Unit Rate for asphaltic concrete.

Granular materials and/or asphalt shall not be used as fill under full-depth asphaltic concrete paving unless positive drainage is provided. If extra material is required in order to bring the subgrade to the proper grade, the material shall be obtained from a suitable earth borrow area.

308.03.02 Prime Coat and Tack Coat

1. Procedure for Prime Coat
Upon a uniformly damp base course, a prime coat of diluted SS-1 emulsified asphalt shall be uniformly applied, as follows:

- dilution rate: 2 parts SS-1 emulsion to 1 part water.
- distribution rate: 2.0 liters per square meter.
- emulsion temperature: 20°C to 50°C.
- ambient air temperature: shall be greater than 4°C.
- curing time: a minimum of two hours. If weather or other conditions have been such that the prime has not fully cured at the end of two hours, the Engineer may extend the curing period as he deems necessary.

2. Procedure for Tack Coat
If tack coat is specified between successive lifts of asphaltic concrete, it shall be applied only after the surface has been cleaned of all loose or deleterious materials or objects, and as follows:

- type: SS-1H emulsion.
- distribution rate: not greater than 0.5 liters per square meter.
- emulsion temperature: 20°C to 50°C.
- ambient air temperature: greater than 4°C
308.03.03 Manholes, Valves and Appurtenances

The Contractor shall bring all manholes, water valve boxes and other appurtenances to the finished grade of the road or median strip at no cost to The City. This work shall be done in each individual block no later than one week after final paving operations have been completed in that block. The cost of repairing or replacing water valves, manholes and other appurtenances damaged as a result of the Contractor's operations shall be borne by him. The City does not allow any tolerance in the shape of the finished surface in the vicinity of any utility appurtenance. The Contractor shall be responsible for correcting any irregularities in the final surface around any utility appurtenance, at his expense and within the time specified by the Engineer.

Raising or lowering of manhole rims shall be done using precast concrete collars, conforming to ASTM Designation C-139, along with an approved cement mortar. The completed work shall be in accordance with the Standard Specifications Sewer Construction. All work shall be subject to inspection and approval by the Engineer before it shall be considered complete.

Adjustment of sewer manholes shall be done in accordance with the following:

- All manhole adjustments shall be in accordance with the Standard Specifications Wastewater Construction.
- Top lift paving shall not commence until all necessary manhole rebuilding has been done.
- The Contractor shall be responsible for lowering or raising of manholes to a maximum of 300mm when the grade change can be made by use of collars or brickwork.

Manhole adjustments within 300mm of final grade which involve alterations to other than brick work or collars shall be undertaken by the Contractor under the Schedule of Force Account Rates. Manholes to be raised or lowered more than 300mm or manholes which require replacement shall be done by the Contractor at Force Account Rates.

Where existing manholes have excessive rows of bricks or collars and the adjustment does not place the manhole within the accepted standard, the manhole shall be brought to standard by the Contractor at Force Account Rates when directed to do so by the Engineer.

N.B. When Wastewater rebuilds or alters a manhole, final grade adjustment shall be completed by the Contractor.

The following procedure shall be used in the adjustment of Water Valves.

- The Contractor shall not use force to adjust a valve without first loosening the set screw on the top box.
- To raise a service valve, either loosen set screw on top box or a collar and threaded nipple can be used.
- To raise a main valve, the set screw should first be loosened. If the top box fails to move, risers can be used to bring it to grade (maximum of three (3) risers).

- The Contractor shall replace any broken top boxes.

This work shall be done at no cost to The City. Replacement of existing broken top boxes shall be done under the Schedule of Force Account Rates. The Contractor shall repair, at his expense, any damage to valves resulting from construction.

Before being considered acceptable, any projecting manhole, valve or other appurtenance shall be ramped at 1:40 at the Contractor's expense.

### 308.03.04 Elevation of Manholes

Where top/final lift of asphalt is not placed in the same year as the base lifts, manhole frames/covers and other surface appurtenance shall be set to interim asphalt grade.

Manholes, etc., are not required to be ramped if the adjacent asphalt has been planed or the top lift omitted, provided frames, etc., do not project by more than 40mm for more than fourteen (14) days. Projecting covers, etc., shall be signed.

Ramping, where required, shall be at 40:1. Ramping shall be at Contractor's expense.

Where top lift, overlays, etc., are to take place it shall be permissible to record the position of appurtenances for raising immediately after the asphalt placement is complete.

### 308.04.00 PAVING OPERATIONS

#### 308.04.01 General

1) **Notification:**

The Contractor shall notify the Materials & Research dispatcher of ROADS of his intention to place asphaltic concrete by 15:00 hours (3:00 p.m.) of the previous working day to permit arrangements to be made for the inspection and testing of the work. Contractor notification directly to a testing agency shall not relieve his obligation in this regard.

Advice as to work for later than the following working day, except in the case of weekends, shall be taken as advice only and shall not constitute notification as required under this section.

**Note:** *Materials & Research maintains a 24 hour answering service at 268-1602.*
2) Asphalt Placing Temperature
No asphalt shall be dispatched to the field unless The City temperature as issued by the Atmospheric Environmental Service meets the requirements of the following table:

<table>
<thead>
<tr>
<th>Depth of Asphalt</th>
<th>Minimum Air Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface lift (&lt;50mm)</td>
<td>15°C</td>
</tr>
<tr>
<td>50mm lift</td>
<td>4°C and rising</td>
</tr>
<tr>
<td>75mm lift</td>
<td>2°C and rising</td>
</tr>
<tr>
<td>≥100mm lift</td>
<td>Compaction requirements shall govern</td>
</tr>
</tbody>
</table>

A 2° Celsius tolerance shall be permitted for plant start-up temperatures.

No asphalt lift of less than 100mm shall be placed on or against any surface which is at a temperature of less than 5° Celsius.

3) Hours of Operation
No loads of mixture shall be dispatched from the plant after sunset or during hours of darkness unless loads can be placed and compacted in accordance with these Specifications, and suitable artificial illumination is provided, all subject to the Engineer's approval.

4) Termination
At the sole discretion of the Engineer the placing of asphaltic concrete may be suspended or terminated at any time after October 31.

308.04.02 Mixing of Hot Asphaltic Mixtures

1) Continuity of Production
For the time period that work is in progress on any City inspected project, at the Engineer's discretion, the plant may be limited to producing only the mix type required for that project.

2) Asphalt Plant Temperatures
Field Laying Temperatures

- Air Temperature Above 15°C - 115°C to 150°C.
- Air Temperature Below 15°C - 140°C to 160°C.

(i) Aggregate ± 8°C of field laying temperature.

(ii) Asphalt Cement - 135°C to 155°C - ± 15°C of aggregate temperature.

308.04.03 Transportation of Hot Asphaltic Mixtures

Vehicles used for the transportation of hot mix asphalt from the plant to the site of work shall have tight metal boxes previously cleaned of all foreign matter. The inside surface may be
lightly lubricated with thin oil or soap solution just before loading but excess of lubricant shall not be permitted. Any puddling of the lubricant constitutes excess usage. For purposes of checking asphalt mixture temperatures, trucks shall have an accessible 15mm diameter hole drilled into the driver's side of the box, at a distance of 300mm from the box bottom and 150mm clear of the reinforcing ribs.

To protect the load from adverse weather conditions during transit, trucks shall carry at all times tarpaulins of sufficient weights and size to cover the entire open area of the truck box. Regardless of weather conditions, tarpaulins shall be used when ordered by the Engineer. Tarpaulins shall be used when the air temperature is below 16° Celsius.

308.04.04 Spreading Operations

1) Truck Operations
Hauling trucks which contact the paving machine during the dumping or spreading process at any point other than the pushing rollers on the paving machine are not allowed.

The speed and weight of hauling trucks shall be regulated so that, in the opinion of the Engineer, no damage occurs to any portion of the work under way. Any damage to the prime coat or the bituminous mat caused by Contractor's equipment shall be repaired by the Contractor at his own expense prior to paving.

2) Level Course
Leveling of uneven or broken surfaces over which asphaltic concrete is to be placed shall be accomplished by the use of asphaltic concrete placed with a motor grader, a paving machine, by hand raking, or by a combination of these methods as directed by the Engineer.

Prior to level coursing or top lift paving, the Contractor shall remove all cold mix asphaltic concrete. Payments for the removal of the cold mix shall be made under the Schedule of Force Account Rates.

Before commencing the level course operation the Engineer shall be contacted so that assistance can be given in maintaining the proper grades, lines and typical cross-sections.

After placement, the asphaltic concrete used for leveling shall be compacted thoroughly with pneumatic-tired rollers.

In the event that the level course is to be used as a wearing surface, the level course shall be machine placed.

3) Spreader Operations
All asphaltic concrete shall be placed with an asphalt spreader, unless otherwise authorized by the Engineer.

The asphaltic concrete shall be laid in lifts to the design thickness applicable to the road classification. Lift thickness shall not exceed 110mm.
On new construction where an established grade; i.e. curb, is lacking, a string line reference shall be required. The maximum spacing between string line stakes shall not exceed eight meters; the line shall be tensioned to 50 kg and secured. Adjacent mats shall be controlled by use of the grade sensor. No relaxation of the above procedure shall be permitted without the written approval of the Engineer.

The spreader shall be operated in such a manner as to distribute the asphaltic concrete mix to proper cross-section, width, and thickness without causing segregation of the mix. Small segregated areas which may occur shall be corrected immediately. The forward motion of the spreader shall be controlled so that no irregularities in the pavement surface are caused by excessive speed. The rate of placement of the mixture shall be uniform, and be coordinated with the production rate of the asphalt plant to minimize intermittent operation of the spreader.

Any failure of the machine to produce a smooth, uniformly dense mat, free from irregularities, shall be corrected immediately to the satisfaction of the Engineer.

4) **Areas Inaccessible to Spreaders**

Areas which are inaccessible to the spreading machine may be paved by other methods, as directed by the Engineer. Motor graders or approved types of truck attached spreaders may be used to pave inaccessible or irregularly shaped areas. Hand raking shall be kept to a minimum.

In small areas or where the use of mechanical equipment is not practical, the mix may be spread and finished by hand. Material shall be handled so as to avoid segregation. Excessive oiling of tools shall not be permitted. Raking shall be done carefully and in such a manner that after the first passage of the roller over the mixture a minimum amount of back patching is required.

Areas which are inaccessible to spreading machine, motor grading or approved types of truck-attached spreaders, and which are not immediately adjacent to the main paving area, and which in the opinion of the Engineer require the placement of the asphalt completely by hand, may be hand placed.

5) **Joints**

Longitudinal joints and transverse joints shall be made in a careful manner.

Paving joints shall not be placed in the same vertical plane. Longitudinal joints shall be offset at least 75mm and transverse joints in succeeding courses shall be offset at least 600mm.

Joints in the surface course shall be offset a minimum of 300mm beyond the limit of proposed lane markings.

Edges against which additional pavement is placed shall be vertically formed to true line. In making the joint along any adjoining edge such as curb, gutter or an adjoining pavement and after the hot mixture is placed by the finishing machine, enough material shall be carried back to fill any space left open.
The exposed edges of all cold asphalt joints and the face of concrete gutter shall be cleaned and painted with a thin coat of hot asphalt cement. When the ambient air temperature is less than 10° Celsius, joints shall be heated using an infrared heater prior to painting with hot asphalt cement.

Where a transverse joint is made with a cold asphalt mat, the joint shall be made on a vertically true line. Cold jointing shall be done in such manner as to ensure a thorough and continuous bond between the cold and the hot mats.

A cold asphalt shall be one where the surface temperature, taken within 600mm of the edge of the mat is less than 65° Celsius.

In order to eliminate longitudinal cold joints in the surface course, the use of two asphalt spreaders in tandem shall be required wherever road widths permit.

6) Scale Sheets and Haul Cards
It shall be the Contractor's responsibility to furnish the Engineer with a copy of all haul sheets or tickets and scale sheets by the end of the next working day.

308.04.05 Compaction Procedures

1) General
The rollers shall be kept in continuous motion while on the hot mat in such a manner that all parts of the pavement receive equal compression.

The surface of the mixture after compaction shall be smooth and true to established section and grade. Areas in which any mixture shows an excess or deficiency of asphalt, or uneven distribution of asphalt due to insufficient mixing, or which becomes loose, broken, raveled, mixed with dirt, or is in any way defective, shall be removed and replaced with fresh hot mixture at the Contractor's expense and be immediately compacted to conform with the surrounding area.

Areas inaccessible to the roller shall be compacted by tamping with mechanical or hand tampers.

2) Final Rolling
Final rolling shall be carried on until all roller marks are eliminated and no further compaction is possible.

3) Density Requirement
   a) Conventional Mixes: The asphalt mat shall have a minimum density of 96 percent of its maximum design density. Densities less than 96 percent shall be paid for as shown in 308.05.02.

   b) SuperPave Mixes: The minimum, in place, compaction level shall be 93 percent of the design maximum density. Densities of 92 percent shall result in payment of 70 percent of the contract price. Density results of 91.0 percent to 91.9 percent shall result in payment of 50 percent of the contract price. Density results less than 91.0 percent shall result in the removal and replacement at the contractor's expense.
4) Field Density Test Area
Field Density Test area shall be a maximum of 1,000 square meters per test lot.

5) Surface Smoothness
The completed surface of the top or wearing course shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds.

Every lift of asphalt placed shall meet the following tolerances:

- The final surface shall not vary more than 6mm when checked with a 3m straight edge.
- Grades following construction shall not vary by more than 15mm from design grade.

6) Repair of Defective Areas
Asphalt spreaders are required for areas greater than 100 m². All required equipment shall be on site prior to placing the asphalt hot mix.

Where 60 percent of the road requires patching and/or several other patches are required across the width of the street it shall be necessary to extend the treatment across the full width of the street.

A patch shall not be placed on top of another patch. The original patch shall be removed.

At the discretion of the Engineer, areas of possible bridging shall be corrected by removing the asphalt, bringing the compacted base to proper grade and patching; all to the satisfaction of the Engineer.

All patches shall be square with no jagged edges.

Patches shall retain the original cross-section and be feathered out properly.

Asphalt skin patching shall be subject to the temperature requirements for asphalt surfacing.

Safety patching shall be allowed between the issuance of the Construction Completion Certificate and the Final Acceptance Certificate.

308.04.06 Diesel Fuel

Diesel fuel is prohibited from use as a lubricant or asphalt release agent on all City Projects. This includes its use on the beds of asphalt delivery vehicles, pneumatic tire rollers, tools and for clean up operations.
308.05.00 PAYMENT ADJUSTMENTS

308.05.01 Quantity Adjustment

The basis for payment for the asphaltic mixture shall be the actual tonnage incorporated in the work unless this tonnage is in excess of the computed volume multiplied by the design asphalt density.

Payment for excess tonnage shall be as follows:

- Flexible pavement 125mm or less laid on a graveled street or an embankment constructed with imported base gravel - "base gravel" Unit Rate.

- In the event that the amount of "B" asphaltic concrete incorporated in the work exceeds the 40mm design thickness, then the excess tonnage shall be paid for at the Unit Rate for leveling course.

- In areas with no vertical control (i.e. curb and gutter or other) no payment shall be made for materials used in excess of those set out in the Contract Documents without prior written approval of the Engineer.

For calculation purposes each street or section shall be treated on an individual basis.

Compensation shall be made for undercutting based on:

- The computed volume multiplied by the design asphalt density, or

- The actual tonnage incorporated in the undercut.

The above quantities are paid for at the Unit Rate for this item, except that for pavement found deficient in density and/or asphalt content, only the price stipulated in Section 308.05.04 shall be paid.
308.05.02  Low Density Adjustment

1. Determination of Value of Low Density Asphalt (conventional mixes)

1. Figure 1.

2. If  
   a) Density is less than 91.5% of design, or
   b) Asphalt cement content is less than:

   3.9% for Mix 'A'
   5.4% for Mix 'B'

   The asphalt shall be replaced at Contractor's expense.
3. Determination of Value of Low Density Asphalt (SuperPave mixes)

The minimum, in place, compaction level shall be 93% of the maximum theoretical density.

<table>
<thead>
<tr>
<th>DENSITY (IN PLACE)</th>
<th>PAYMENT VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>92.0% - 92.9%</td>
<td>90%</td>
</tr>
<tr>
<td>91.0% - 91.9%</td>
<td>50%</td>
</tr>
<tr>
<td>&lt;91.0%</td>
<td>Remove &amp; replace</td>
</tr>
</tbody>
</table>

308.05.03 Asphalt Cement Content Adjustment

When deviations exceed 5% of project production the value shall adhere to 307.04.03

308.05.04 Quality Adjustment

1. Payment shall be determined as follows:

   Unit Rate x (Percentage Payment for Density) x (Percentage Payment for Asphalt Content Tolerance)

308.06.00 ROAD PLANING

308.06.01 General

The work shall consist of the milling of pavements to remove imperfections, bringing the planed surface to the specified grade and cross-section. Surface of the planed pavement shall be free of continuous longitudinal striations and acceptable for use as a riding surface for extended periods of time.

308.06.02 Equipment

The equipment furnished shall be specifically designed and built for this type of work. It shall be self-propelled with sufficient power, traction and stability to maintain accurate depth of cut and slope.

Automatic grade and slope shall be provided. Acceptable tolerances on the milled surface shall be ± 6mm of reference grade and cross-section and of ± 3mm for matching adjacent milled surface.

The cutting head shall be capable of full drum width milling of a 75mm thickness of asphaltic concrete in a single pass.
The equipment shall have a means of controlling dust.

Equipment using heaters shall have adequate shielding to prevent damage to property in the vicinity of the planing.

Means shall be provided to immediately remove materials being trimmed from the surface of the traveled roadway. Personnel shall be provided to insure that all cuttings are removed from street surface within 30m of milling operation and swept within 150m. Stock piling of planed material shall not be permitted on the project site.

The machine shall be capable of producing a minimum coverage of 2,000 square meter per hour while planing a minimum of 15mm of the existing pavement per pass and be able to cut flush to all gutters, curb walls, manholes, valves, catch basins or other obstructions within the paved area.

**308.06.03 Construction**

Sufficient passes, or cuts, shall be made such that all irregularities or high spots are eliminated, and that 100 percent of the surface area is planed to the design grade or to the satisfaction of the Engineer. The Contractor shall provide all necessary labor, materials and equipment to load the asphalt cuttings into dump trucks supplied by him and hauled to a disposal area designated by the Engineer.

All material recovered in the planing process remains the property of The City.

No work shall be permitted between the period 7 - 9 a.m. and 4 - 6 p.m. on major and arterial streets during weekdays.

Certain streets may require night planing or weekend planing as designated by the Engineer. Upon completion of planing, the surface shall be left in such condition that it can be reopened to traffic as soon as the loose materials have been removed.

**308.06.04 Method of Measurement**

Pavement planing performed and provided above shall be measured by the square meter of variable depth up to a maximum of 25mm below the surface i.e. any planing up to a depth of 25mm shall be paid at the rate quoted for that depth. An additional pay item shall be provided for areas requiring extra depth in increments of 25mm. The Contractor shall provide a planing rate for 50mm and 75mm cuts.

**308.07.00 HOT IN-PLACE RECYCLING**

**308.07.01 General**

The work included in this Section shall be the heating, scarifying, re-mixing, re-spreading and re-compacting of existing asphaltic concrete in accordance with the Specifications.
308.07.02 Equipment

The hot in-place recycler shall be self-propelled and capable of producing a minimum of twenty-one (21) MJ using liquid propane. The heating area shall be complete with a suitable hood to control road surface heating and to prevent heat damage to surroundings. The hot in-place recycler shall be equipped with dual rows of spring mounted scarifying teeth, independently operated. The teeth shall be spring mounted and the vertical spring action shall be at least 75mm to enable scarifying of depressions in the road surface.

The hot in-place recycler shall be capable of completing an average of 350 to 420 square meter of roadway surface per hour.

The hot in-place recycler shall have a wheelbase of at least 9.15 meters to provide maximum leveling action.

The hot in-place recycler shall have a minimum width of 3.05 meters.

The hot in-place recycler shall be equipped with adjustable blades, or a reversing auger to move the recycled material along the screed to provide a consistent smooth finished surface. The hot in-place recycler shall be equipped with an adjustable, heated vibratory screed with hydraulic side extensions.

The hot in-place recycler shall be equipped with a means of applying an asphalt rejuvenating agent after the surface has been scarified but before the recycled asphalt is re-mixed. The rejuvenating agent shall be applied at a rate that shall be determined for each separate location. Approval of the Engineer shall be obtained for the type of rejuvenating agent, which the Contractor proposes to use.

Overhanging trees shall be protected from heat damage by individual shielding and water spray or any combination the Contractor deemed practical in conjunction with The City Parks and Recreation Department. The Contractor shall be responsible for all damages to trees and shrubbery caused by the hot in-place recycling operation.

308.07.03 Preparation

The surface of the roadway shall be dry and cleaned of all loose and foreign matter prior to hot in-place recycling.

308.07.04 Scarifying

The surface of the existing asphalt pavement shall be uniformly heated by a continuously moving heater scarifier. Minimum scarification penetration shall not be less than 13mm at any point across the full width of scarifying. The pavement being scarified shall be moved by a spinning or tumbling action, in order to fill cracks and turn the worn and polished faces of the exposed aggregate.
308.07.05 Re-Spreading

The re-mixed material shall be re-spread on the roadway surface by means of a heated vibratory screed to provide a constant and smooth surface with a cross-section acceptable to the Engineer. An oscillating screed or tamper bar screed shall not be acceptable.

A gutter cut of 15mm, tapered to a minimum of 1 meter from the lip of gutter, shall be required to allow for the following surface overlay to match the lip of gutter.

A minimum temperature of the re-mixed material measured directly behind the screed shall be as follows:

<table>
<thead>
<tr>
<th>Air Temperature</th>
<th>Mix Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>10°C</td>
<td>120°C</td>
</tr>
<tr>
<td>15°C</td>
<td>115°C</td>
</tr>
<tr>
<td>20°C</td>
<td>110°C</td>
</tr>
</tbody>
</table>

If the ambient air temperature is below 10°C, permission shall be required from the Engineer to proceed with any work.

308.07.06 Compaction

Compaction equipment used shall meet the requirements of Section 308.02.04. Compaction of the scarified material shall be carried out by the use of pneumatic-tired rollers and steel-wheeled rollers. All compaction shall be completed within five minutes of scarifying.

The Contractor shall supply a proposed list of rolling procedures, including equipment to be used, to the Engineer for his approval.
**DETAILED SPECIFICATIONS**

<table>
<thead>
<tr>
<th>309.00.00</th>
<th>SPECIAL SURFACE CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>309.01.00</td>
<td>Asphaltic Curbs</td>
</tr>
<tr>
<td>309.02.00</td>
<td>Asphalt walkways and Bicycle Paths</td>
</tr>
<tr>
<td>309.03.00</td>
<td>Driveway Aprons</td>
</tr>
<tr>
<td>309.04.00</td>
<td>Roadway Paving Stones</td>
</tr>
<tr>
<td>309.05.00</td>
<td>Subdivision Roadway Entrance Features</td>
</tr>
</tbody>
</table>
309.00.00  **SPECIAL SURFACE CONSTRUCTION**

309.01.00  **ASPHALTIC CURBS**

309.01.01  **General**

The asphaltic hot mix composition used in the construction of asphalt curbs shall comply with the requirements of the Specifications for asphalt concrete pavements. Aggregate gradation shall be within the limits of Mix B, Asphaltic Concrete. A job mix of the aggregate gradation and asphalt content shall be determined, in the laboratory and in the field, to provide a finished curb of adequate stability and desired surface texture. If required, approved mineral filler shall be employed in the mix as directed by the Engineer.

309.01.02  **Asphalt Content**

Asphalt content by weight of total mix shall be increased from 0.5 to 1.0 percent over that used for hot asphaltic mixtures of the same aggregate gradation.

309.01.03  **Preparation of Curb Foundation**

Asphalt curbs are placed on existing pavement surfaces. Except for newly laid asphalt pavements with the surface still tacky and free from dust, a light tack coat of emulsified asphalt SS-1 shall be applied, by brush, before placing the asphalt curb.

309.01.04  **Placing Curb Mix**

Placement temperatures shall be according to temperature range as listed under "Temperature of the Paving Mix". The cross-section of the asphalt curb shall conform to standard curb molds. Curbs shall be consistent and constructed smooth, any sharp breaks are not accepted.

No curb mix shall be placed or transported when the air temperature is below 4° Celsius without the written permission of the Engineer.

1) **Machine Placing**

Asphalt curbing shall be placed by a self-propelled curbing machine which meets the Engineer's approval. Machine laid work requires no additional compaction. In areas where compaction is inadequate, the mix shall be adjusted, the machine loaded with additional weight or other measures taken to provide adequate compaction.

The curbing machine shall not be kept running while waiting for trucks. Curb mix shall be permitted to remain in the hopper while the machine is not in operation. The hopper shall be charged so as not to jar the curbing machine out of alignment.
2) Hand Placing
In areas inaccessible to the curbing machine, material shall be placed by hand in wood or metal forms constructed to the desired mold or cross-section of the asphalt curb. Material placed by hand shall be tamped into place and screeded to a smooth finish in a workmanlike manner, so that it blends with machine placed curb in cross-section alignment and grade. Forms are removed as soon as proper shape of the material can be maintained.

309.01.05 Joints

Asphalt curb construction should be a continuous operation in one direction to eliminate curb joints. However, where conditions are such that this is not possible, the joints between successive days work should be carefully made to ensure a continuous bond between the old and new sections of the curb. All contact surfaces of previously constructed curb should be painted with a thin, uniform coat of hot asphalt material just prior to placing the fresh curb material to the old joint.

309.01.06 Method of Measurement

Asphalt curb shall be measured by the number of linear meter of work completed and accepted. No deduction shall be made for flattening of curbs for entrances.

309.02.00 ASPHALT WALKWAYS AND BICYCLE PATHS

309.02.01 General

A walkway is a structure used by pedestrians only, whereas a bicycle path may be used by both cyclists and pedestrians.

309.02.02 Construction

In general, construction shall conform to Standard Drawing 454.1005.008.

Asphaltic concrete shall comply with the requirements of the Specification for Mix B in Chapter 307, Asphaltic Concrete. Mixing, placing and compaction shall conform to the requirements of Chapter 308, Asphaltic Concrete Pavements. Minimum thickness of asphalt shall be 100mm on a compacted subgrade. If the Contractor excavates below grade, he shall backfill with approved base gravel, compacted to the Engineer's satisfaction, at no expense to The City.

The finished asphalt surface shall be smooth, true to line, grade and cross-section.

309.02.03 Width of Construction

Walkways and bicycle paths are to be constructed to a basic width of 2500mm except as follows:

(i) In easements and rights-of-way adjacent to side property lines, the width shall be the full width of the easement or right-of-way, or three meters, whichever is the lesser.
(ii) Adjacent to rear property lines, the walkway or bicycle path shall be constructed on centreline, and to the width requirements on (i).

(iii) Adjacent to rear property lines, with a park or Community reserve on one side, the walkway or bicycle path shall be constructed on the property line opposite the reserve site, to the width requirements in (i).

309.03.00 DRIVEWAY APRONS

309.03.01 General

The following policies are in effect

- All driveways aprons shall adhere to the provisions in Chapter 311.

- Concrete, asphalt and inter-locking paving stones built to The City's standards by either the developer, builder, or homeowner shall be acceptable for driveway aprons;

- In cases where the developer cannot secure the construction of the driveway to The City's Specifications prior to the F.A.C. inspection, he has the option to frame and gravel the driveway in order to obtain the F.A.C., provided the garage did not form part of the original builder's package, and has only recently been constructed by the homeowner, or if the driveway apron is not to City Specifications.

- In those situations where the developer has to frame and gravel the driveway apron, he shall also issue a letter to the homeowner with a copy to the Development Office/Bylaw Enforcement Officer indicating that the driveway shall be completed to the above Specifications by the end of the following construction season.

- Minimum lateral clearance from the edge of the driveway apron to any obstacles, including fire hydrants, power poles, streetlights and trees, shall be 2.0 metres. A reduced clearance of 1.0 metre will be allowed if guard barriers are provided in accordance with the appropriate safety and design standards.

- Minimum lateral clearance from the edge of the driveway apron to any catch basins shall be 1.0 metre.

309.03.02 Residential Asphalt Driveway Apron

1) General

Asphalt shall be placed between the curb and separate sidewalk to conform with dimensions shown on Standard Drawing 454.1010.004.

Granular material shall conform to the requirements set forth in Chapter 303.

The asphaltic concrete shall be placed at a depth of 150m and shall comply with the Specifications for Mix B in Chapter 307.
2) Design
Surface shall be a minimum of 75mm of type "B" Asphaltic Concrete.
Granular base shall be a minimum of 100mm thick of 25mm crushed gravel.

3) Excavation
Excavation by hand or machine shall be performed to the proper line, grade and cross-section. All deleterious matter encountered at subgrade level shall be removed and replaced with approved base gravel. Before deposition of the asphaltic concrete the subgrade shall be thoroughly compacted by approved mechanical tamping devices to the Engineer's satisfaction.

If the Contractor excavates below grade he shall backfill with approved base gravel, at no extra cost to The City.
Excavated material shall be disposed of as described in these Specifications under "Excavation".

4) Granular Backfill
When the grade line of the asphalt apron is such that the walkway cross-section is in fill or embankment over 150mm deep, approved base gravel shall be used as fill material. Fills of 150mm or less shall be made with 25mm crush material. All granular materials are properly mechanically compacted to the Engineer's satisfaction. The base gravel shall be placed in 150mm layers and each layer or lift properly compacted with the use of vibratory compactors. Where necessary, water shall be used to aid compaction. The vibratory compactors shall be of an approved type as specified in Chapter 308.

5) Asphalt Hot Mix
The asphaltic hot mix wearing surface shall be placed to a minimum thickness of 150mm and be adequately compacted by approved mechanical compactors or self-propelled rollers, to the Engineer's satisfaction. The finished asphalt surface shall be smooth, true to line, grade and cross-section.

6) Forms
Side forms for asphalt driveway aprons shall be 1 x 6 lumber, properly seasoned and free from warps or other defects. The forms shall be well staked, braced or otherwise rigidly held true to the established lines and grades. No asphaltic hot mix shall be deposited against the forms until the forms and their placing have been approved by the Engineer. Forms shall not be removed after the asphaltic wearing surface has been placed.

309.03.03 Residential Paving Stone Driveway Apron

1) General
The driveway shall be constructed between the curb and separate sidewalk to conform with dimensions shown on Standard Drawing 454.1010.004 and conform to the requirements set forth in Chapter 315.

Lean concrete shall conform to the requirements set forth in Chapter 310.

Interlocking paving stones shall conform to the requirements of ASTM C936-82.
The finished section shall consist of a minimum 100mm of lean concrete overlaid by a layer of sand between 15mm and 20mm overlaid by the paving stones.

2) Excavation
Excavation by hand or machine shall be performed to the proper line, grade and cross-section. All deleterious matter encountered at subgrade level shall be removed. If the Contractor excavates below grade he shall backfill with approved base gravel at no extra cost to The City.

Excavated material shall be disposed of as described in the Specification under "Excavation".

3) Lean Mix Concrete
The lean mix concrete shall be placed to a minimum thickness of 100mm. The surface shall be smooth, true to line, grade, and cross-section.

4) Forms
Side forms for driveway aprons shall be 1 x 6 lumber, properly seasoned and free from warps or other defects. The forms shall be well staked, braced, or otherwise rigidly held true to the established lines and grades. Forms shall not be removed after the interlocking paving stone surface has been placed.

309.04.00 ROADWAY PAVING STONES

309.04.01 General

Construction shall conform to the requirements set forth in Chapter 315.

Written approval shall be granted by the Engineer prior to construction of road surface with paving stones.

Paving stones shall be set at a finished grade of 5mm above the lip of gutter.

A 150mm border of Class "A" concrete shall be placed along the transverse edges of the paving stone surface.

Paving stones shall be placed on a 10mm thick bedding of sand containing 6 percent bentonite.

Joints between paving stones shall be filled with sand containing 6 percent bentonite. Open areas between paving stones shall be filled with a non shrink mortar.

Thickness of Class "A" concrete base shall be 150mm for residential and collector streets 200mm for arterial and Major roads.

309.04.02 Maintenance Period

The paving stone area shall be subject to separate certification for acceptance by The City, with a maintenance period between the issuing of a C.C.C. and F.A.C. of five (5) years.
309.05.00  SUBDIVISION ROADWAY ENTRANCE FEATURES

309.05.01  General

Subdivision roadway entrance features shall not be constructed on roadways classified as "major" streets.

Unless prior written approval has been obtained from ROADS for the use of an alternate material, all subdivision roadway entrance features shall be made with synthetic fibre concrete. Subdivision designs showing entrance features using imprinted asphalt pavement will be rejected.

The surface texture of subdivision roadway entrance features shall have a skid resistance greater than or equal to the skid resistance of asphalt pavement.

Entrance features shall be located such that no manholes, valves or other utility appurtenances are encased within.

Materials and construction shall conform to the requirements set forth in Chapter 310.
### DETAILED SPECIFICATIONS

#### 310.00.00 PORTLAND CEMENT CONCRETE

<table>
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<tr>
<th>Subsection</th>
<th>Description</th>
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<td>Classifications</td>
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<tr>
<td>310.02.00</td>
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<td>310.03.00</td>
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<td>310.04.00</td>
<td>Concrete Properties</td>
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<td>310.05.00</td>
<td>Concrete Batching and Mixing</td>
</tr>
<tr>
<td>310.06.00</td>
<td>Testing</td>
</tr>
</tbody>
</table>
PORTLAND CEMENT CONCRETE

CLASSIFICATIONS

Class “A” Concrete

Class "A" concrete shall be used in areas where the streets are wider than 11 meters and at all driveway and lane crossings, bus stop aprons and wheelchair ramps or as designated by the Engineer. Class "A" concrete shall extend a minimum distance of 45 meters behind the face of curb line on each street intersecting into a Class "A" category street.

Class “B” Concrete

Class “B” concrete may be used in areas where the streets are 11 meters wide or less or as designated by the Engineer.

Lean Concrete

Lean concrete may be used as a base for interlocking concrete paving stone sidewalks and as a substitute for asphalt in the rehabilitation of the asphaltic roadway after curb and gutter replacement.

Synthetic Fibre Concrete

Synthetic fibrous concrete may be used as an alternative to concrete requiring steel wire mesh.

Synthetic fibrous concrete shall meet Class “A” concrete Specifications.

Fibre Reinforced Overlay Concrete - White Top

Fibre reinforced overlay concrete, hereinafter referred to as White Top shall refer to a minimum 100mm thick fibre reinforced concrete overlay on a prepared asphaltic base.

White Top concrete shall meet Class “A” concrete Specifications.

The white top road surface area shall contain steel fibre and no concrete colouring agent.

Coloured concrete shall be used in stamped concrete crosswalks. To facilitate stamping, synthetic fibre reinforcement shall be used in the coloured concrete.
310.02.00 MATERIALS

310.02.01 Cement

1) General
Cement used on the work shall be Portland Cement and shall be approved by the Engineer. Bulk or bag cement may be used, but bulk cement shall be batched by an approved weighing device. The cement shall meet the requirements of CSA A5-M88. The Contractor shall disclose the source of the cement being used.

2) Cement Types
Type 10 Normal
Type 30 High Early
Type 50 Sulphate Resistant

3) Storage
Cement shall be stored in a suitable weather tight building, silo or bin and protected from dampness. Facilities shall be provided to permit sampling and inspection of each shipment. Prior to use, representative samples shall be taken for testing.

4) Rejection
Cement shall be rejected if it fails to meet any of the requirements of these Specifications. Cement which has been in storage more than one (1) year after the original acceptance shall not be used.

310.02.02 Aggregate

1) General
Prior to establishing a source of aggregates, the Contractor shall have the aggregate sampled at the source of supply by The City’s appointed testing firm. The source of supply shall be approved if the samples submitted meet the requirements of these Specifications.

Records of the grading of all aggregates used for the production of concrete shall be maintained and disclosed to the Engineer upon request.

2) Fine Aggregate
Fine Aggregate: Less than 6mm particle size of natural or manufactured sand.

Fine aggregate shall meet the requirements of ASTM Designation C-33 except as modified by the following paragraphs.

Fine aggregate shall be natural or manufactured sand, washed clean, having hard, strong, sharp, durable uncoated grains and free from injurious amounts of dust, lumps, soft or flaky particles, mica, shale, alkali, organic matter, loam, or other deleterious substance. Sand shall be tested for impurities by colorimetric test in conformity with ASTM Designation C40 and sand giving a colour darker than the reference standard colour shall be rejected.
Should the necessity for frequent rejections occur, no further sand shall be accepted from that source and another approved source shall be required.

3) Coarse Aggregate
Coarse Aggregate: Greater than 6mm particle size.

Coarse aggregate shall conform to the requirements of ASTM Designation C-33 except as modified by the following paragraphs.

Coarse aggregate shall consist of gravel or broken stone composed of strong, hard, durable uncoated pebbles, or rock fragments, washed clean and free from injurious amounts of shale, coal, clay, lumps, soft fragments, dirt, glass and organic or other deleterious substances.

Aggregate sizing shall conform to ASTM Designation C-33, Table II Size No. 57.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>40mm</td>
<td>100</td>
</tr>
<tr>
<td>25mm</td>
<td>95 - 100</td>
</tr>
<tr>
<td>16mm</td>
<td>25 - 60</td>
</tr>
<tr>
<td>5.0mm</td>
<td>0 - 10</td>
</tr>
<tr>
<td>2.5mm</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

Aggregates shall be kept clean and free from all other materials during transportation and handling. The aggregates shall be kept separated from each other at the site, until measured and placed in the mixer.

4) Lean Concrete Aggregate
Lean concrete aggregate shall meet the following gradation:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>25mm</td>
<td>100</td>
</tr>
<tr>
<td>19mm</td>
<td>70 - 100</td>
</tr>
<tr>
<td>5.0mm</td>
<td>35 - 65</td>
</tr>
<tr>
<td>425μm</td>
<td>15 - 30</td>
</tr>
<tr>
<td>80μm</td>
<td>0 - 15</td>
</tr>
</tbody>
</table>

5) White Top Aggregate
White top coarse aggregate shall meet the following gradation:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.00mm</td>
<td>100</td>
</tr>
<tr>
<td>12.50mm</td>
<td>90 - 100</td>
</tr>
<tr>
<td>9.50mm</td>
<td>40 - 70</td>
</tr>
<tr>
<td>5.0mm</td>
<td>0 - 15</td>
</tr>
<tr>
<td>2.5mm</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>
310.02.03 Water

Water used in mixing concrete shall be clean and shall not contain acids, alkalies or organic materials. All water shall be furnished from sources approved by the Engineer. The Contractor makes his own arrangements for the supply and payment of all water used on the work.

310.02.04 Additives

1) General
Permission shall be obtained from the Engineer for the use of additives.

No additional payment shall be allowed to the Contractor for use of additives.

2) Fly Ash
Fly ash shall not be used in Class “A” or Class “B” concrete. If permitted by the Engineer fly ash may be used in non-shrink fill concrete, lean concrete and grout mixes.

Under special conditions and if permitted by the Engineer, fly ash may be used in extruded concrete. Prior to extrusion, the contractor shall inform the Materials and Research group of ROADS of his intention to use fly ash in the mix.

Fly ash shall only be incorporated into the concrete mix to improve workability. Under no circumstance shall fly ash be used as a substitute for cement.

3) Air Entraining Agent
Air entraining agent conforming to ASTM Designation C-260 shall be added to the batch independently. Sufficient air entraining agent shall be added to produce the air content specified, at the time of placing in the forms.

4) Water Reducing Agent
Water reducing agents, if used, shall conform to the requirements of ASTM Designation C-494. Before using a water reducing agent, the concrete supplier shall furnish evidence that it is compatible with the brand of air entraining agent he proposes to use.

For "White Top" concrete the water reducing agent shall be a Super Plasticizer. Brand name and specifications shall be submitted to the Engineer for review and acceptance prior to preparation of trial mixes.
5) Calcium Chloride

Calcium chloride shall only be used when approved by the Engineer, but in no case shall the amount added be greater than 2 percent of the cement weight. It shall not be used when the air temperature is above 4° Celsius.

310.02.05 Fibres

1) Synthetic Fibre

- Fibre shall be polypropylene
- Fibre Tensile strength shall be 550 MPa minimum.
- Fibre content shall be a minimum of 1 kg/m³
- Fibre shall be of the following length

<table>
<thead>
<tr>
<th>Agg. Top Size</th>
<th>Fibre Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>40mm</td>
<td>50mm</td>
</tr>
<tr>
<td>25mm</td>
<td>50mm</td>
</tr>
<tr>
<td>15mm</td>
<td>38mm</td>
</tr>
</tbody>
</table>

2) Steel Fibre

- Fibre shall be of carbon steel
- 50mm maximum length
- Aspect ratio (L/D) of 50 minimum
- Fibre shall be crimped or ends upset
- Steel fibre addition shall be a minimum of 1.5% of total weight of mix.

310.02.06 Curing Membrane

All curing membranes shall meet the requirements of ASTM Designation C-309.

310.03.00 CONCRETE MIX DESIGN

A testing firm shall prepare concrete mix designs which are submitted to the Engineer for each source of concrete supply prior to the commencement of the Contract. Trial mixes shall be prepared in the batch plant and/or truck mixed in accordance with the Concrete Specifications.

In each case where there is a change in the materials used a new trial mix shall be required.
310.04.00 CONCRETE PROPERTIES

310.04.01 Minimum Cement Content

Each cubic meter of concrete prepared under these Specifications shall contain not less than the following amount of Portland Cement:

<table>
<thead>
<tr>
<th>Class</th>
<th>Amount (kg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class &quot;A&quot;</td>
<td>325</td>
</tr>
<tr>
<td>Class &quot;B&quot;</td>
<td>300</td>
</tr>
<tr>
<td>Lean Concrete</td>
<td>150</td>
</tr>
<tr>
<td>White Top Concrete</td>
<td>450</td>
</tr>
</tbody>
</table>

* Quantity determination shall take place after air-entraining agent has been incorporated into the mix.

310.04.02 Water/ Cement Ratio

The water/ cement ratio for White Top concrete shall be 0.35 maximum.

310.04.03 Slump

All concrete, except lean concrete, shall have a maximum slump of 65mm Test Reference ASTM Designation C-143. Non-compliant concrete shall be removed and replaced at the Contractor’s expense.

Lean Concrete shall have a slump between 25mm and 75mm

310.04.04 Air Content

All concrete, except lean concrete, shall have a minimum air content of 5 percent with no tolerance allowed. Test Reference ASTM Designation C-231. Non-compliant concrete shall be removed and replaced at the Contractor's expense.

Lean concrete shall have an air content between 6% and 8%.
310.04.05 Air Content and Compressive Strength

Concrete supplied shall conform to the following requirements for air content and minimum compressive strength.

**MINIMUM ALLOWABLE COMPRESSIVE STRENGTH**

<table>
<thead>
<tr>
<th>PERCENT AIR CONTENT</th>
<th>CLASS &quot;A&quot;</th>
<th>CLASS &quot;B&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>27.5 Mpa</td>
<td>24.0 MPa</td>
</tr>
<tr>
<td>7</td>
<td>26.0 Mpa</td>
<td>22.65 MPa</td>
</tr>
<tr>
<td>8 and above</td>
<td>24.25 Mpa</td>
<td>21.25 MPa</td>
</tr>
</tbody>
</table>

The minimum allowable compressive strength shall be interpolated for values between reference points.

Lean concrete compressive strength shall be between 5 MPa and 10MPa.

White Top' concrete shall meet the following compressive strengths:
- 3 days 25MPa minimum
- 28 days 35MPA minimum

Concrete not achieving the minimum allowable strength shall be removed and replaced at the Contractor's expense.

310.04.06 Seasonal Requirement

Concrete placed prior to September 30 shall attain the minimum allowable compressive strength in 28 days. For concrete placed after September 30, minimum allowable compressive strength shall be attained in seven days.

310.05.00 CONCRETE BATCHING AND MIXING

310.05.01 Equipment

1) General
Mixers and agitators will be operated within the limits of capacity and speed of rotation designated by the manufacturer of the equipment.

2) Concrete Plant
Bins with adequate separate compartments shall be provided in the batching plant for fine and for coarse aggregate. Each bin compartment shall be designed and operated so as to discharge efficiently and freely, with minimum segregation, into the weighing hopper. Means of control shall be provided so that, as the quantity desired in the weighing hopper is approached, the material may be shut off with precision. Weighing hoppers shall be constructed so as to eliminate accumulations of tare materials and to discharge fully.
Indicating devices shall be in full view and near enough to be read accurately by the operator while charging the hopper. The operator shall have convenient access to all controls.

Scales shall be accurate when static load tested to ± 0.4 percent of the total capacity of the scale.

The device for the measurement of water shall be capable of delivering to the batch the quantity required within the accuracy required in these Specifications. Measuring tanks shall be equipped with outside taps and valves to provide for checking their calibration, unless other means are provided for readily and accurately determining the amount of water in the tank.

3) Mixers and Agitators
Mixers may be stationary mixers or truck mixers.

Agitators may be truck mixers or truck agitators.

Stationary mixers shall be equipped with a metal plate or plates on which are plainly marked the mixing speed of the drum or paddles, and the maximum capacity in terms of the volume of mixed concrete.

Each truck mixer or agitator shall have attached in a prominent place a metal plate or plates on which are plainly marked the gross volume of the drum, the capacity of the drum or container in terms of the volume of mixed concrete and the minimum and maximum mixing speeds of rotation of the drum, blades, or paddles.

All stationary and truck mixers shall be capable of combining the ingredients of the concrete within the specified time.

The agitator shall be capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

310.05.02 Proportioning

1) Cement
Except as otherwise specifically permitted, cement shall be measured by mass. It shall be weighed on a scale and in a weigh hopper which shall be separate and distinct from those used for other materials. When the quantity of cement in a batch of concrete exceeds 30 percent of the full capacity of the scale, the quantity of cement as indicated by the scale, shall be within ± 1 percent of the required weight. For smaller batches to a minimum of one cubic meter, the quantity of cement used shall be not less than the required amount nor more than four percent in excess. Under special circumstances, approved by the Engineer, cement may be measured in bags of standard weight. No fraction of a bag of cement shall be used unless it is weighed.
2) Aggregate
Aggregate shall be measured by mass. Batch masses shall be based on dry materials and be the required masses of dry materials plus the total mass of moisture (both absorbed and surface) contained in the aggregate. The quantity of aggregate used in any batch of concrete as indicated by the scale shall be within ± 2 percent of the required mass when weighed in individual aggregate weigh batches.

In a cumulative aggregate weigh batcher, the cumulative mass after each successive weighing shall be within ± 1 percent of required cumulative amount when the scale is used in excess of 30 percent of its capacity. For cumulative mass less than 30 percent of scale capacity, the tolerance shall be ± 0.3 percent of scale capacity of ± 3 percent of the required cumulative mass, whichever is less.

3) Water
Mixing water shall consist of water added to the batch, ice added to the batch, water occurring as surface moisture on the aggregates, and water introduced in the form of admixtures. The added water shall be measured by mass or volume to an accuracy of one percent of the required total mixing water. Added ice shall be measured by mass. In the case of truck mixers, any wash water retained in the drum for use in the next batch of concrete shall be accurately measured; if this proves impractical or impossible the wash water shall be discharged prior to loading the next batch of concrete. Total water (including any wash water) shall be measured or weighed to an accuracy of ± 3 percent of the specified total amount.

4) Additives
Powdered additives are measured by mass, and paste or liquid additives by mass or volume.

Volumetric measurement shall be within an accuracy of ± 3 percent of the required amount, or 30 cm³ whichever is greater.

Weighing accuracy shall be within ± 3 percent of the required mass.

Additive dispensers of the mechanical type capable of adjustment for variation of dosage, and of simple calibration, are recommended.

310.05.03 Mixing

1) General
Ready mixed concrete shall be mixed and delivered in accordance with the requirements set forth in ASTM Designation C-94, CSA. Standard A.23.1.3 and shall be subject to all provisions herein relative to materials, strength, proportioning, consistency, measurement and mixing.
2) Mixing Requirements
Under normal ambient weather conditions the concrete shall:

- Be mixed for a minimum of 10 minutes at mixing speed before placing.
- Be deposited in the forms within 90 minutes, after the introduction of mixing water, and aggregate. The time of charging shall be machine printed on the driver's delivery form.

3) Cold Weather Requirements
When the air temperature is at or below 4°C or when in the opinion of the Engineer there is a probability of its falling to that limit during the placing period, or within 24 hours, the temperature of the concrete, immediately after being deposited in the forms, shall be not less than 16°C nor more than 32°C. To accomplish this, the mixing water, and if necessary the fine aggregates, are heated. Aggregates shall not be heated above 65°C and all frozen lumps of aggregate are excluded from the mix. When the exposure is severe, either due to low air temperature, location of the work, or thin sections of concrete, the temperature of the concrete shall approach the higher 32°C limit.

To avoid the possibility of flash set when either water or aggregate is heated to a temperature in excess of 38°C water and aggregate shall come together first in the mixer in such a way that the temperature of the combination is reduced to below 38°C before cement is added. For mass concrete, the minimum temperatures may be reduced at the discretion of the Engineer.

4) Retempering
Concrete shall not be retempered if test values are within Specifications at the time of delivery to the site.

Concrete may be retempered at the job site with water and/or air entraining agent if the following requirements are met:

- Mixing time after the admixture or water has been introduced shall not be less than three minutes at mixing speed.
- Total mixing and agitating time for the load shall not exceed 90 minutes.

Off-site retempering of concrete shall not be permitted.
310.06.00   CONCRETE TESTING

310.06.01   General

All concrete supplied for City Contracts shall be tested by The City or by a recognized Testing Laboratory appointed by the Engineer.

310.06.02   Cement

Cement shall be sampled without undue delay. The method of sampling shall be subject to approval by the Engineer.

At the end of every month the Contractor shall submit to The City copies of the cement tests, which were received by the concrete ready-mix plants from their suppliers. The tests shall be representative of the cement used in the concrete poured during the month.

When cement is stored for a period exceeding six (6) months it shall be re-tested prior to use.

Tests required are:
- Fineness Test.
- Normal Consistency.
- Time of Set (Vicat Method) ASTM Designation C-191.
- Compressive Strength ASTM Designation C-109.

The Engineer reserves the right to appoint an independent testing laboratory to carry out tests on the cement as frequently as is deemed necessary.

310.06.03   Mix Analysis

Concrete shall be weighed and tested in the plastic state for slump, entrained air, cement content and sand and gravel analysis.

Concrete samples may be taken at the plant or construction site at a frequency of one per day per crew or as designated by the Engineer.

All concrete shall meet the Specifications for slump, entrained air, and cement content. All fine and coarse aggregates shall meet the gradation and Specifications for their application.

Additional air and slump tests on site are taken as required by the Engineer.

310.06.04   Test Cylinders

Test cylinders shall be made, stored and tested in accordance with ASTM Designation A23.2. In hot weather correct storage temperatures shall be maintained by ventilation from sand or burlap, and in cold weather by using heating devices.
When heating is impractical at the site it shall be noted that cylinders are not to be transported any considerable distance immediately after molding. It is preferable to transport the sample of concrete to the molding and curing site, so that the freshly molded specimens are moved only a few feet by hand. At all times the cylinders shall be handled in a manner that provides adequate protection against damage and ensures that test results provide a sound basis for evaluation of concrete quality.

Each test consists of three cylinders, broken at 28 days. The average breaking strength of the two cylinders with most closely related breaking strengths determines the compressive strength of the test sample.

Air and slump tests shall be taken in every case when cylinders are cast.

### 310.06.05 Field Tests

In addition, concrete in place in the field may be tested as follows.

1) **Density Tests**  
Approximately 24 hours after placing, concrete may be tested for density using rapid test methods.

2) **Concrete Spacing Factor**  
At the discretion of the Engineer a 100mm diameter core may be taken and subjected to further laboratory testing by the linear traverse method. Refer ASTM Designation C-457, "Modified Point-Count Method, Air-paste ratio method of calculation".

Concrete tested by this method using a magnification of 60X and found to have a spacing factor greater than 0.2mm shall be rejected, and complete replacement of the work shall be required.

Notwithstanding ASTM Designation C-457, the results of one full traverse shall be held as representative of all concrete placed the same day.

### 310.06.07 Compliance Verification

Where concrete is deemed unacceptable and is removed, the Contractor shall verify, by commissioning an approved testing laboratory to conduct linear traverse testing at his own expense, that the concrete left in place at each end of the excavation complies to the Specifications. Testing shall be in accordance with ASTM Designation C-457 as amended by Section 310.06.05.
DETAILED SPECIFICATIONS

311.00.00  CONCRETE SIDEWALK, CURB AND GUTTER

311.01.00  General
311.02.00  Site Preparation
311.03.00  Base Preparation
311.04.00  Forms
311.05.00  Reinforcing
311.06.00  Concrete Placing
311.07.00  Finishing
311.08.00  Curing
311.09.00  Commercial Sidewalks
311.10.00  Crossings, Bus Stop Aprons and Wheel Chair Ramps
311.11.00  Concrete Walkways and Bicycle Paths
311.12.00  Rehabilitation
311.13.00  Maintenance Standards
311.14.00  Quantity Measurements
311.00.00 **CONCRETE SIDEWALK, CURB AND GUTTER**

311.01.00 **GENERAL**

Portland Cement concrete sidewalk, curb and gutter, medians, traffic islands, gores, driveway crossings and aprons shall be constructed in accordance with these Specifications and the Standard Drawings. The type of construction used and the location shall be as shown on the construction plans, or as directed by the Engineer, and be in accordance with the provisions of this chapter.

Standard face curb shall be required around schools and at bus stops.

Wheel chair ramps are compulsory at all intersections, where sidewalks cross either curb and gutter or curb and at Community Mailbox locations.

See Chapter 310 for classes of concrete, slump, air, etc.

311.01.01 **Standard Drawings**

Standard Drawings shall be taken to show absolute minimum section dimensions. Any shortfall from this shall be cause for removal and replacement.

311.01.02 **Protection of work**

The Contractor shall supply and place all necessary material to protect the work from rain, dust, frost or other similar weather action. The Contractor shall sprinkle the roadway with water at his own expense, if deemed necessary by the Engineer for the protection of the work.

The Contractor shall also barricade the work and keep people, animals and vehicles off the work for a period of five days after the finishing of the concrete is completed. Any damage occurring to the work during this five day period regardless of origin, shall be replaced or repaired by the Contractor to the satisfaction of the Engineer within one month after notice is given to the Contractor.

Where the Engineer considers damage to any private walk, driveway, steps, fence, gate, posts or other private property, is caused by negligence on the part of the Contractor, the Contractor, at his own expense and within two weeks of notice being given, shall repair or replace the specific damage to the satisfaction of the Engineer. The Engineer's decision on all matters pertaining shall be final.

311.01.03 **Traffic**

If it is necessary to block off lanes of traffic in order to have access to the job site, the Contractor shall make the necessary arrangements with the Transportation Department before commencement of the work.
311.01.04 Access

The Contractor shall maintain adequate access for pedestrian and vehicular traffic to all public and private property during the entire operation at no extra cost to The City.

311.01.05 Markings

1) Contractor and Year of Construction
The Contractor shall mark the sidewalk, curb and gutter with a suitable marking tool approved by the Engineer, showing the name of the Contractor and the year of construction. The letters and numerals of the marking tool shall be 40mm high.

Marks are placed at the end of curve of each corner of the block; i.e. there shall be a minimum of eight marks per block. If the construction begins or terminates within the middle of the block, the Contractor shall also mark these locations or as directed by the Engineer. In addition, a similar mark shall be embossed on the corner on each apron and driveway crossing.

2) Reinforcing
All sections containing reinforcing rods shall be marked at their extreme limits with a marking tool showing the letter "R". This letter shall be 40mm high.

311.01.06 Cold Weather Requirements

1) Air Temperature
The air temperature shall be taken to be the official City temperature as issued by the Atmospheric Environment Service.

2) Off Season Concrete
Between September 30 and the subsequent May 01 the following applies:

1. The minimum allowable concrete compressive strength shall be attained in seven days.

2. The Contractor shall adequately cover and protect the freshly placed concrete and maintain it at a minimum temperature of 4°C for the first 24 hours after placing. The concrete shall be prevented from freezing for 72 hours.

3) Job Preparation
When concrete is placed in cold weather, all equipment needed for adequate protection and curing shall be on hand and ready for use before concrete placement is started.

4) Placing
Snow and ice shall be removed using heat where necessary. In no case shall concrete be deposited on or against any surface which is at a temperature of less than 4°C.
5) Temperature Control
The Engineer, at his sole discretion, may require the Contractor, at the Contractor’s expense, to establish, by way of an independent third party, a record of the daily temperature of the concrete for its initial 72 hours in each pour of 150 linear meters or portion thereof.

6) Auxiliary Heating
If the Contractor uses forced air heating units, the concrete shall be kept continuously moist during the complete heating and curing period. Combustion type heaters may be used but they shall be so constructed and so placed that their combustion gases do not come in contact with surfaces of the concrete during placing and curing.

The period of protection shall be a minimum of 72 hours and the Contractor shall bear the cost of all heating and protection.

311.01.07 Hot Weather Requirements
The requirements of this Section govern whenever the ambient air temperature is 23°C or above.

The concrete temperature at time of placing shall not exceed 30°C.

Retarding admixtures may be used subject to the approval of the Engineer.

311.01.08 Temperature Non-Compliance
Any concrete failing to comply with the temperature requirements shall:

(a) if compliant to all other Specifications, be left in place with no payment, or if in a development area, the developer shall deposit with The City an amount of money equivalent to the value of the work,

(b) if non-compliant in any other aspect, be replaced,

(c) if freezing has occurred, be replaced.

Where non-compliance occurs, the test indicating noncompliance shall be held as representative of the test area.

311.01.09 Extruded Sidewalk, Curb and Gutter
The Contractor shall be given the option of constructing extruded sidewalk, curb and gutter at the Unit Rate. Automatic grade and line control shall be required.

Extruded concrete shall be finished as shown in the applicable drawings, with the surface brush finished; a dense uniform surface shall be required on curb and gutter.
311.01.10  **Monolithic Sidewalk**

Monolithic sidewalks shall be constructed in one operation unless prior written approval has been granted by the duly authorized ROADS representative. If written approval is granted to construct in two separate operations, the Contractor shall install 150mm long dowels, made from #10 rebar, into the back of curb at 750mm centre to centre. The cost of installing dowels shall be included in the Unit Rate for Monolithic Sidewalk.

In areas where a separate sidewalk is constructed at the back of an existing curb, dowels shall be drilled into the back of curb at 750mm intervals. The cost of installing dowels shall be included in the Unit Rate for separate Sidewalk.

311.01.11  **Termination**

At the sole discretion of the Engineer, the placing of concrete may be suspended or terminated at any time after September 30.

311.02.00  **SITE PREPARATION**

311.02.01  **Break Out**

The Contractor shall not break out any existing sidewalk and/or curb and gutter without first receiving approval from the Engineer. The designated amount of breakout shall be paid for at the Unit Rates. Any breakout exceeding the designated amount and the related replacement shall be at the Contractor's own expense.

All breakout shall end at a contraction, expansion or surface joint. The edge of a surface mark shall be sawn to a depth of 50mm minimum, while contraction joints may be neatly hand chiseled. All work involved in saw-cutting or hand chiseling shall be included in the Unit Rates.

The broken pieces of concrete shall be properly disposed at Waste Management sites, and conform to those conditions outlined in Chapter 302 within 24 hours after commencement of the break out operation.

311.02.02  **Excavation and Fill**

1) **General**

The excavation shall be to proper grade, line and cross-section for placing of concrete sidewalk, curb and gutter, or combined sidewalk, curb and gutter and construction of concrete catch basins and concrete invert crossings. If the Contractor excavates below grade, he shall backfill with approved base gravel, compacted to the satisfaction of the Engineer at no extra cost to The City.

Excavation includes the removal and disposition of all material of whatever nature encountered, within the boundaries necessary for the preparation and construction of concrete sidewalk, curb and gutter or combined sidewalk, curb and gutter, catch basins and other structures to the required cross-section, alignment and depth shown on the plans.

All unsuitable matter encountered at sub-grade level shall be removed and replaced with
approved gravel fill, thoroughly compacted (Chapter 305). The sub-grade shall provide a uniform bearing capacity over the area of the structure.

All approved loam or grass sods encountered during excavation shall be stockpiled at site for use during backfilling, and lawn rehabilitation.

Under no circumstances shall any excavated material be sold or otherwise disposed of by the Contractor, Sub-Contractors, or any of their employees. Excavated material from a natural gravel base area may be used as base gravel material for fills or embankments providing the use of such material has first been approved in writing by the Engineer.

2) Gravelled Streets
Where concrete sidewalk, curb and gutter or combined sidewalk, curb and gutter is constructed on a street or avenue which has been gravelled, the Contractor at no cost to The City, shall blade the gravel to within the middle 3.6 meters of the roadway. On completion, this material shall be replaced to the satisfaction of The City.

311.03.00 BASE PREPARATION

311.03.01 Earth Subgrade and Base Gravel Fill

   The subgrade shall be true to cross-section and grade. Irregularities in the subgrade may be adjusted by use of compacted crushed gravel. Prior to the placing of concrete the subgrade shall be compacted to a uniform density of not less than 97.0 percent of design density.

   When it is necessary to bring the base to proper elevation by the use of gravel, the Contractor shall supply approved gravel, and provide all material and labour necessary to load, haul and place it on the finished subgrade. Placing and compaction of gravel shall be carried out in accordance with Chapter 305.

   Where concrete sidewalks are placed on a fill, a shoulder of one meter width (measured from the edge of the sidewalk) shall be constructed. The fill shall be constructed with 3:1 side slopes.

   The Contractor shall place and compact a 50mm lift of 25mm crushed gravel prior to placing concrete for islands or medians. In areas, where island and median concrete is placed above asphalt, the entire volume between the asphalt and the concrete shall be filled with compacted 25mm crushed gravel. The supply, placing, and compacting of this gravel shall be deemed incidental to the Unit Rates for Sidewalks, or Median and Island Concrete.

   If, in the opinion of the Engineer, there is a danger of excessive absorption of concrete water by the earth or gravel base, the Contractor shall adequately sprinkle the base with water.

311.03.02 Replacement of Unstable Material

   Where unstable material is encountered during excavation, the Contractor shall notify the Engineer and, if directed, shall excavate the unstable material and backfill the area with an approved impervious fill, in accordance with Chapter 302. The Contractor shall be responsible for the replacement, at his own expense, of any failure of the work which, in the opinion of the Engineer, was caused by an unstable base.
311.04.00 FORMS

311.04.01 Formwork

Forms for sidewalk, curb and gutter, combined sidewalk curb and gutter, aprons, invert crossings and catch basins shall be of metal or timber properly seasoned and free from warps or other defects. Metal forms shall be of approved type and section. The face of curb form shall be removable without disturbing back and gutter forms. Forms shall be smooth and clean on the surface(s) next to the concrete and be oiled with an approved lubricant.

Forms shall be rigidly held true to the established lines and grades. No concrete shall be deposited against forms until the forms and their placing has been approved by the Engineer.

Any forms which have lost their shape or dimension or whose surfaces have become dented or rough, shall not be used. The Engineer may at any time, disallow the use of any forms he considers unsatisfactory to secure proper quality of the work.

311.04.02 Stripping of Forms

Face of curb forms are to be removed after the initial set. Adequate care shall be taken in removing forms to avoid spoiling or marring the concrete. Such patching as may be necessary shall be started immediately after removal of the forms.

Immediately after form removal and/or patching, the exposed surfaces shall be sprayed with a curing membrane.

311.05.00 REINFORCING

1) General
Where required by the Engineer, structures shall be reinforced in accordance with the drawings provided.

Cold drawn steel wire shall meet the requirements of ASTM Designation A 82.

Wire mesh shall meet the requirements of ASTM Designation A 185. Overlapping of wire mesh reinforcing shall be a minimum of 300mm and be wired together.

Bar reinforcing shall meet ASTM Designation A 184 and ASTM Designation A 304 intermediate grade new billet deformed steel. Overlapping of bar reinforcing shall be 30 bar diameters and be wired together.

The mesh and/or bar reinforcing shall be supported above the compacted gravel base to ensure a 50mm cover of concrete. The manner of supporting the reinforcing shall be approved by the Engineer.
2) **Wire Mesh**
A single layer of 150mm by 150mm No. 10 by 10 gauge wire mesh shall be installed in private residential driveway crossings and commercial sidewalks.

A double layer of 150mm by 150mm, No. 10 by 10 gauge wire mesh shall be installed in public lanes and commercial driveway crossings.

The mesh shall extend the full width of the crossing. In aprons, the mesh shall extend to the full width, special attention being made that the mesh extends into the corners of the apron. All acute angle apron corners shall be constructed and reinforced as shown in the Standard Drawing 454.1013.004.

Reinforcing mesh shall be rolled or otherwise straightened to make a perfectly flat surface before placing.

3) **Reinforcing Bars**
A 10M reinforcing bar shall be installed, as shown in the drawings, in separate curb and gutter at all crossings.

The Engineer may specify that reinforcing bars, in addition to mesh, are used on certain crossings.

4) **Synthetic Fibre Concrete**
The Engineer may specify that synthetic fibre concrete be used instead of steel reinforced concrete

5) **Bull Noses on Medians**
Where bull noses are to be constructed at the ends of medians, reinforcing rods may be left extending from the median in order to tie into the bull nose.
311.06.00  CONCRETE PLACING

311.06.01  General

The Contractor shall notify the Materials & Research dispatcher of ROADS of his intention to place concrete by 15:00 hours (3:00 p.m.) of the prior working day to permit arrangements to be made for the inspection and testing of the concrete. Contractor notification directly to a testing agency shall not relieve his obligation in this regard.

Advice as to work for later than the following working day, except in the case of weekends, shall be taken as advice only and shall not constitute notification as required under this section.

Note: Materials & Research maintains a 24 hour answering service at 268-1602.

After mixing, the concrete shall be transported to the job site, and delivered as close as possible to the point of deposit. Rehandling of concrete shall not be permitted.

Concrete operations shall be continuous until the section, panel, or scheduled pour is completed.

311.06.02  Placing of Concrete

The concrete shall be placed in such a manner as to prevent segregation of the ingredients. Special care shall be taken to place the concrete against the forms, particularly in corners, in order to prevent voids, rough areas, and honey combing.

The concrete shall be placed in such a manner as to prevent spreading, the concrete shall be struck-off and compacted by means of an approved vibrating screed. Vibrators or vibrating screeds shall operate at a minimum of 5000 cycles per minute. The technique and use of vibrators or vibrating screeds shall be at the discretion of the Engineer. Every precaution shall be taken to make all concrete solid, compacted, watertight, and smooth.

Freshly placed concrete shall be protected in an approved manner against damage from the elements, and construction operations harmful to concrete.

311.06.03  Joints

1) Expansion joints
Lateral expansion joints are required at the beginning and end of every corner. The joint shall consist of an approved mastic preformed material, 15mm by 90mm cross-section, laid plumb and straight, 6mm below the finished sidewalk grade.
2) Contraction Joints
Contraction joints shall be cut at every 1.5 meters by means of a marking tool or other approved method. Joints shall not be less than 30mm in depth and 6mm in width. The edges of the joint shall be rounded off with an edger having a radius of 6mm.

Contraction joints in medians, traffic islands and gores shall extend the full width of the median, traffic island, curb and gutter and gore. If because of irregular shapes the matching of joints is not possible, the Engineer may approve an alternate jointing pattern.

Contraction joints in monolithic sidewalk shall extend through the full width of the sidewalk and curb and gutter.

Contraction joints in regional pathways shall be sawed. In lieu of sawing the toolmark shall be broomed after cutting.

Contraction joints at catch basins shall be cut through the full width of the sidewalk in line with both outside edges of the catch basin side inlet.

3) Sawed Joints
Saw cuts as specified are made with a concrete saw capable of producing a true straight joint of constant depth as specified.

4) Surface Joints
Surface joints shall be 15mm in depth and 6mm in width. The edge of the joint shall be rounded off with an edger having a radius of 6mm.

5) Isolation Joints
Expansion joint material, 15mm thick, and the full depth of the sidewalk, shall be placed around all surface installations and between the sidewalk and existing buildings.

Contractor shall be required to carefully fit, cut and mark the sidewalk around all openings, iron covers, manholes, vaults, waterworks stop cock boxes, lamp standards, hydrants, poles and other surface installations in accordance with Standard Drawing 454.1013.018. The surface joint shall be neatly tooled and marked to the satisfaction of the Engineer.

311.07.00 FINISHING

311.07.01 Troweling and Brushing
After placing, the concrete shall be adequately worked with wood and steel trowels to a smooth finish with the required edges neatly rounded. Excessive troweling shall be avoided. If there is evidence of concrete bleeding, finishing shall cease until the excess water has evaporated to the satisfaction of the Engineer.

Brush finish shall be applied with a nylon bristle brush approved by the Engineer. The brushing shall be carried out in accordance with applicable drawings and in such a manner and at such a time as to minimize the depth and quantity of brush marks. All surplus water shall be removed from the bristles before brushing commences. No mortar coat or water wash shall be used.
Brush finish shall be applied perpendicular to the pedestrian traffic except at crossings which are brushed perpendicular to the vehicle traffic.

311.07.02 Tolerances

After troweling, the surface grade along the lip of gutter shall be true to an accuracy of plus or minus 6mm in three meters. The maximum allowable variation across the gutter shall be 3mm.

All concrete work shall meet the following tolerances:

i) The elevation of any given point shall not vary by more than 20mm from the design grades.

ii) Deviations in alignment at any given point from that given on the survey stakes shall not exceed 15mm and the fluctuations in the alignment shall not be greater than 25mm in 100 meters.

311.08.00 CURING

The surface of the concrete shall be protected by a curing compound. The membrane material shall be applied uniformly, in one application, by means of an approved pressure distributor at an average of 0.2 litres per square meter.

The compound, applied after finish treatment is completed, shall present a uniform appearance and effectively obscure the original colour of the concrete.

Under no circumstances shall any material be added to the curing compound as delivered by the manufacturer.

311.09.00 COMMERCIAL SIDEWALKS

311.09.01 General

All of the previous Sidewalk Specifications do apply to Commercial Sidewalks except as amended in this Section.

311.09.02 Concrete

Class "A" concrete shall be used.

High early strength concrete shall be placed at lane crossings as required at no extra cost to The City.
311.09.03 Breaking Out

The breaking out of existing sidewalk and/or curb and gutter shall not commence until such time as the Engineer and the Contractor have measured the involved areas. Where parking meters are removed the Transportation Department shall be notified so that the parking meter heads may be removed before breakout begins. The Contractor shall not remove the meter heads or remove the meter standards with the heads attached. All traffic sign posts, parking meter standards and like utilities shall be carefully removed and preserved by the Contractor at his expense. All hand chipping and all repairs to building entrances, tiles, etc., shall be deemed incidental to the Unit Rates. No allowance shall be made for extras of this nature.

311.09.04 Excavation for Deep Base

The excavation shall extend 600mm out from the face of the curb and 300mm out from the back of walk where there are no adjacent buildings to a depth indicated by the Engineer and shall comply with all conditions as outlined in Chapter 302.

The Contractor shall at all times be responsible for the proper support of transit poles and electric light standards. The bottom of the excavation shall be to the proper grade and cross-section. If the Contractor excavates below grade, he shall backfill with approved base gravel, compacted to the satisfaction of the Engineer at no extra cost to The City. All excavation shall be approved by the Engineer before proceeding with the construction of the base.

311.09.05 Base Gravel Fill

The Contractor shall supply approved base gravel according to Specifications and provide all material and labour necessary to load, haul, place and compact said gravel on the finished sub-grade as specified under Chapter 304. The compacted base gravel shall be carried over the full extent of the excavation as indicated in the Standard Commercial Sidewalk Drawing and as noted above. The additional excavation, backfill and compaction adjacent to the sidewalk and curb and gutter structure shall be deemed incidental to the Unit Rate for base gravel fill.

311.09.06 Crushed Gravel Base

Sufficient crushed gravel to provide a leveling base shall be placed on top of the base gravel fill and shall extend to the edge of the gutter only.

311.09.07 Insulation

Rigid-foam insulation shall be used in the construction of all Commercial Sidewalk where the sidewalk is < 3m from a structure, as shown on the Standard Drawing 454.1013.011.
311.09.09 Special Finish

Where additional finishing techniques are required on commercial sidewalk, payment shall be made at the Unit Rate.

311.10.00 CROSSINGS, BUS STOP APRONS AND WHEEL CHAIR RAMPS

311.10.01 General

Payment for "high early" concrete shall be allowed only on work orders given to the Contractor after September 15.

311.10.02 Contractors Responsibility

1) Public Lane Crossings

The Contractor shall be responsible for the correct placing of all public lane crossings. Where necessary, the location of public lane crossings shall be supplied by the Engineer. Unless the lane is hard surfaced, a 250mm concrete apron shall be required at all public lane crossings where no sidewalk is present or proposed.

Where the sidewalk and the curb are separate, a driveway crossing apron between the curb and sidewalk shall be placed at all public lane crossings unless directed otherwise by the Engineer.

2) Private Driveway Crossings

In the case of private driveway crossings, the Contractor shall be responsible only for those driveway crossings that are marked by signs, or when one or more of the following conditions exist.

1. A sidewalk, or curb and gutter previously cut down for crossings.
2. A dirt, gravel, asphalt or concrete driveway already existing on private property.
3. A garage already existing on private property.
4. A vehicle gate existing in a fence on private property.
5. Loading doors are present on commercial buildings that are built to or near the property line.

Unless the driveway is hard surfaced, a 250mm concrete apron shall be required at all driveway crossings where no sidewalk is present or proposed.
3) Construction Scheduling
Weather permitting, the Contractor shall start construction within two weeks from the date the work order is issued and shall be completed within two weeks from the commencement of work.

Where the completion of other work, such as paving, is contingent upon crossing construction, the Contractor shall expedite the crossing construction.

311.10.03 Regulations Governing Private Driveway Crossings

1. Dimensions for driveways shall be in accordance with the Standard Drawing 454.1010.004 and 454.1010.005.

2. Driveways shall not front on a freeway, expressway or major road. City Bylaw 8500, Appendix A shall apply.

3. A minimum of 6.7 meters from back of walk to the front of the parking stall shall be required.

4. A minimum of 2.75 meters shall exist between building and the property line.

5. If a common driveway is requested in writing by both property owners concerned, the distance between buildings shall be a minimum of 2.75 meters.

6. Where a private driveway crossing and public lane crossing adjoin, no island shall be required unless there is a pole or utility located within 1.5 of the walk. In this event an island of sufficient width shall be constructed to protect the pole or utility.

7. Except in the case of a common driveway, curb depressions shall not overlap the extension of a property line.

8. A driveway shall not be constructed on a corner radius except with the approval of the Engineer.

9. Driveways on corner properties shall be a minimum of 12 meters apart, measured at the curb line.

10. Driveways are not permitted within a crosswalk.

11. Driveways are not permitted within a bus zone unless approved by the Engineer.

The City shall be responsible for compensating the Contractor for any changes made to any crossing covered by the above conditions, unless the Engineer deems the necessary changes are due to negligence on the part of the Contractor in not placing, or not placing correctly, the crossing. The decision of the Engineer shall be final in any matter pertaining to crossings.
311.10.04 Reinforced Crossings

Where the boulevard width between separate sidewalk and curb and gutter is one meter or less, the concrete apron shall be constructed monolithic with the separate sidewalk. A deep tool joint 35mm shall be installed along the face of walk for the full width of the crossing. The edge of the joint shall be rounded off with an edger having an arc of a circle of 6mm radius.

Where the boulevard is greater than one meter, the apron shall be constructed separately from the sidewalk, curb and gutter and an approved 15mm preformed expansion joint shall extend through the full depth and width of the crossing between the sidewalk and apron.

In each of the above cases an approved 15mm preformed expansion joint shall extend through the full depth and width of the crossing between the apron and curb and gutter.

The requirement for expansion joints in crossings may be waived at the discretion of the Engineer.

Where it may be necessary to depress either or both of the face of sidewalk and back of sidewalk to facilitate easier vehicular access at crossings, the Contractor shall obtain special permission from the Engineer.

Where driveway crossings exceed six meters in length, 30mm deep contraction joints may be constructed laterally across the driveway crossing.

311.10.05 Crossings On

1) Curb and Gutter
Crossings on curb and gutter shall be constructed in accordance with the applicable drawings.

2) Separate Sidewalk
At private driveway crossings the required sidewalk slab thickness shall be 100mm.

At public lane and commercial crossings the required sidewalk slab thickness shall be 150mm.

3) Monolithic Sidewalk
Driveway crossings shall be constructed in accordance with curb and gutter and sidewalk Specifications. Reinforcing shall extend into the curb and gutter.

311.10.06 Bus Stop Aprons

At bus stop aprons the required sidewalk slab shall be 100mm and be constructed in accordance with either Standard Drawing No. 454.1012.001 or 454.1012.002. Where the apron abuts on existing sidewalk or curb and gutter, an expansion joint shall be required. The contact edge of such structures shall be faced to provide a straight and plumb surface for the joint. The requirement for expansion joints may be waived at the discretion of the Engineer.

Curb placed adjacent to bus stop aprons shall be standard rather than rolled.
311.10.07 Wheel Chair Ramps

Wheelchair ramps shall be constructed at all intersection locations where sidewalks abut curbs and gutters and at Community Mailbox locations. Wheelchair ramps are not required where sidewalks are not provided or planned.

Where the design of intersections includes medians, traffic islands etc., ramps shall be formed where normal passage of wheelchairs occurs. Where the median or traffic island is less than 3m in width, the ramps shall be cut straight through on a continuous grade providing the positive drainage is maintained.

Payment for wheelchair ramps shall be under the Unit Rate for sidewalk and for curb and gutter. No separate payment shall be made for wheelchair ramps.

311.10.08 Temporary Crossings

1) Temporary Gravel Driveway Crossing
The Contractor shall supply and place 100mm of approved crushed gravel on top of the finished sub-base. Upon the above-mentioned layer, the Contractor shall supply and place 50mm of approved gravel crushed to maximum size of 25mm. The gravel shall be leveled off at a slope of 6mm per 300mm towards the street and be properly tamped or rolled, to the satisfaction of the Engineer.

2) Temporary Asphalt Driveway Crossing
The Contractor shall construct temporary asphalt driveway crossings as required, on a compacted 100mm crushed gravel base. For residential driveway crossings a 50mm mat of hot asphaltic mixture Type B shall be placed on the prepared base. A 100mm mat shall be required for commercial crossings. Construction procedure shall conform with Chapter 308.

311.11.00 CONCRETE WALKWAYS AND BICYCLE PATHS

Construction of concrete walkways and bicycle paths shall conform to the requirements of the Section on "Asphalt Walkways and Bicycle Paths" in Chapter 309, except that the surfacing material shall be Class "B" concrete conforming to the requirements set forth in Chapter 310. A longitudinal centreline tool joint or sawcut shall be made in all concrete walkways and bicycle paths wider than 2440mm. Contraction joints shall be made in accordance with Section 311.06.03, item 2.
311.12.00 REHABILITATION

311.12.01 General

When the Contractor shall be required to replace existing City sidewalk and/or curb and gutter on which private walks and/or driveways abut, it shall be his responsibility to replace the said walks and driveways to meet the new City sidewalk and/or curb and gutter to the satisfaction of the Engineer. Payment for the above work shall be deemed incidental to the Unit Rate of the specific sidewalk.

Should this work not be completed within two weeks of the construction commencement date, The City may complete the work and any expenses incurred are charged to the Contractor.

311.12.02 Backfilling and Backsloping

Where an excavation has been made wider than the finished concrete width, this area between the excavation and the finished concrete surface when both are level, shall be filled with a well compacted soil substantially free from any granular material and be shaped as herein specified. In locations susceptible to washout, the fill material shall be 50mm gravel or as directed by the Engineer.

All backfilling and backsloping for sidewalk, curb and gutter, combined sidewalk, curb and gutter, aprons and catch basins shall be at a slope of 3:1 or a slope approved by the Engineer both to start at the finished concrete surface.

All of the costs involved in backfilling and backsloping are borne by the Contractor. Backfilling and backsloping for lane crossings and private driveway crossings shall be at a slope of 1:10 or a slope approved by the Engineer, both to start at the finished concrete surface. The backfill for all crossings shall be well compacted 50mm crushed gravel. In no case does the Contractor backfill or backslope beyond the property line without permission of the Engineer.

All costs involved in backsloping and graveling these lane crossings and private driveway crossings shall be borne by the Contractor.

Where a backfill or any other fill is made by the Contractor such fill shall be maintained unless otherwise directed by the Engineer at its original slope, at no cost to The City, until the work is measured and checked.

Where an excavation is carried out past the end of any sidewalk, curb and gutter or combined sidewalk, curb and gutter, the Contractor shall adequately compact fill in the excavated area to present a smooth walking surface when completed.
311.12.03 **Leveling Boulevards**

In addition to all excavation and backsloping covered under these Specifications, the Contractor, at his own expense, shall grade at a slope of two percent towards the road, the unimproved boulevard strips between the sidewalk and curb and gutter, or roadway where no curb and gutter exists.

Improved boulevards between the sidewalk and curb and gutter may be graded where the owner agrees and is aware that he shall loam at his own expense. Otherwise, an improved boulevard shall be backsloped at a 3:1 slope from the new structure.

311.12.03 **Miscellaneous Loaming**

Loam shall be used as backfill as directed by the Engineer. Where established lawns are disrupted by construction, they shall be restored to equal or better condition using approved sod.

The Contractor, where directed by the Engineer, shall backfill with loam and compact any part or the whole of any excavation deemed necessary for the satisfactory completion of the work involved in this Contract.

All loam delivered shall be free of quack grass, perennial weeds and/or any other plants or organic or inorganic matter which renders the loam unsatisfactory in the opinion of the Engineer.

311.12.04 **Asphalt Rehabilitation**

The Contractor shall be responsible for the Asphalt Rehabilitation to Specifications of paved streets damaged during the construction of the work under this Contract.

Unless otherwise specified the hot asphaltic mixture shall be Mix “B”.

All asphalt rehabilitation shall conform with Specifications subject to the following modifications:

a) Asphalt shall be required for the entire fill operation or lean concrete fill topped with 50mm of hot asphaltic concrete.

Asphalt rehabilitation shall be carried out to the satisfaction of the Engineer, within five days of completion of the concrete work. Work not completed within this time period may be done by The City, with all expenses for the rehabilitation being charged to the Contractor.

311.12.05 **Mortar and/or Tar Cleanup**

Mortar and/or tar on the sidewalk and/or curb and gutter which is considered detrimental to pedestrian safety or appearance of the sidewalk and/or curb and gutter shall be removed or the sidewalk and/or curb and gutter replaced, at the discretion of the Engineer.
311.13.00 MAINTENANCE STANDARDS

Maintenance Standards in Table 1 do apply, at the time of the final acceptance inspection, to all sidewalks, curb and gutter, guard rail and related on grade concrete work.

311.13.01 Surface Condition

1. Loss of surface mortar and/or aggregate less than 3mm deep. Crazing shall not be included if there is no evidence of loose or lifting mortar.

2. Loss of surface mortar and/or aggregate between 3mm and 6mm deep.

3. Loss of surface mortar and/or aggregate greater than 6mm deep.

<table>
<thead>
<tr>
<th>% of Surface Area</th>
<th>Replacement</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>Separate Sidewalk Flag</td>
</tr>
<tr>
<td>2</td>
<td>Monolithic Sidewalk Flag</td>
</tr>
<tr>
<td>5</td>
<td>3m Curb Section</td>
</tr>
<tr>
<td>10</td>
<td>3m Gutter Section</td>
</tr>
<tr>
<td>15</td>
<td>Liquidated damages (original construction cost based on Unit Rates).</td>
</tr>
</tbody>
</table>

XXX Replacement
311.13.02 Sidewalk, Curb and Gutter Failures

Replacement of affected sections shall be required when one or more of the following exist:

1a. **Crack greater than 3mm in width in curb & gutter**
   - excluding expansion joint
   - no vertical displacement
   - no chipping greater than 3mm
   - less than 5% in length of crack with spalling edges
   - spalling edges maximum total width for both sides is less than 3mm from outer edge of crack (see detail)
   - special consideration if crack is located at invert of curb & gutter

1b. **Crack greater than 1mm in width on flag of sidewalk**
   - excluding expansion joint
   - no vertical displacement
   - no chipping greater than 3mm
   - less than 5% in length of crack with spalling edges
   - spalling edges maximum total width for both sides is less than 3mm from outer edge of crack (see detail 1a)
2. **Cracks with**
   - any vertical displacement or faulting greater than 1mm

3) **Longitudinal Crack**
   - greater than 1mm in width
4a) Joint displacement or settlement on a road grade less than or equal to 4%
   • at a joint of greater than 15mm
   • of any part of the sidewalk greater than 15mm over 6m of sidewalk

4b) Settlement on a road grade greater than 4%
   • any part of the sidewalk is greater than 20mm over 6m of sidewalk
5 Dished sidewalk or curb & gutter

6 Reverse cross fall or cross fall greater than 3% or less than 0.7%
7 Random cracking
- two or more cracks between any two edges
- cracks of any size in one section of sidewalk or curb & gutter, including hairline or pencil cracks.

8 Corner chip greater than 75mm
Deficiencies considered detrimental to pedestrian safety or appearance of the sidewalk and/or curb & gutter, including but not limited to the following:

- Graffiti or writing
- Significant scarring/paper damage
- Foot or animal prints
- Rain damage
- Chipping greater than 75mm
- Chipping where 2 or more are 50mm+
### 311.13.03 Sectional Replacement

All breakouts shall end at a contraction, expansion or surface joint. The edge of a surface mark shall be sawn to a depth of 50mm minimum, while contraction joints may be neatly hand chiseled to produce a true straight joint. The contact edge shall be exposed to produce a good bond.

### 311.13.04 Specifications

All replacement work shall be placed in accordance with the Detailed Sidewalk Specifications.

### 311.13.05 Grouting

No grouting of cracks shall be allowed.

### 311.13.06 Sealants

Joints which have expanded up to a maximum of 13mm without vertical displacement shall be sealed by use of an approved flexible sealant.
311.14.00 QUANTITY MEASUREMENTS

311.14.01 Excavation

1) General

311.13.02 Sidewalk, Curb and Gutter Failures

Replacement of affected sections shall be required when one or more of the following exist:

1. Any crack greater than 3mm in width, with no vertical displacement, or chipping or spalling edges.
2. Any crack with vertical displacement, or chipping or spalling edges.
3. Any longitudinal crack greater than or equal to 1.5mm in width.
4. A displacement, at a joint of greater than or equal to 12mm.
5. A dished surface of sidewalk and/or gutter.
6. A reverse cross fall, or cross fall greater than 8 percent or less than 0.7 percent.
7. A random cracking of any size.
8. Any feature considered detrimental to pedestrian safety or appearance of the sidewalk and/or curb and gutter.

311.13.03 Sectional Replacement

All breakout shall end at a contraction, expansion or surface joint. The edge of a surface mark shall be sawn to a depth of 50mm minimum, while contraction joints may be neatly hand chiseled to produce a true straight joint. The contact edge shall be exposed to produce a good bond.

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311.14.00 QUANTITY MEASUREMENTS

311.14.01 Excavation

1) General
The Unit Rates for sidewalk, curb and gutter, combined sidewalk, curb and gutter and concrete invert crossing shall include all excavation where the subgrade is 600mm or less below existing grade. When the design grade is more than 600mm below existing grade, payment shall be made on the computed in place volume between the 600mm grade and the design subgrade. In place volume shall be computed prior to excavation.

2) Driveway Crossings, Bus Stop Aprons and Wheel Chair Ramps
For all “Driveway, Bus Stop Apron and Wheel Chair Ramp” Contracts, the Unit Rate for concrete work includes ordinary excavation costs as noted above, except overhaul costs.

3) Special Project Contracts
For all Special Project Contracts, where excavation costs are covered by payment for earthwork, the Unit Rate for concrete work shall not cover any excavation costs other than base preparation.

311.14.02 Concrete

1) Sidewalk, Combined Sidewalk, Curb and Gutter
- measurement shall be taken on the centre line of the structure.
- measurement for width of sidewalk shall be between the face and back of walk.
- measurement for width of combined sidewalk, curb and gutter shall be between the back of curb and back of walk.
- additional width of sidewalk, i.e. other than specified in the Standard Drawings, shall be paid at the Unit Rate.

2) Curb and Gutter
- measurement shall be taken along the face of curb.

3) Aprons
- measurement for length of aprons shall be the mean length.
- measurement for width of aprons shall be the distance between back of curb and face of walk.

4) Irregular Shapes (triangles, etc)
- measurements are made and the areas computed.

Note: No measurement shall be made on any block where the backfill and/or clean-up has not been carried out in accordance with these Specifications, or where the walk is not complete.
# DETAILED SPECIFICATIONS

## 312.00.00 PORTLAND CEMENT PAVEMENT

- **312.01.00** General
- **312.02.00** Materials
- **312.03.00** Equipment
- **312.04.00** Paving Operations
- **312.05.00** Strike-off, Consolidation, and Finishing
- **312.06.00** Integral Curbs
- **312.07.00** Joints
- **312.08.00** Curing
- **312.09.00** Joint Sealing
- **312.10.00** Surface Tolerances
- **312.11.00** Opening Pavement to Traffic
- **312.12.00** Thickness Verification
- **312.13.00** Unit Rate Adjustment
- **312.14.00** White Top
- **312.15.00** Bus Lay-by
312.00.00  PORTLAND CEMENT PAVEMENT

312.01.00  GENERAL

Portland Cement Pavement consists of air-entrained Portland Cement Concrete manufactured in accordance with the applicable provisions of these Specifications, and constructed, on a prepared base, in accordance with provisions herein specified and in conformity with the dimensions, lines, grades, thicknesses and typical cross-section as shown on the drawings.

312.02.00  MATERIALS

312.02.01  Concrete

Materials supplied shall meet the provisions set forth in Chapter 310 for Type "A" concrete.

312.02.02  Curing Material

The surface of the concrete shall be protected by a curing compound, conforming to ASTM Designation C-309 Type 2 (white pigmented) or CGSB 90-GP-1a..

The membrane material shall be applied uniformly, in one application, by means of an approved pressure distributor at an average of 0.2 litres per square meter.

The compound, applied after finish treatment is completed, shall present a uniform appearance and effectively obscure the original colour of the concrete.

Under no circumstances shall any material be added to the curing compound as delivered by the manufacturer.

312.02.03  Joint Materials

1) Premoulded Joint Fillers
Premoulded joint fillers consist of strips of bituminous fibre filler conforming to requirements of ASTM Designation D-1751.

The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint unless otherwise authorized by the Engineer. When the use of more than one piece is authorized for a joint, the abutting ends are fastened securely and held accurately to shape.

2) Joint Fillers and Sealers
Poured joint fillers and sealer are asphaltic-latex compounds conforming to the requirements of ASTM Designation D-1190. Other types approved by the Engineer may be used.
312.02.04 Reinforcing

1) Tie Bars for Longitudinal Joints
Tie bars shall be deformed and meet the current CSA Designation G30-12M77, Billet-Steel Bars.

Dimensions:

<table>
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<tr>
<th>Dimension</th>
<th>Value</th>
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</thead>
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<tr>
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<tr>
<td>Length</td>
<td>800mm</td>
</tr>
<tr>
<td>Spacing</td>
<td>750mm</td>
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</tbody>
</table>

Metal chairs for holding tie bars in the correct position while the concrete is being placed, when specified, shall be adequate in strength and rigidity to carry the bars without tipping, sagging or being displaced.

312.03.00 EQUIPMENT

312.03.01 General

All equipment necessary for the proper handling of materials, batching, mixing, placing, finishing, and curing of the concrete pavement shall be in good working conditions. Throughout the construction period, the Contractor shall maintain sufficient and adequate equipment to assure proper execution of the work.

312.03.02 Mixing Equipment

1) General
Concrete may be mixed at the site of construction, at a central point, or wholly or in part in truck mixers. Each mixer shall be of an approved type and shall have attached prominently a manufacturer’s plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

2) On-Site Mixers
On-site mixers shall be capable of combining aggregates, cement, and water into a uniform mass within the specified mixing period and of discharging the mixture without segregation.

The on-site mixer shall be equipped with an approved timing device which shall automatically lock the discharge lever when the drum has been charged, and release it at the end of the mixing period. The device shall be equipped with a suitable warning device adjusted to give a clear, audible signal each time the lock is released. If the timing device fails, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed in 90 seconds.
The skip of the mixer shall be equipped with a cushioning device in order to prevent excess impact due to lowering of the skip.

A pan or tray shall be attached to the mixer under the discharge bucket to prevent mortar or other materials from spilling or dripping on the pavement surface.

3) Truck Mixers and Truck Agitators
Truck mixers used for mixing and hauling concrete and truck agitators used for hauling centrally-mixed concrete shall conform to the requirements of ASTM C-94 or CSA A-23.1.18.3.

4) Non-Agitator Trucks
Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight metal containers capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection.

312.03.03 Slip-Form Paver

Portland Cement Concrete, placed by slip form pavers and related equipment, shall be to the depth, width, crown, and grade shown on the plans.

The slip-form paver shall spread, consolidate, screed, and float finish the concrete in one pass.

The slip-form paver shall be self-propelled and shall be mounted on two sets of crawler treads each not less than 250mm wide and 6.5m long, except that, where a widening strip is constructed adjacent to a previously constructed pavement the propelling unit may be mounted on rubber tired wheels and operated on the adjacent pavement. The machine shall be of ample strength to withstand severe use and shall be fully and accurately adjustable for loss of crown or other derangement due to wear.

The paver shall be equipped with:

1. A mechanically operated primary strike-off which meters the concrete to the vibratory mechanism.
2. A vibrator and tamping bar extending over the full width of the pavement and operating behind the strike-off with a frequency of not less than 3 600 V.P.M.
3. An extrusion plate not less than one meter in width (measured longitudinally with the pavement); set with its leading bull-nosed edge higher than the trailing edge so that the concrete is extruded under compression.
4. A rubber belt no less than 600mm wide, set behind the extrusion plate and operated with a lateral movement of 100mm to 200mm.
The slip-forms on opposite sides of the pavement shall be connected laterally above the pavement and the forms by cross frames of a type that shall assure rigidity. Forms shall extend the full depth of pavement, and the face of the forms shall not have an inward slope or batter of more than 15mm. The forms shall be of sufficient length that the concrete remains stable and rigid at the edges by the time the forms have passed.

Slip form pavers not complying with the specified requirements are subject to approval by the Engineer prior to their use.

When slip-form and related equipment is used for placing of Portland Cement Concrete, Specifications relating to the use of fixed side forms or the use of equipment designated to ride on fixed forms shall not apply.

312.03.04 Forms

Forms shall be of such cross-section and strength and so secured as to resist the pressure of the concrete when placed and the impact and vibration of any equipment which they support, without springing or settlement. The method of connection between sections shall be such that the joints shall not move in any direction.

All side forms for this work shall be of metal. These shall be shaped steel sections and shall have a depth of at least equal to the edge thickness of the work prescribed and shall have a base equaling 80 percent of the height of the form with a minimum base width of 150mm. The forms shall be free from warps, bends or kinks. Approved flexible forms shall be used for construction where the radius is 60m or less.

312.03.05 Edging Tools

Edging tools shall be of an approved type, having a radius of 3mm not less than 250mm long, 125mm wide, having a lip of not less than 20mm deep and the metal in such lip shall not exceed 3mm in thickness.

312.03.06 Additional Equipment

The Contractor shall furnish all other tools and supplies necessary for the proper execution of the work.

312.04.00 PAVING OPERATIONS

312.04.01 1)General

Adjustments to equipment and working techniques are made as required to produce pavement of the specified standards of dimensions, strength, finish and riding quality.

If a construction area fails to meet the requirements of the Specifications, it shall be removed at the direction of the Engineer and replaced at no expense to The City.

2) Weather Requirements

All weather requirements set forth in Chapter 311 shall apply.
312.04.02 Protection of Subgrade

The finished subgrade shall be maintained in a smooth and compacted condition until the concrete has been placed. No storage piles of fine or coarse aggregate are placed directly upon finished subgrade.

The mixer, ready-mix trucks or other equipment shall not operate between the forms in the paving lane unless conditions of the job do not permit operation from the shoulder or outside the lane. If it is necessary to operate trucks between the forms, and the trucks cause rutting or displacement of the subgrade material, either lighter trucks shall be used or suitable runways shall be provided. The Contractor shall reroll or hand-tamp the subgrade to correct any rut or other objectionable irregularities that may have been caused by trucking.

Only when job conditions make it absolutely necessary and when written consent of the Engineer has been obtained shall a mixer or ready-mix trucks be permitted to operate from previously paved areas.

312.04.03 Setting Forms

The forms when set are uniformly supported for the entire length at the specified elevation. Forms shall be joined neatly and in such a manner that the joints are staggered and free from play or movement in any direction.

After the forms are set they are checked with a three meters straight edge. The maximum deviation from the design elevation and alignment shall be:

1. 3mm for the top surface of any form or line of forms.
2. 6mm for the inside face of forms.

The alignment and grade elevations of the forms shall be checked by the Contractor and the necessary corrections made immediately before placing the concrete. Forms remain in place at least 12 hours after the concrete has been placed against them. All forms shall be thoroughly cleaned and oiled each time they are used.

Forms shall be removed during daylight hours only, and in such a manner as to avoid damage to the pavement.

312.04.04 Site Mixing

The mixing of the concrete shall be done in a mixer of approved type which insures a uniform distribution of the materials throughout the mass, so that the mixture is homogeneous.

The mixing drum rotates at the peripheral speed recommended by the manufacturer. The mixing of each batch shall continue not less than 90 seconds after all the materials are in the mixer. The batch timing device shall automatically lock the batch discharging device during the full mixing time and release it at the end of the mixing period.
Whenever the mixer is operated on old or new concrete pavement, the following requirements shall be made:

1. The pavement slab shall have attained a flexural strength of at least 4.0 MPa.

2. The pavement slab shall be thoroughly cleaned prior to operation of the mixer.

3. The mixer shall be operated at all times on planks at least 25mm thick and the planks shall be laid to provide a continuous track for the full width of mixer treads.

4. The mixer shall not be operated on a pavement slab under which the subgrade is unstable due to heavy rain, uncompleted drainage works, or water discharged from the curing operations.

### 312.04.05 Placing Concrete

Spreading shall be accomplished by the use of a mechanical concrete spreader of a type and design approved by the Engineer, unless an alternative method is approved by the Engineer.

At the time of placing the concrete, the base shall be true to cross-section, thoroughly consolidated and free of any soft areas. At all times during the operation, at least 150m of foundation shall be prepared ahead of the mixer.

Prior to placing concrete, the base surface shall be thoroughly wetted so that it shall not absorb moisture from the concrete to be placed. The method of sprinkling shall be such that no pools of water form on the base. No concrete shall be placed around manholes or other structures until they have been brought up to the required grade or alignment or until expansion joint material is placed around them for the full depth of the pavement.

The concrete shall be deposited on the base in a manner requiring a minimum of rehandling. It shall be distributed to sufficient depth above the base that, when consolidated and finished, the slab thickness as shown on the plans shall be obtained at all points and the surface shall not be below the grade specified at any point.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them but shall not be dumped onto a joint assembly.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. The vibrator shall never be operated longer than 15 seconds in any one location.

The pavement shall be constructed to its full width of the lane in a single construction operation. Concrete in a longitudinal section shall not be placed until the adjacent parallel slab has attained an age of 7 days or has attained a flexural strength of at least 4.0 MPa. The face of the previously constructed slab shall be painted with one coat of approved asphaltic latex material before the new concrete is placed.
Longitudinal joints between lanes or sections are constructed in accordance with the details shown on the plans.

When concrete placement is interrupted for any reason longer than 30 minutes, an emergency construction joint shall be constructed as shown in the Standard Drawings. Except as provided above, no joint of any kind shall be placed across the pavement at any other location than that directed or shown on the plans. Sections less than three meters in length are not permitted and, if constructed, are removed at the Contractor's own expense.

312.05.00 STRIKE-OFF, CONSOLIDATION AND FINISHING

312.05.01 General

The sequence of operations shall be the strike-off and consolidation, floating if necessary, straight-edging, and final surface finish. The pavement shall be struck off and consolidated with a mechanical finishing machine, vibrating screed, or by hand-finishing methods when approved by the Engineer. A slip-form paver with provision for integral curb may be used. Adding water to the surface of the concrete to assist in finishing operations shall not be permitted.

312.05.02 Placing and Finishing

1) Machine Placing and Finishing

The pavement shall be struck off and consolidated with a mechanical finishing machine. Hand finishing methods may be used only with the written permission of the Engineer, except in areas where the width of the slab changes.

During the operation of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. Except when making a construction joint, the finishing machine shall not be operated beyond that point where the just-noted ridge, or surplus, of concrete can be maintained ahead of the front screed.

The concrete, through the use of this machine, shall be left with a true and even surface, free from rock pockets. When properly consolidated and finished the surface of the pavement shall be to the exact grade elevation, crown, and cross-section shown on the plans.

After the concrete has been struck off and consolidated, it shall be further smoothed by means of a mechanical float of a design approved by the Engineer. The machine shall be of such a design that the float is operated transversely across the pavement, with its longitudinal axis approximately parallel to the centre line. Successive passes shall be lapped by at least half the length of the float.

After floating, the pavement shall be scraped with a straightedge. The straightedge shall be from two to three meters long and equipped with a handle of sufficient length to permit it to be operated from the edge of the pavement. The straightedge shall be operated so that any excess water, laitance, and inert material are removed from the surface of the pavement.

Prolonged operation over any given area shall be avoided.
Hand finishing tools shall be kept available for use in the event of a breakdown of the finishing machine.

2) Hand Placing and Finishing
When hand finishing is permitted, the concrete shall be struck off and consolidated by a vibrating screed to the exact elevation as shown on the plans. When the forward motion of the vibrating screed is stopped, the vibrator shall be shut off.

After the concrete has been struck off and consolidated, it shall be further smoothed by the use of a float. The float shall not be less than 3.5m long and 150mm wide, and shall be properly stiffened and provide handles at each end. The float shall be operated from foot bridges spanning the pavement.

Hand finishing and the use of edging tools are kept to an absolute minimum. No tool marks of any kind should be present in the finished surface.

Prolonged operation over any given area shall be avoided.

3) Straight-Edge Finishing
After the floating is completed, but while the concrete is still plastic, minor irregularities and score marks remaining in the pavement surface are eliminated by means of long-handled wood floats and straightedges. When necessary, excess water and laitance are removed from the surface transversely by means of a finishing straightedge. The long-handled floats may be used to smooth and fill in open-textured areas in the pavement surface, but the final finish shall be made with the straightedge.

The use of long-handled floats shall be held to the minimum necessary to correct local surface unevenness not taken care of by the float. It shall not be used to float the entire pavement surface.

Straightedges shall not be less than three meters in length and shall be operated from bridges and from the side of the pavement. A straightedge operated from the side of the pavement shall be equipped with a handle one meter longer than half the width of the pavement. The surface shall be tested in trueness with a straightedge, which shall be held in successive positions parallel and at right angles to the centre line of the pavement in contact with the surface and the whole area covered as necessary to detect variations.

The straightedge shall be advanced along the pavement in successive stages not more than half its length. Depressions are immediately filled with freshly mixed concrete, struck-off, consolidated and refinished. Projections above the required elevations also shall be struck-off and refinished. The straightedge testing and finishing continues until the entire surface is free from observable departure from the straightedge and conforms to the required grade and contour; and when the concrete is hardened, shall conform with the surface requirements specified.
4) Surface Finish
The surface shall be finished with a coarse broom texture or other special texturing as specified.

After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints are worked with an approved tool. A well defined and continuous radius shall be produced and a smooth-dense mortar finish obtained.

312.05.03 Pavement Protection
The Contractor shall have available materials to protect the surface of the plastic concrete against rain. When slip-form construction is being used, materials to protect the edges of the pavement are also required.

312.06.00 INTEGRAL CURBS
Integral curbs may be used along the edges of all pavement where shown on the plans and are formed to the cross-section in accordance with the plans. They are constructed simultaneously with the pavement with extrusion equipment or hand formed immediately after the finishing operation.

312.07.00 JOINTS

312.07.01 General
Joints shall be of the type shown on the plans and are constructed where designated on the plans or directed by the Engineer. The base at joint locations shall be approved by the Engineer before any joint materials are set in place.

All joints are perpendicular to the subgrade and, longitudinal joints are parallel to the centre line of the pavement.

312.07.02 Joint Construction
Joints shall be constructed as follows:

1) Sawed Weakened Plane Joint
Sawed contraction joints are created by sawing grooves in the surface of the pavement with an approved concrete saw. After each joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly cleaned.

The grooves are cut to depths equal to one quarter the thickness of the concrete slab, and the width of the cut shall not exceed 6mm.
Sawing of the joints begins as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually four to 24 hours. All joints are sawed before uncontrolled shrinkage cracking occurs. If necessary, the sawing operations are carried on both day and night, regardless of weather conditions. A standby saw shall be available in the event of breakdown.

The sawing of any joint shall be omitted if a crack occurs at or near the joint location before the time of sawing. In general, all joints are sawed in sequence. All contraction joints in lanes adjacent to previously constructed lanes are sawed before uncontrolled cracking occurs. If extreme conditions make it impracticable to prevent erratic cracking by early sawing, the contraction joint grooves shall be formed before initial set of concrete.

2) Expansion and Isolation Joint
The expansion joint filler shall be continuous from form to form, shaped to the subgrade, curb section, and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used unless approved by the Engineer. Thickness of the filler shall be 15mm.

The expansion joint filler shall be held in a vertical position. An approved installing bar or other device shall be used if necessary to ensure proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate in horizontal alignment more than 6mm from a straight line. If joint fillers are assembled in sections, there are no offsets between adjacent units. No plugs of concrete are permitted anywhere within the expansion space.

All fixed objects, such as buildings, poles, pipes, catch basins, manholes, inlet castings, etc., within or abutting the pavement shall be isolated from the concrete by expansion joint material as specified for the full depth of the slab and of the thickness shown on the plans.

See Standard Drawings 454.1015.007 regarding isolation joints.

3) Transverse Joint
Transverse joints consist of planes of weakness created by forming or cutting grooves in the surface of the pavement. They shall be equal to at least one quarter of the depth of the slab. Transverse joints shall extend continuously through the pavement and curb. (Spacing as shown in the plans).

For high speed routes the skewed joints shall be spaced at consecutive intervals of 3.5m - 4.0m - 5.5m - 6.0m on a counter-clockwise skew of 300mm for each two meters of lane width.

4) Contraction Joint
Contraction joints shall be of the "sawed weakened plane" type and are constructed in accordance with the provisions specified herein at locations as shown in the plans or as directed by the Engineer.

5) Construction Joint
Construction joints shall be placed at the end of each days work and at places where paving operations are interrupted for a period of more than 30 minutes and are formed by placing a bulkhead complete with keyway for the full width of the lane.
6) Expansion Joint
Expansion joints shall be constructed where the pavement slab abuts some permanent structure such as railway crossings, bridge approaches, or at such other intermediate points as shown on the plans or where specified by the Engineer.

7) Longitudinal Joint
For full width paving, longitudinal joints are to be formed by sawing unless otherwise approved by the Engineer. These joints shall comply with provisions for Sawed Weakened Plane Joints as specified.

Where the pavement is constructed in separate abutting lanes, the longitudinal joint shall be keyed together as shown on the plans. Unconfined outside lanes are joined by tie bars placed through the joint at 750mm spacing. The tie bars are held securely in position to ensure proper alignment during the placing and finishing of the concrete.

Before placing an adjacent lane, the perpendicular face of the first lane constructed shall be thoroughly coated with an asphaltic-latex to prevent a bond between adjacent lanes. When placing the second slab; concrete shall not be left overhanging the lip formed in the first slab by the edging tool.

312.08.00 CURING
Concrete shall be cured properly by protecting it against loss of moisture, rapid temperature change, and mechanical injury for at least 3 days after placement.

After finishing operations have been completed, the entire surface of the newly placed concrete shall be covered by curing medium approved by the Engineer. The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these surfaces with continuous curing treatment equal to the method selected for curing the slab.

Membrane curing shall be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the required rate of 0.25 litres per square meter.

312.09.00 JOINT SEALING
Joints shall be filled within a period from 7 to 14 days after the concrete has been placed. Immediately before sealing, the joints shall be thoroughly cleaned in such a manner that all loose and foreign material, including membrane curing compound, is removed. Joints shall be inspected and approved by the Engineer prior to sealing.

All joints shall be filled to not less than 3mm from the surface of the pavement and in no case are they overflowed.

Any material spilled on adjacent pavement areas shall be removed immediately and the pavement surface cleaned.
The use of sand or similar material to cover the seal shall not be permitted. Joint sealing material shall not be placed when the air temperature in the shade is less than 10°C unless approved by the Engineer.

312.10.00 SURFACE TOLERANCE

Areas of pavement showing high spots exceeding 3mm in 3m, but not exceeding 13mm when tested shall be ground down by approved methods until the deviation does not exceed 3mm.

In the case of pavement constructed using the slip-form method, an additional 3mm deviation shall be allowed on the outer 150mm of each pavement edge, adjacent to the slip-form.

Where the deviation exceeds 15mm, the Contractor shall remove and replace the pavement at his own expense. The area removed shall not be less than 1.5m in length, nor less than the full width of lane involved. If the area of pavement to be removed extends to within 1.5m of a transverse joint, the pavement shall be removed to that joint.

Areas corrected by grinding to acceptable tolerances shall be coated with an approved surface sealer.

312.11.00 OPENING PAVEMENT TO TRAFFIC

The entire pavement shall be cleaned of all debris and construction equipment as soon as curing and sealing of joints has been completed. Neither construction nor any other traffic shall be permitted to use the pavement until 7 days after the placement of concrete.

The pavement may be opened to traffic only upon the written authority of the Engineer and only after the flexural beam tests indicate a minimum flexural strength of 4.0 MPa when tested by the third point loading method.

312.12.00 THICKNESS VERIFICATION

312.12.01 General

Prior to final acceptance of the work, the pavement shall be cored by The City or its appointed Testing Firm, and thickness determined by measuring the cores in accordance with A.A.S.H.O. Designation T148.

Pavement which is deficient in thickness by more than 8mm shall be subject to reductions in Unit Rate as provided herein. Areas of pavement deficient in thickness by more than 25mm shall be removed and replaced when directed by the Engineer.
312.12.02 Determination of Pavement Thickness

The pavement shall be divided into units which are considered separately when adjustments in Unit Rate are required due to deficient pavement thickness.

Major pavement lanes of each specified thickness and of each separate pour width are divided into basic units of 2,500 m$^2$ each. The remaining fractional area at the end of each main line pour width shall be considered as a separate unit if the fractional area exceeds 1,000 m$^2$, or is included in the adjacent basic unit if the area does not exceed 1,000 m$^2$.

An individual ramp, cross-over, intersection, or other irregular area of pavement not included in the main line shall be considered as a separate unit when cored for pavement thickness determination. Small irregular unit areas may be included by the Engineer as part of another unit.

Five cores shall be taken at random from each pavement unit. If the average of the lengths of five cores is deficient by more than 8mm five additional random cores shall be taken from the unit. The average of the lengths of the ten cores shall determine the thickness of the pavement unit. In calculating the average thickness, any core having a length in excess of the specified thickness by more than 5mm shall be considered as having the specified length plus 5mm. Any core having a length deficiency greater than 25mm shall not be included in the calculation for determination of average thickness.

When the length of any random core is less than the specified thickness of the pavement by more than 25mm exploratory cores are taken at not less than 3m intervals parallel to the centre line in each direction from the random core until, in each direction, an exploratory core shall be obtained which is not deficient in length by more than 25mm.

The area of pavement found deficient in thickness by more than 25mm includes the monolithic pour width of the lane or lanes and a length equal to the distance between points located midway between the last two cores at each end of the deficient section.

The average thickness of the remainder of the unit shall be determined from the random cores obtained outside the area that is deficient by more than 25mm.

Exploratory cores are not used in the computation of average thickness for determination the adjusted Unit Rate.
UNIT RATE ADJUSTMENT

1) Thickness Adjustment
Pavement found deficient in thickness by more than 7.5mm but not more than 25mm shall be paid by the reduced price as shown below:

Deficiency In
Pavement Thickness
(millimetres)

Payment % of Unit Rate

When the thickness of the pavement is deficient by more than 25mm and the judgment of the Engineer is that the area of such deficiency should not be removed and replaced, there shall be no payment for the area retained. No additional payment over the Unit Rate shall be made for any pavement which has an average thickness in excess of that specified on the plans.

2) Strength Adjustment
In the case where the compressive strength of the test cylinders for any portion of the work falls below the requirements set forth in Chapter 310, the concrete shall be paid for on the following basis.

<table>
<thead>
<tr>
<th>% Minimum Allowable Strength</th>
<th>% Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% - or greater</td>
<td>100%</td>
</tr>
<tr>
<td>80% - 99.9%</td>
<td>Unit Rate x Average Test Strength</td>
</tr>
<tr>
<td>Minimum Allowable Strength</td>
<td></td>
</tr>
<tr>
<td>70% - 79.9%</td>
<td>No Payment</td>
</tr>
<tr>
<td>Less than 70%</td>
<td>Replacement</td>
</tr>
</tbody>
</table>
312.14.00  WHITE TOP PAVEMENT

312.14.01  General

All of the previous Portland Cement Pavement Specifications do apply to White Top pavement except as amended in this Section.

312.14.02  Construction

Where the pavement is constructed in separate abutting panels or lanes, the longitudinal joint shall be keyed together as shown on the plans. Unconfined outside lanes are jointed by tie bars placed through the joint at 750mm spacing. The tie bars are held securely in position to ensure proper alignment during the placing and finishing of the concrete.

Before placing an adjacent lane, the perpendicular face of the first lane constructed shall be thoroughly coated with a coring membrane to prevent a bond between adjacent lanes. When placing the second slab; concrete shall not be left overhanging the lip formed in the first slab by the edging tool.

312.14.03  Surface Finish

The surface shall be finished with "Astro Turf" or equivalent drag.

312.14.04  Joints

Joints shall be constructed in accordance with Section 312.07.02, except that the depth of the joints shall be one half the thickness of the White Top slab.

No "T" joints shall be permitted.
312.14.05 **Joint Fillers and Sealers**

Sealant shall be self-leveling meeting the requirements of U.S. Federal Specification TT-S-0022E.

Class A - Type 1, ± 25% movement capability.

<table>
<thead>
<tr>
<th>Cured Sealant Properties</th>
<th>Test Method</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shore A Hardness:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Conditions</td>
<td>TT-S-00227E</td>
<td>25-30</td>
</tr>
<tr>
<td>After heat aging</td>
<td>TT-S-00227E</td>
<td>30-35</td>
</tr>
<tr>
<td>Artificial Weathering</td>
<td>ASTM G 23-75</td>
<td>No elastomeric property change after 1000 hours</td>
</tr>
<tr>
<td>Bond-Cohesion after water immersion</td>
<td>TT-S-00227E</td>
<td>No failure masonry</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM D 412-75</td>
<td>1500 kPa</td>
</tr>
<tr>
<td>Ultimate Elongation</td>
<td>ASTM D 412-75</td>
<td>575%</td>
</tr>
<tr>
<td>Recovery</td>
<td>TT-S-00227E</td>
<td>96%</td>
</tr>
<tr>
<td>Weight Loss</td>
<td>TT-S-00227E</td>
<td>0.9%</td>
</tr>
<tr>
<td>Tear Resistance</td>
<td>ASTM D 624-73</td>
<td>25 kg/25mm</td>
</tr>
<tr>
<td>Straining</td>
<td>TT-S-00227E</td>
<td>passes</td>
</tr>
<tr>
<td>Service Temperature</td>
<td>N/A</td>
<td>-40°C to 82.5°C.</td>
</tr>
</tbody>
</table>

312.15.01 **Bus Lay-bys**

Portland Cement Pavement shall be used for Bus Lay-bys. Minimum pavement thickness shall be 225 mm and in accordance with Standard Drawing 454.1012.008.
**DETAILED SPECIFICATIONS**

313.00.00  **FENCING**

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
<tr>
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<tr>
<td>313.02.00</td>
<td>Barbed Wire Fencing</td>
</tr>
<tr>
<td>313.03.00</td>
<td>Chain Link Fencing</td>
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<tr>
<td>313.04.00</td>
<td>Fence Removal</td>
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<tr>
<td>313.05.00</td>
<td>Fence Removal and Relocation</td>
</tr>
</tbody>
</table>
313.00.00  FENCING

313.01.00  GENERAL

Fencing shall be supplied and erected in accordance with the following Specifications and to line and grade established by the Engineer. The Contractor shall be responsible for determining the location of all underground utilities prior to digging post holes.

Fencing shall be paid for at the Unit Rate measured in its erect position.

313.02.00  BARBED WIRE FENCING

313.02.01  Materials

Fencing wire shall be "Four Point" 12½ gauge galvanized strands. Diagonal bracing shall be 6 gauge soft galvanized wire. This bracing wire shall be doubled for all installations. Staples are 30mm long galvanized steel.

Posts and braces shall be of pressure treated wood, with a minimum diameter of 100mm. Posts and braces shall be two meters long. Gate droppers shall be 1.4m long and shall be a minimum of 50mm in diameter. Dressed lumber with nominal dimensions of 50mm by 100mm may also be used for gate droppers.

313.02.02  Installation

Posts shall be installed a maximum of four meters apart, with the bottoms of the posts 750mm below the finished grade line. The posts shall be set and tamped in a plumb and firm position.

Adjacent to each end of a gate, in each direction from a change in direction or an intersection of fences, a bracing panel two meters long shall be installed. If a tangent length of fencing exceeds 300m, or a curved length of fencing exceeds 150m, a bracing panel shall be installed.

Bracing panels shall have one brace post installed horizontally 150mm from the top of the two fence posts. Bracing wire shall be run diagonally in both diagonals from the top of one post to the bottom of the other. Bracing shall be stretched.

Four strands of barbed wire are strung, with the wires located 150mm, 450mm, 750mm and 1m below the top of each post. Each wire shall be stretched and stapled to each post on the opposite side of the post to the roadway right-of-way.

Gates shall have barbed wire spacing the same as the rest of the fence. Droppers are spaced at a maximum of 2.5m apart. At the hinge post, no dropper is required, as the wire may be connected directly to the gate post. At the fastening end of the gate the end dropper shall be connected to the gate post by the use of two wire loops, one at the bottom of the gate and one at the top.
313.02.03 Maintenance

The City shall not hold the Contractor responsible for damages resulting from traffic or malice following the issuance of the Construction Completion Certificate.

313.02.04 Ends, Gates, Corners and Braces

Unless otherwise specified, end, gate, corner and other bracing panels or gates, shall be included in the Unit Rate for fencing and no additional compensation shall be paid.

313.03.00 CHAIN LINK FENCING

313.03.01 Materials

Fence fabric shall conform to CGSB Standard CAN/CGSB-138.1-M, unless otherwise specified in the Contract documents. If green, olive green, brown or black coloured vinyl-coated wire is specified, colours shall conform to ASTM Standard F 934.

Gates and gate hardware shall be as specified in CGSB Standard CAN/CGSB-138.4-M. Gate frames, in addition to meeting the minimum requirements of CGSB Standard, shall be designed such that the outer member will not sag in excess of one percent of the gate leaf width or 50mm, whichever is less. Gates shall be assembled with fabric mounted on the outside. Gate heights shall match fence heights unless otherwise specified. Gate sections three meters or more in width shall have three hinges per section.

All posts and rails shall be of Type "A" or Type "B", at the discretion of the Contractor.

Type "A" posts and rails shall be steel butt weld pipe, Schedule 40, as specified by ASTM Standard A53, except that the hydrostatic testing requirement is waived, and the minimum weight shall be no less than 95 percent of the nominal weight. Pipe shall be zinc-coated in accordance with ASTM Standard A53-88a, Section 19. This ASTM Standard requires, among other things, an average zinc coating of 550g/m² and a minimum zinc coating of 490g/m².

Type "B" posts and rails shall be made from steel pipes. The pipe shall be formed from steel strip conforming to ASTM Standard A-569. The steel in the formed pipe shall have a minimum yield strength of 350 MPa. The product of the yield strength and section modulus of the pipe shall be not less than that of pipe meeting the requirements for Type "A" posts and rails.

The outer surface of Type "B" posts and rails shall have all of the following protective coatings, applied in the following order:

a) hot dip zinc coating, conforming to ASTM Standard B-6, High Grade or Special High Grade, applied at an average weight of 305 g/m² and at a minimum weight of 275 g/m², as determined by the test method in ASTM A-90.
b) chromate conversion coating, with a weight of 46.5 milligrams/m² ± 23 milligrams/m², as determined by a strip and weight method for the zinc and chromate and by determining the percentage of each by atomic absorption spectrophotometer.

c) clear acrylic polyurethane coating with a thickness of 0.1mm ± 0.025mm.

The combined outer coating shall have an ability to resist:

a) 1,000 hours of exposure to salt fog with a maximum of 5% red rust when tested in accordance with ASTM B117.

b) 500 hours of exposure to 100% relative humidity without blistering and peeling when tested in accordance with ASTM D2247,

c) 500 hours of exposure in a weatherometer without film cracking of the clear coat when tested in accordance with ASTM G23, Type E or EH carbon arc, or ASTM G26, Type B or BH xenon arc.

The inner surface of type "B" posts and rails shall have either a zinc coating as per ASTM F1234, Type B, applied at an average rate of 305 g/m² and a minimum rate of 275 g/m²; or an ASTM F1234, Type D coating with a minimum zinc powder loading of 91 percent by weight and a minimum thickness of 0.075mm. The inner coating shall have the ability to resist 650 hours of exposure to salt fog with a maximum 5 percent red rust when tested in accordance with ASTM B117.

Fittings shall be constructed of aluminum or steel, as specified by ASTM Standard F 626. Fittings shall be of adequate strength for the intended purpose. Steel fittings shall be hot-dipped galvanized to achieve the same zinc coating at that required for Type "A" posts and rails.

### 313.03.02 End, Gate, Corner and Strain Posts

Unless otherwise specified, end, gate, corner and strain posts are paid for at the Unit Rate for the respective class of post, which shall include excavation and pouring of footings, supply and installation of posts, post tops and braces.

Gates are paid for at the Unit Rate, which includes the supply and installation of the gate complete with hinges, latch, fabric and miscellaneous material necessary for its completion. Gate terminal posts are paid for as gate posts.

### 313.04.00 FENCE REMOVAL

Fencing shall be removed with care, avoiding damage to fence components. All salvageable material, as designated by the Engineer, shall be transported to a City storage area designated by the Engineer.
313.05.00 FENCE REMOVAL AND RELOCATION

All fence designated for relocation shall be disassembled in a careful workmanlike manner. If required, the Contractor shall provide safe storage of the fence components. Any damaged, or otherwise defective materials shall be replaced by the Contractor.

The fence shall be reassembled at the lines and grades established by the Engineer, to a standard similar to that of the fence removed. Any excess salvageable materials shall be transported to a City storage area designated by the Engineer.
# DETAILED SPECIFICATIONS

<table>
<thead>
<tr>
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<tr>
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<td>Steel W-Beam on Wooden Posts</td>
</tr>
<tr>
<td>314.03.00</td>
<td>Steel Box Beam on Steel Posts</td>
</tr>
<tr>
<td>314.04.00</td>
<td>Precast Concrete Guardrail</td>
</tr>
<tr>
<td>314.05.00</td>
<td>Concrete Guardrail</td>
</tr>
</tbody>
</table>
314.00.00  GUARDRAILS

314.01.00  GENERAL

Guardrails shall be installed at locations as shown on the drawings, or as directed by the Engineer.

All terminal sections and approach end treatments are formed from the same material as rail elements. Installation at each location shall conform to the Standard Drawings.

Guardrails shall be paid for at the Unit Rate measured in its erect position.

Unless otherwise specified, each “Approach/End Treatment” or “Attachment to Structures” shall be paid for as a separate item of specified length.

314.02.00  STEEL W-BEAM ON WOODEN POSTS

314.02.01  Materials

1) General
Guardrail parts are standardized and are interchangeable with parts produced by guardrail manufacturers. Dimensions and details are shown on Standard Drawings.

2) Rail
Rail elements are formed from open hearth or electric furnace steel and shall meet the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauge</td>
<td>12 minimum</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>550 MPa minimum</td>
</tr>
<tr>
<td>Elongation (A.S.T.M)</td>
<td>12% minimum</td>
</tr>
<tr>
<td>Des: E-8</td>
<td>50mm gauge length</td>
</tr>
</tbody>
</table>

The load shall be applied through a 75mm flat surface at the centre of a freely supported 3.65m clear span and when the joint is tested it shall be at the centre of the span.

<table>
<thead>
<tr>
<th>Max Deflection</th>
<th>Load Traffic</th>
<th>Load Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>70mm</td>
<td>680 kg</td>
<td>550 kg</td>
</tr>
<tr>
<td>140mm</td>
<td>900 kg</td>
<td>1,180 kg</td>
</tr>
</tbody>
</table>

Rail elements shall be galvanized to conform to the requirements for the Coating Class 2.50 of the current ASTM Designation A-525.

3) Bolts
Bolts, nuts and washers shall be galvanized to meet the requirements of ASTM Designation A-153. The post connection shall withstand a 2,250 kg side pull in either direction.
4) Posts and Blocks
The wood posts and blocks shall be constructed with pine; and conform to No. 1 Structural Grade for posts and timbers as classified and defined by NLGA 1970, Standard Grading Rules for Canadian Lumber.

All posts and blocks shall be incised and pressure treated with Chromate Copper Arsenate (CCA) to a minimum net retention of 6.4 kg/m³ of wood (3.5 kg/m³ for blocks), in accordance with CSA Standard 080.14: Pressure Preserved Wood for Highway Construction.

5) Recycled Plastic
The use of recycled plastic posts and blocks shall be subject to the prior written approval of the Engineer.

314.02.02 Installation

Posts shall be spaced on 1.9m centres measured along the centerline of the rail. The rail elements shall be erected to produce a smooth continuous rail paralleling the line and grade of the highway surface or as shown on the plans. The rail elements shall be lapped in the direction of traffic. Terminal sections are attached to the ends of each installation.

314.02.03 Attachment to Concrete Structures

The rail elements are bolted to concrete structures as shown on the Standard Drawings for Steel W-Beams. In the vicinity of the structures the guardrail shall be strengthened by the addition of a 150mm X 3.7 kg channel bolted to the wooden posts below the W-Beam for a distance of 7.6m. This 150mm X 3.7 kg channel shall be galvanized or metalized as specified below the steel box beam guardrail.

314.03.00 STEEL BOX BEAM ON STEEL POSTS

Details of this guardrail are shown on the Standard Drawings for steel box beams.

314.03.01 Materials

There are three types of material as follows:

1) Corten Grade “A” Steel
Corten Grade “A” Steel shall be in accordance with CSA. G 40.11 Grade A. Bolts for the connection of the steel to structures shall be painted to match the matured Corten A colour, the colour of "Stelcoloy Weathering Steel - Halifax Rural" or approved equal.

2) Metallized Steel
Metallized Steel shall be in accordance with Stelco 50 or approved equal, and with a minimum yield strength of 350 MPa.

Steel shall be field or shop metallized to provide a deposition of not less than 0.15mm thickness of zinc on all surfaces 0.92 kg/m².

Work shall be in accordance with the requirements of American Welding Society C2.2

Surfaces to be metallized shall be cleaned by a dry blast cleaning process in accordance with the latest edition of CGSB Schedule 31-P-404, Classification 2.1.2 "Commercial Blast Cleaning".

Blast cleaning shall be carried out at such a rate that blast-cleaned metal is not exposed for more than one hour prior to application of the spray metal coating.

The zinc coating shall be applied by wire or powder process and shall be of first class commercial quality, free from surface blemishes, breaks, etc. and of uniform thickness.

A thickness gauge shall be kept on hand at all times and coating thickness shall be checked as often as necessary to ensure uniformity. Immediately after completion of a section of the railing the entire area shall be spot-checked with a magnetic thickness gauge and if thin spots are found additional metal shall be applied immediately.

3) Galvanized Steel
Galvanized Steel shall be in accordance with Stelco 50 or approved equal, and with a minimum yield strength of 350 MPa. Galvanizing of the box beam and posts shall conform to the requirements for the coating Class 0.6 litres per square meter of the current ASTM Designation A-525. Galvanizing of the bolts, nuts and washers shall conform to the requirements of ASTM Designation A-153.

314.03.02 Installation

Posts shall be spaced on 1.8m centres measured along the centerline of the beam. In the vicinity of structures spacing can be closer as shown on the Standard Drawings for post installation. The beams are erected to produce a smooth continuous rail paralleling the line and grade of the highway surface or as shown on the plans.

314.04.00 PRECAST CONCRETE GUARDRAIL

Details of this guardrail are shown on the Standard Drawings for standard concrete barrier.

314.04.01 Materials

1) Concrete
- Concrete shall be a minimum of 35 MPa compressive strength at 28 days.
- Cement shall be Type 30 Portland Cement meeting the requirements of CAN3-A5-M77.
- Aggregate gradation shall conform to the requirements of ASTM Designation C33.
  Fine aggregate Clause 3
Coarse aggregate Table 2, Size 67
- Maximum water-cement ratio shall be 0.43
- Slump shall be 75mm maximum.
- Air entrainment shall be 6% minimum.
- Concrete shall also comply with Chapter 310 of the Specifications regarding entrained air spacing factor.
- No calcium chloride shall be used.

2) Reinforcing Steel
Reinforcing steel shall be intermediate grade deformed bars meeting the requirements of ASTM Designation A615, Grade 40.

3) Miscellaneous Metals
Miscellaneous metals shall conform to the requirements of ASTM Designation A36 or better.

4) Air Entraining Agents
Air entraining agents shall conform to the requirements of ASTM Designation C260.

314.04.02 Mix Design
Prior to any casting of guardrail, the proposed mix design including source of proposed aggregates shall be submitted to the Engineer for approval.

314.04.03 Testing
The manufacturer shall notify the Engineer of casting times in order that arrangements for concrete testing and/or inspection, at the expense of The City, can be made. For this purpose, the supplier shall allow the Engineer free access to those portions of his plant where the guardrails are being produced and stored.

Concrete cylinders are tested in accordance with the following current ASTM standards:
- Test for compressive strength: ASTM Designation C39.

314.04.04 Forms
Forms shall be true to shape, lines and dimension as called for on the drawings. They shall be substantial and tight to prevent leakage of moisture. Maximum tolerance for final dimensions shall be ± 5mm.

314.04.05 Inserts
All inserts shall be placed accurately and securely in position by templates prior to concrete placement.
314.04.06 Concrete Compaction

Concrete shall be thoroughly compacted by mechanical vibrators during casting. It shall be worked around reinforcement, embedded fixtures and into the corners of the forms. Vibrators are internal and/or form vibrators at the manufacturer's option.

314.04.07 Curing

1) Moist Curing
The surfaces of fresh concrete shall be kept continuously moist for a period of at least 7 days and are protected against the harmful effects of sunshine, drying winds, cold running water, surface water and mechanical shock. The temperature of the concrete shall be kept at 20° Celsius for not less than seven days.

2) Steam Curing
If steam curing is used to maintain a daily cycle of casting, the following criteria for curing shall be adhered to:

- There shall be a minimum of 4 hours delay after final placing of the concrete prior to the application of steam.
- The maximum rate of temperature rise of the concrete shall be 20° Celsius per hour.
- The maximum temperature to which the concrete shall be raised is 70° Celsius.
- The maximum rate of cooling shall be 20° Celsius per hour.

Immediately after stripping of forms, the members shall be moist or steam cured for an additional five days at a temperature of not less than 65° Celsius.

After completion of moist curing or steam curing, the members are stored and allowed to dry out for a further period of 30 days prior to being put into service.

314.04.08 Protective Coatings for Metal

Connector-lifting coupling inserts and threaded caps shall be completely galvanized.

314.04.09 Handling, Storage and Delivery

Care shall be taken in the handling, storage and delivery of completed precast units to avoid damage. Damage to units prior to acceptance by The City at the point of delivery shall be rectified by the supplier at no extra cost to The City.

The units are delivered to the site of work as directed by the Engineer, and are unloaded and stacked at a specified location.
314.04.10 Installation

Backfill behind the guardrail shall be placed and compacted prior to placing pavement against the face of the guardrail.

Concrete slabs between the curb and the guardrail on guardrail taper sections shall be constructed as shown on the plans, and shall conform to the Specifications for concrete sidewalk, concrete curb and gutter.

314.05.00 CONCRETE GUARDRAIL

Concrete guardrail shall have a cross-section as shown on Standard Drawings.

Unless otherwise specified, the concrete leveling slab between the asphalt and the concrete guardrail (if required) shall not be considered incidental to the Unit Rate of concrete guardrail.

314.05.01 Materials

1) Concrete
Concrete shall be Class "A" conforming to all Specifications for Portland Cement Concrete Chapter 310.

2) Reinforcing Steel
Reinforcing steel shall conform to ASTM Designation A432, with deformations conforming to ASTM Designation A305.

3) Crushed Gravel
25mm crushed gravel (Chapter 303) shall be used to trim the subgrade to the design line and grade.

314.05.02 Cast In-Place Concrete Guardrail

1) Length
Guardrail sections shall not exceed six meters in length.

2) Joints
Joints between sections shall have joint filler and dowels installed as shown on the plans.

3) Curves
Guardrail sections shall be curved on curved roadways and are not a series of chords unless the degree of curvature of the roadway is greater than 8 degrees (218m radius).
314.05.03 Extruded Concrete Guardrail

Extruded concrete shall comply with the Specifications for cast in place concrete guardrails except as herein provided.

The concrete shall be continuously extruded. Sawing or deep tool marking of contraction joints is required. The contraction joints shall have a minimum depth of 25 percent of the section thickness and placed at three meters spacing, unless otherwise specified by the Engineer. Any contraction cracks that occur between contraction joints shall be grouted, with material approved by the Engineer, within 30 days of construction completion.

Reinforcing steel shall not be used.

1) Tolerance

- The surface grade along the top of guardrail shall be true to an accuracy of 6 mm in 3 lineal metres.
- The maximum allowable variation across the top of the guardrail shall be 3 mm.
- The elevation of any given point along the top of the guardrail shall not vary by more than 20 mm from the design grades.
- Deviation in alignment at any given point shall not exceed 15 mm and shall not be greater than 25 mm in 100 lineal metres.
- Maximum tolerance for cross-section dimensions shall be 5 mm.
DETAILED SPECIFICATIONS

315.00.00 ARCHITECTURAL PAVEMENTS

315.01.00 Exposed Aggregate Concrete
315.02.00 Concrete Paving Stones
315.04.00 Paving Brick
315.05.00 Sealants
315.00.00  ARCHITECTURAL PAVEMENTS

315.01.00  EXPOSED AGGREGATE SURFACES

315.01.01  General

An exposed aggregate surface is a decorative finish for concrete work achieved by removing the outer skin of mortar and exposing the coarse aggregate or by seeding the surface of the concrete prior to initial set.

315.01.02  Aggregate

1) Colour
Colour shall be selected from locally available aggregate.

2) Size:

<table>
<thead>
<tr>
<th>Sieve Size in mm</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>95 - 100</td>
</tr>
<tr>
<td>3</td>
<td>15 - 35</td>
</tr>
<tr>
<td>2</td>
<td>0 - 10</td>
</tr>
</tbody>
</table>

3) Hardness
Mohs’ Scale of Mineral Hardness minimum value of 5.

4) Shape
50% fracture on one face

5) Soundness Tests
The following soundness tests shall be performed.

- ASTM C127
- ASTM C295

315.01.03  Exposing Aggregate

1) Seeding Method
The base concrete to receive an exposed aggregate surface by the seeding method shall:

- contain a minimum of 335 kg of cement/m³
- have a water/cement ratio no greater than 0.53 by weight
- have a maximum slump of 100mm
- contain a minimum of 5% entrained air

The base concrete shall be placed, vibrated and screeded. Screed operation shall produce a level surface 33mm below the desired finish to allow for the volume of select aggregate to be seeded.
Apply only one layer of stone, removing stacked stone or sliver particles. Embed the aggregate into the concrete by tapping with a wood float or a rolling device. Use a magnesium float for final embedding - mortar completely surrounds and slightly covers all particiles. A surface retarder may be desirable.

2) Washing and Brushing Method
Exposure of the aggregate shall be accomplished by removing matrix by washing and brushing. Concrete shall be sufficiently set to prevent aggregate from being dislodged. The Contractor shall prevent wastewater from entering the storm sewer system.

3) Other Exposure Methods
Other methods to achieve an exposed aggregate surface, i.e. sandblasting and/or the use of acid, shall be at the discretion of the Engineer.

315.01.04 Curing
Cast-in-place concrete to receive an exposed aggregate finish shall be cured by established standard procedures as outlined in Chapter 311. Curing shall begin as soon as the exposure operation ceases.

315.02.00 CONCRETE PAVING STONES

315.02.01 General
This Specification shall indicate the manufacture, delivering, and placing of concrete paving stones of various types in accordance with the Specifications and Standard Drawings. ASTM C936 with the following modifications.

315.02.02 Materials
1) Cement
Cement shall be Portland Cement conforming to the requirements of CAN3-A5-M77.

2) Aggregates
Aggregates shall conform to the requirements of CAN-A23-M77.

3) Admixtures
Admixtures shall conform to the requirements of CAN-A23.1-M77.

4) Concrete Strength
Concrete Compressive Strength prior to delivery to site

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Strength</td>
<td>55 MPa</td>
</tr>
<tr>
<td>Minimum Strength</td>
<td>50 MPa</td>
</tr>
</tbody>
</table>

5) Absorption
Maximum absorption per individual sample shall not exceed 5% when tested in accordance with ASTM C140.
6) Freezing and Thawing Resistance
The manufacturer shall satisfy the purchaser either by proven field performance or a laboratory freezing-and-thawing test that the paving stones have adequate resistance to freezing and thawing. If a laboratory test is used, when tested in accordance with Section 8 of Method C67, specimens shall have no breakage and not greater than 1.0 percent loss in dry weight, of any individual paving stone when subjected to 50 cycles of freezing and thawing. This test shall be conducted not more than 12 months prior to delivery.

7) Abrasion Resistance
When tested in accordance with Method C418, specimens shall not have a greater volume loss than 15cm³ per 50cm². the average thickness loss shall not exceed 3mm.

8) Mix Design
The supplier shall, immediately after award of Tender and prior to any casting of interlocking stone, submit to the Engineer for approval, the proposed mix design including source of proposed aggregates.

9) Testing
The supplier shall notify the Engineer of casting items in order that arrangements for concrete testing and/or inspection can be made as desired, at the expense of The City. The supplier shall allow the Engineer free access to those portions of his plant where the paving stones are being produced and stored, for this purpose.

315.02.03 Workmanship and Procedures

1) Forms
Forms shall be true to shape, lines, and dimension called for on the drawings. They shall be substantial and tight to prevent leakage of moisture. Maximum tolerance for final dimensions shall be ±2mm.

2) Compaction
During casting sufficient vibratory or other mechanical effort shall be applied to thoroughly compact the concrete.

315.02.04 Curing

1) Moist Curing
The surfaces of fresh concrete shall be kept continuously moist for a period of at least 7 days and shall be protected against the harmful effects of sunshine, drying winds, cold running water, surface water, and mechanical shock. The temperature of the concrete shall be kept at 20° Celsius for not less than 7 days.

2) Steam Curing
If steam curing is used to maintain a daily cycle of casting, the following criteria for curing shall be adhered to:

- There shall be a minimum of four hours delay after final placing of the concrete prior to the application of steam.
- The maximum rate of temperature rise of the concrete shall be 20° Celsius per hour.
- The maximum temperature to which the concrete shall be raised shall be 70° Celsius.
- The maximum rate of cooling shall be 20° Celsius per hour.
Immediately after stripping of forms, the members shall be moist or steam cured for an additional five days at a temperature of not less than 65° Celsius.

315.02.05 Handling, Storage and Delivery

Care shall be taken in the handling, storage, and delivery of completed interlocking stone to avoid damage. Damage to units prior to acceptance by The City at the point of delivery shall be rectified by the supplied at no extra cost to The City.

The concrete paving stones shall be delivered to the site of work as directed by the Engineer, and shall be unloaded and stacked at a specified location.

315.02.06 Inspection and Testing

1) Visual Inspection
All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Minor cracks incidental to the usual methods of manufacture or minor chipping resulting from customary methods of handling in shipment and delivery shall not be deemed grounds for rejection.

2) Sampling and Testing
The purchaser or his authorized representative shall be accorded the proper facilities to inspect and sample the units at the place of manufacture from lots ready for delivery. Sampling and Testing of Units shall be in accordance with Method C140.

315.02.07 Rejection
In case the shipment fails to conform to the specified requirements, the manufacturer may sort it, and new specimens shall be selected by the purchaser from the retained lot and tested at the expense of the manufacturer, in case the second set of specimens fail to conform to the test requirements, the entire lot shall be rejected.
315.02.07 Base Preparation

1) General
The base shall be as shown on the Standard Drawing 454.1013.013 for sidewalks.

2) Sand Bedding Course
The Sand Bedding Course shall meet the following gradation:

<table>
<thead>
<tr>
<th>Sand</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5mm</td>
<td>100</td>
</tr>
<tr>
<td>5.0mm</td>
<td>95 to 100</td>
</tr>
<tr>
<td>2.5mm</td>
<td>80 to 100</td>
</tr>
<tr>
<td>1.18mm</td>
<td>50 to 85</td>
</tr>
<tr>
<td>630 μm</td>
<td>25 to 60</td>
</tr>
<tr>
<td>314 μm</td>
<td>10 to 30</td>
</tr>
<tr>
<td>160 μm</td>
<td>2 to 10</td>
</tr>
</tbody>
</table>

The sand bedding course shall be spread evenly over the area to be paved and screeded to a level that will produce the required 15mm thickness when the paving stones have been placed and vibrated.

Once screeded and leveled, this sand bedding course shall not be disturbed in any way.

315.02.08 Construction

1) Edge Restraint
All edges of the paving stones installation shall be restrained. There shall be positive edge restraint and the type of restraint used shall be subject to the approval of the Engineer.

2) Laying of Paving Stones
The concrete paving stones shall be laid in a pattern approved by the Engineer.

The concrete paving stones shall be laid in such a manner that the desired pattern can be maintained and the joints between the stones do not exceed 3mm.

The gaps at the edge of the paved surface shall be filled with standard edge pieces or with stones cut to fit. The stones shall be cut to a straight even surface without cracks or chips.

The concrete paving stones shall be vibrated to their final level.

After vibration, sand shall be brushed over the surface and vibrated to completely fill the joints. Sands worked between the paving stones shall be thoroughly mixed with six (6) percent by weight of bentonite clay.

Surplus material shall then be swept from the surface and the entire site left clean.
After final vibrating the surface shall be true to line and grade and shall not vary by more than 8mm when tested with a 3m board at any location on the surface.

3) Areas with Vehicle Traffic
Paving stones used in areas subject to vehicle traffic shall be set on a concrete base. Paving stones shall be seated on a latex or polymer modified mortar. All joints shall be mortar filled. Prior to use the design section and material shall be submitted to the Engineer for written approval.

315.03.00 PAVING BRICK

315.03.01 General
This Specification covers fired units made from clay, shale, fire clay, or mixtures thereof. The units are intended for use as a paving material to support pedestrian and light vehicular traffic.

315.03.02 Material

1) Requirements
The brick shall conform to the requirements of ASTM CO-2, with the following modifications:

ASTM Standards:

C7 Specifications for Paving Brick
C67 Sampling and Testing Brick and Structural Clay tile
C88 Test for soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate
C410 Specifications for Industrial Floor Brick

No breakage and not greater than 0.5 percent loss in dry weight on any individual unit.

Sulphate Soundness Test - the brick shall survive 15 cycles of the sulphate soundness test in accordance with Sections 3, 4, and 7 of the Method C88 with no visible damage.

Warpage - the concave or convex warpage of that face of the brick that is to become the surface shall not exceed 1.6mm for each 150mm of brick length when measured in accordance with Section 12 of Methods C67.

Efflorescence - when brick is tested in accordance with Section 10 of Methods C67, the rating for efflorescence shall not be more than "slightly effloresced."

2) Classifications
Light traffic paving brick are classified according to the severity of their use-environment. Two types of environment are considered: (1) weather and (2) traffic:
(1) **Weather:** Class SX - brick intended for use where the brick may be frozen while saturated with water.

**TABLE 1:** Physical Requirements*

<table>
<thead>
<tr>
<th>Designation</th>
<th>Compressive Strength, flatways, gross area, Min. Mpa</th>
<th>Cold Water Absorption Max.% Max.</th>
<th>Saturation ** Coefficient Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class SX</td>
<td>55.2</td>
<td>5</td>
<td>0.78</td>
</tr>
</tbody>
</table>

* Minimum modules of rupture values should be considered by the purchaser for uses of brick where support or loading may be severe.

** The saturation coefficient shall be the ratio of absorption by 24 hour submersion in room temperature water to that after 5 hour submersion in boiling water.

(2) **Traffic:**

**TABLE 2:** Abrasion Requirements

**NOTE 1** The abrasion index shall be calculated from the cold absorption in percent and the compressive strength in pounds per square inch (megapascals) as follows:

\[
\text{Abrasion index} = \frac{100 \times \text{absorption}}{\text{compressive strength}}
\]

**NOTE 2** The volume abrasion loss should be determined in accordance with Method C418, with the following changes in procedure:

1. The sand shall be a natural silica sand from Ottawa, ILL., graded to pass a 314μm sieve and retained on a 160μm sieve.

2. The test shall be run on dry brick.

3. The duration of the test shall be 2 minutes.

4. The rate of sand flow shall be 400g/min.

5. The volume loss shall be determined by filling the abraded depression with modeling clay, striking off level with the original surface of the brick, and removing and weighting the modeling clay. The volume loss shall be calculated from the bulk density of the modeling clay. The bulk density should be determined on each lot of modeling clay.
An alternative method of determining the weight of clay used in filling the sand-blast cavity is to determine the weight of the modeling clay sample before and after filling the cavity.

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion Index</td>
<td>Volume Abrasion Loss</td>
</tr>
<tr>
<td>max.</td>
<td>max, cm³/cm²</td>
</tr>
<tr>
<td>0.11</td>
<td>1.7</td>
</tr>
</tbody>
</table>

**TABLE 3: Tolerances on Dimensions**

<table>
<thead>
<tr>
<th>Dimensions, mm</th>
<th>Permissible Variation, max, plus or minus mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application PS</td>
<td></td>
</tr>
<tr>
<td>76 and under</td>
<td>3.2</td>
</tr>
<tr>
<td>Over 76 to 102 incl.</td>
<td>4.7</td>
</tr>
<tr>
<td>Over 127 to 203 incl.</td>
<td>6.4</td>
</tr>
</tbody>
</table>

**TABLE 4: Maximum Permissible Extend of Chipping from Edges and Corners**

NOTE: The aggregate length of chips on a single unit shall not exceed 10 percent of the perimeter of the exposed face of the brick.

<table>
<thead>
<tr>
<th>Chipping in Millimeters in from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
</tr>
<tr>
<td>--------------------</td>
</tr>
<tr>
<td>6.4</td>
</tr>
</tbody>
</table>

**315.03.03 Visual Inspection**

The brick shall be free of cracks or other imperfections detracting from the appearance of a designated sample when viewed from a distance of 4.6 m for Type PX and a distance of 6m for Type PS.

The parts of the brick that will be exposed in place shall be free of chips that exceed the limits given in Table 4.
Unless otherwise agreed upon by the purchaser and the seller, a delivery of brick shall contain not more than 5 percent brick that do not meet the combined requirements of Tables 2, 3 and 4, and including broken brick.

315.04.00  BRICK PAVEMENT

315.04.01  General

Rigid brick paving shall consist of units laid in a bed of mortar with subsequent mortar joints between the units. Construction shall be on a concrete or asphaltic concrete base as specified.

315.04.02  Latex - Portland Cement Mortars

Materials and installation are contained in ANSI A119.4 "Specifications for Latex - Portland Cement Mortar". Manufacturers directions shall be carefully followed.

315.04.03  Leveling Bed

The mortar leveling bed shall be 10mm to 14mm thick. Brick paving stones are buttered with mortar and shoved into the leveling bed of mortar.

315.04.04  Joints

1) General
Joint width shall be specified within the range of 10mm to 14mm.

2) Expansion Joints
Expansion Joints shall be provided:
- parallel to curbs and edging
- at 90 degree or right angle turns
- around interruptions

315.04.05  Protection of Work

No pedestrian or vehicle traffic shall be permitted within 48 hours after the paving stones have been placed.

315.05.00  SILANE SURFACE TREATMENT

315.05.01  General

This work consists of treating concrete surfaces with a silane protective solution, including surface preparation and application, in accordance with these Specifications.
315.05.02 Material
Silane bridge treatment shall be a 40 percent solution of alkyltrialkoxy silane in anhydrous isopropanol.
A sample of the silane solution shall be submitted to the Engineer for testing.

315.05.03 Equipment
Minimum requirements for construction equipment as required for surface preparation and application of the silane solution are specified herein.

1) Sandblasting Equipment
Equipment required for sandblasting methods of surface preparation:
- Sandblasting unit - Compressed air-pressure typesand-blasting equipment of proper size and capacity to clean concrete surfaces as specified.

2) Application Equipment
Equipment for application of silane solution:
- Spray equipment - Low-pressure airless type spray equipment with 100 - 200 kPa application pressure. Deck surfaces shall be treated using a spray bar unit calibrated to provide even coverage. Small deck areas may be treated using a hand held sprayer.

315.05.04 Construction

1) Surface Preparation
All concrete surfaces prepared for treatment shall be thoroughly cleaned prior to application of the silane solution. The method of cleaning shall remove curing compounds, laitance, dirt, dust, salt, oil, asphalt, or other foreign materials.
If necessary, solvents and hand tools shall be used as required to remove bonded materials detrimental to treatment of the concrete surface.

The cleaning process shall not cause any undue damage to the concrete surface, remove or alter the existing surface finish or expose the coarse aggregate of the concrete. The method of cleaning shall be performed in such a manner as to provide a reasonably uniform appearing surface colour.

All concrete surfaces shall be substantially dry prior to application of the silane surface treatment. Wet surfaces shall be allowed to fully dry prior to the application of the silane solution. Surfaces shall be lightly water-wetted 12 to 24 hours following treatment.

2) Application
The silane protective solution shall be used as supplied by the manufacturer. It shall not be diluted or altered in any way. The solution shall be sprayed onto concrete surfaces at a coverage rate of 1 litre/3m² on bridge decks, and at a rate of 1 litre/4m² on surfaces not subject to wear or abrasion.
3) Limitations
The silane solution shall not be applied when the air or concrete temperature is less than 40° Celsius or more than 100° Celsius or when the wind or other conditions prevent proper application. Surface treatment of new concrete prior to 28 days curing shall not be permitted.

4) Traffic
Traffic shall be kept off treated surfaces until the solution has penetrated completely and is surface dry (usually 30 to 45 minutes).
DETAILED SPECIFICATIONS

316.00.00 NOISE BARRIERS

316.01.00 General
316.02.00 Wood Noise Barrier
316.03.00 Precast Concrete Noise Barrier - Zero Slump
316.04.00 Precast Concrete Noise Barrier - Wet Cast
316.00.00 NOISE BARRIERS

316.01.00 GENERAL

Manufacturers shall prove, prior to tendering, to the Engineer that they are capable of fulfilling these specifications.

1) Design
The noise barrier shall be designed in accordance with the National Bridge Code as a slender structure not usually sensitive to wind action. Design wind loads and ice accretion on panels shall be as prescribed for sign panels. Reference wind pressure for a 25 year return period shall be used. The reference wind pressure shall be determined on a site specific basis as described in the National Bridge Code.

The site specific depth and size of post foundations shall be determined in accordance with the National Bridge Code based on the determined soil design parameters along the alignment of the noise barrier.

Where post foundations are to be installed on or within one meter from a downward slope of 3:1 or steeper, the embedment depth of the foundations shall be a minimum of 500mm greater than the requirements of the National Bridge Code which assumes level ground surrounding the post location.

The top of the barrier profile shall be installed level. To accommodate sloping ground, the barrier shall be evenly stepped with all panels installed level. Steps shall not exceed 300mm in height. If stepping is required the minimum height of the noise barrier, as specified, shall be maintained.

Termination of barriers higher than two meters, shall be by stepping the height of the noise barrier down to a minimum height of two meters.

2) Sound Transmission Class (STC)
The Sound Transmission Class (STC) of the specimen shall be 20 or greater and shall be determined from the measured sound transmission loss in accordance with ASTM-E413.

3) Post Foundation Concrete
Concrete used for post foundations shall be sulphate resistant and shall achieve a minimum of 25 MPa compressive strength at 28 days. Maximum slump shall be 100mm. The concrete in the footings shall be cured for a minimum period of five days before the noise barrier panels are installed.

4) Materials
All materials shall have a minimum predicted maintenance free lifespan of 20 years.

Noise barrier made from materials other than wood and/or concrete shall be subject to the same specifications in regard to durability and shall meet or exceed the accelerated weathering test and the test for colour fastness. Materials normally subject to damage from Ultra Violet (U.V.) rays shall be treated to make them U.V. resistant.
Materials used to fill cavities in double walled noise barrier systems to increase sound absorption shall be manufactured to meet CGSB Standard 51-GP-10-M, rigid type. The noise reduction coefficient (NRC) shall not be less than 0.70 using 25mm of insulation thickness on a F400 mount in accordance with ASTM Standard E795.

All materials shall be protected from weather and damage while in transit or at the construction site.

5) Samples
Prior to production of materials the Contractor shall supply members for two complete panels, erected on temporary supports suitable for visual inspection.

Full production of materials shall not commence until approval of the sample panels, in respect to finishes, colour, dimensions, tolerances, workmanship, etc., has been given.

The sample fence approved by the project Engineer shall be used as a standard for consistency of colour and texture from plank to plank.

6) Finish
The surface texture shall be subject to approval by the Engineer.

5) Drawings
Minimum specifications are shown in the Contract Drawings. The successful tenderer shall be required to submit Shop Drawings to scale showing the proposed method of panel erection, post details, and attachment method. The Shop Drawings and attached notes shall stipulate the construction of both posts and panels and the respective finishes and bear the seal of a professional engineer registered in the Province of Alberta.

6) Construction
The fence shall be constructed at the location and grade established by the Engineer and shall conform to all applicable Standard Drawings.

316.02.00 WOOD NOISE BARRIER

316.02.01 Material
All materials shall conform the requirements as set forth in Chapter 300.

316.02.02 Height Restriction
Maximum height of a Wood Noise Barrier shall be 2400mm, measured at the midpoint of the panel.
316.03.00 PRECAST CONCRETE NOISE BARRIER - ZERO SLUMP

316.03.01 General

1) Mix Design
The supplier shall submit to the Engineer for approval the proposed mix design, including source of proposed aggregates immediately after award of Tender and prior to any casting of product.

316.03.02 Materials

1) Cement
Cement shall be Type 10 or 30 Portland Cement meeting the requirements of CAN3-A5-M77.

2) Fine Aggregate
Fine aggregate shall be manufactured sand, washed clean, having hard, strong, sharp, durable, uncoated grains and free from injurious amounts of dust, lumps, soft or flaky particles, mica, shale, alkali, organic matter, loam, or other deleterious substance.

Manufactured sand shall be fine aggregate produced by crushing rock, gravel, or slag. Aggregate sizing shall conform to the following.

<table>
<thead>
<tr>
<th>Sieve Size - mm</th>
<th>Percent Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5</td>
<td>100</td>
</tr>
<tr>
<td>5.0</td>
<td>92 - 100</td>
</tr>
<tr>
<td>2.5</td>
<td>70 - 90</td>
</tr>
<tr>
<td>300μm</td>
<td>10 - 25</td>
</tr>
<tr>
<td>150μm</td>
<td>0 - 8</td>
</tr>
<tr>
<td>80μm</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

3) Coarse Aggregate
Coarse aggregate shall consist of gravel or broken stone composed of strong, hard, durable, uncoated pebbles, or rock fragments, washed clean and free from injurious amounts of shale, coal, clay, lumps, soft fragments, dirt, glass, and organic or other deleterious substances.
Aggregate sizing shall conform to the following:

<table>
<thead>
<tr>
<th>Sieve Size - mm</th>
<th>Percent Passing by Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>100</td>
</tr>
<tr>
<td>12.5</td>
<td>90 - 100</td>
</tr>
<tr>
<td>5.0</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

Absorption shall not exceed 7% ASTM C140.
4) Admixtures
Chemical Admixtures shall conform to CSA. A266.2 and be approved by the Engineer.

5) Reinforcing Steel
Reinforcing steel shall be deformed bars meeting the requirements of ASTM Designation A615 and CSA. G30.12-M1977.

Minimum yield strength:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>300 MPa</td>
</tr>
<tr>
<td>400</td>
<td>400 MPa</td>
</tr>
</tbody>
</table>

Reinforcing steel shall be accurately and firmly anchored in place as designated in the drawings.

316.03.03 Production

1) Tolerances
Tolerances shall be in accordance with CAN3-A23., Section 10.

2) Curing
Curing shall conform to requirements of CAN3-A23.4-M78, Section 21.

Planks shall be steam cured for a minimum of eight hours.

316.03.04 Erection

1) Delivery, Handling and Storage
Delivery, handling, and storage shall be in accordance to CAN3-23-24, Section 31.

Precast members shall not be handled for shipment until 75 percent of design strength is achieved. Proof of strength shall be a compressive strength of a cube (core) on a field cured plank at the Contractors expense.

2) Rejection
The Engineer reserves the right to reject any product not meeting the requirements of these Specifications including, but not limited to, the occurrence of one or more of the following:

(a) defects that indicate any imperfect concrete mixing or molding.

(b) surface defects indicated by honeycombed or open textures and damaged areas where such defects would affect the structural adequacy.

Minor surface cavities or irregularities which are satisfactorily repaired shall not constitute cause of rejection. Repairs shall not be made until the Engineer has inspected the extent of the irregularity and has determined whether or not the product shall be accepted.
3) Cleaning, Patching and Repairs
Cleaning, patching, and repair of precast concrete shall be in accordance with CSA. A23.4, Clause 30.

Approval by the Engineer shall be required for all cleaning, patching, and repairing methods.

Clean soiled precast concrete surfaces by approved means.

316.03.05 Testing

1) General
The supplier shall notify the Engineer of casting times. Concrete testing and/or inspection shall be done at the expense of The City. The supplier shall allow the Engineer free access to those portions of his plant where the planks are being produced and stored.

Strength testing of concrete shall be carried out by a testing laboratory designated by The City. The City shall pay costs for testing. The Contractor shall bear the cost of supplying materials for test samples.

At the Engineer's option, cube samples shall be taken on site from the precast concrete members and tested to confirm that the specified compressive strength has been attained.

Planks shall be tested at the discretion of The City. These planks shall be cubed (cored), and tested for compressive strength and absorption.

2) Plastic Concrete Testing
To evaluate the concrete mix, a set shall consist of three standard size 150mm x 305mm cylinders, using heavy steel molds.

A total of six lifts are to be in the casting process with each lift compacted by 45 blows of a modified Proctor compaction hammer as specified by ASTM D1557-78. One cylinder to be tested in compression at seven days and the remaining two cylinders at 28 days after standard moist curing.

Test detail are cited in the paper published in the Canadian Journal of Civil Engineering, Vol. 14, Number 3, June 1987, pages 308 - 313.

3) Hardened Concrete Testing
To evaluate the in-place hardened concrete produced by these special mixes, cube specimens shall be cut from the middle third of a sound barrier plank chosen at random from each day's production.

4) Moisture Content
Moisture content of the batches of mix shall be sampled on a random basis using a "Speedy Moisture Tester". Minimum water contents shall be maintained at all times.
5) Absorption
Test each of six cubes for 24 hour water absorption at room temperature in accordance with procedures of ASTM C140.

6) Compression
Zero slump concrete shall achieve a minimum of 25 MPa compressive strength at 28 days for saturated cube sample.

Three cubes shall be tested in compression in accordance with procedures of ASTM C140.

316.04.00 PRECAST CONCRETE NOISE BARRIER - WET CAST

316.04.01 Mix Design

1) General
Immediately after award of Tender and prior to any casting, the supplier shall submit to the Engineer for approval, the proposed mix design including source of proposed aggregates.

2) Compressive Strength
Unless otherwise noted, wet cast concrete shall achieve a minimum of 30 MPa compressive strength at 28 days for laboratory samples and 25 MPa for saturated core samples.

3) Water - Cement Ratio
Maximum water-cement ratio shall be 0.43.

4) Air Entrainment
Air entrainment minimum 5%.

5) Absorption
Absorption to be 5% maximum ASTM Designation C140.

6) Calcium Chloride
No calcium chloride shall be used.

316.04.02 Materials

1) Cement
Cement shall be Type 10 or Type 30 Portland Cement meeting the requirements of CAN3-A5.

2) Aggregate
Aggregate gradation shall conform to the requirements of ASTM Designation C33.

Fine Aggregate - Sections 4 to 7
Coarse Aggregate - Sections 8 to 10

3) Rebars
Reinforcing steel shall be deformed bars meeting the requirements of ASTM Designation A615, Grade 400 or CSA G30.12.
Reinforcing steel shall be accurately and firmly anchored in place as designated in the drawings.

4) Air Entraining Agents
Air entraining agents shall conform to the requirements of ASTM Designation C260.

316.04.03 Testing

1) General
Strength testing of concrete shall be carried out by a testing laboratory designated by The City. The City shall pay costs for testing. The Contractor shall bear the cost of supplying materials for test samples.

The supplier shall notify the Engineer of casting times in order that arrangements for concrete testing and/or inspection can be made, at the expense of The City. The supplier shall allow the Engineer free access to those portions of his plant, where the planks are being produced and stored, for this purpose.

2) Linear Transverse
A 100mm diameter core shall be taken and subjected to laboratory testing by the linear transverse method, refer ASTM Designation C-457, "Modified Point-Count Method, Air-paste ratio method of calculation".

Concrete tested by this method using a magnification of 60X and found to have a spacing factor greater than 0.2mm shall be rejected, and complete replacement of the work shall be required.

Notwithstanding ASTM Designation C-457, the results of one full traverse shall be held as representative of all concrete cast the same day.

3) Compression
Concrete cylinders shall be tested in accordance with the following current ASTM standards:

a. Molding: ASTM Designation C192
b. Curing: ASTM Designation C31
   c. Cylinder compressive strength ASTM Designation C39
d. Cube compressive strength ASTM Designation C42

At the Engineer's option, core samples shall be taken on site from the precast concrete members and tested to confirm that the specified compressive strength has been attained.

Any concrete found non-compliant as to the above Sections shall be rejected and removal and replacement may be required at the discretion of the Engineer.
DETAILED SPECIFICATIONS

317.00.00 RAILWAY CROSSING PLANKS

317.01.00 General
317.00.00  RAILWAY CROSSING PLANKS

317.01.00  GENERAL

All railway crossing planks within the Streets Right-of-Way shall be constructed in accordance with Canadian Pacific Railway and/or Canadian National design specifications. General arrangement to be as shown on Standard Drawing 454.1007.014.

The rate of transition, from railway longitudinal grade to pavement road crown, shall be 1 percent per 6 meters.

Note: To maintain constant pavement depth the subgrade shall also conform to the rate of transition.
DETAILED SPECIFICATIONS

318.00.00 MUDJACKING AND SOIL STABILIZATION

318.01.00 General
318.02.00 Grout Mixes
318.03.00 Grout Material
318.04.00 Equipment
318.05.00 Construction
318.06.00 Testing
318.07.00 Measurements
318.00.00 MUDJACKING AND SOIL STABILIZATION

318.01.00 GENERAL

318.01.01 Definitions

1) Mudjacking
Restoration of surface grade of concrete flatwork or pavement by pressure injection of grout.

2) Soil Stabilization
The use of a cementacious grout to enhance the bearing properties of a soil.

318.01.02 Mudjacking
The work shall include the following:
- Coring or drilling of holes through the existing concrete/pavement structure of a diameter not to exceed 63mm.
- Supply equipment, labour and grouting materials for pressure grouting to fill all voids between the underside of the concrete/pavement and the existing subgrade to restore concrete/pavement elements to control elevations.
- Repairing all grouting holes.
- Removal of all temporary repairs and construction debris.
- The Contractor shall prevent wastewater or mudjacking slurry from entering the storm sewer system.

318.01.03 Soil Stabilization
A fine particle grout shall be used to fill soil pore space without significant fissuring of the soil mass. Scope of the work shall be backfill stabilization and moisture reduction in areas of frost susceptible soils. The work shall include the following:
- Coring or drilling of holes through the existing concrete pavement structure of a diameter not to exceed 63mm and at horizontal spacings to produce an ultimate grid of two meters centre-to-centre within the area to be densified/stabilized, as shown on the Drawings.
- Supply equipment, labour and grouting materials for pressure grouting to fill all voids and soil pores spaces and to otherwise densify all soil strata where deficient soil density may currently exist. Provide for partial completion of grouting at any individual grouting location, and for progressive grouting from depth to underside of the existing concrete pavement.
- Repairing all grouting holes.
- Removal of all temporary repairs and construction debris.
318.01.04 Sequential Work

Procedures and materials to execute the work described in 318.01.02 and 318.01.03 may be performed sequentially using the same grouting hole when the occasion permits, and when approved by the Engineer.

318.01.05 Temperature

Operations are to be suspended when air temperature is less than 5° Celsius.

318.02.00 GROUT MIXES

318.02.01 Type “A” Grout

Type A grout shall be an approved fine particle grout with the solids component consisting of Type 30 Portland cement and silica fume.

Type A grout shall be used to stabilize reasonably dense fine grained soils which contain no significant fissuring in the soil mass, and to fill soil pore spaces within the soil mass. This type of grout may also be used to modify the natural moisture content of frost susceptible soils.

318.02.02 Type “B” Grout

Type B grout shall be an approved grout with the solids component consisting of Type 10 Portland cement, and bentonite.

Type B grout shall be used to densify and stabilize medium to loose fine grained soils whose mass does not typically contain significant void spaces and to stabilize well graded granular soils by filling voids between particles which generally have particle-to-particle contact. This type of grout may also be used for mudjacking concrete pavement slabs where no void space initially exists between the slab and the supporting subgrade.

318.02.03 Type “C” Grout

Type C grout shall be an approved grout with the solids component consisting of Type 10 Portland cement, fine sand and bentonite with or without an approved pozzolan.

Type C grout shall typically be used to fill substantial sized void spaces within the targeted zone of subgrade stabilization and for typical mudjacking purposes.
318.02.04 Mix Designs

Mix designs for each type of grout shall be submitted to the Engineer for approval. Submission requirements shall include:

- Batch proportions to produce a unit volume of injectable grout, as well as intended dosage rates of permitted admixtures.

- Verification of compliance with the following physical property requirements, as submitted by an independent testing firm acceptable to the Engineer and who shall be retained and reimbursed by the Contractor:

318.02.05 Mix Properties

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow, seconds</td>
<td>10-16</td>
<td>15-30</td>
<td>N/A</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>3-5</td>
<td>3-5</td>
<td>3-5</td>
</tr>
<tr>
<td>@ 28 days, Mpa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleeding @ 1 hr.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>after casting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slump, mm</td>
<td>N/A</td>
<td>N/A</td>
<td>150-250</td>
</tr>
<tr>
<td>Spread, max, in diameter, mm</td>
<td>N/A</td>
<td>N/A</td>
<td>400</td>
</tr>
<tr>
<td>Density, kg/m$^3$</td>
<td>1350-1450</td>
<td>1400-1600</td>
<td>1700 min.</td>
</tr>
<tr>
<td>Cement content kg/m$^3$</td>
<td>400</td>
<td>450</td>
<td>300</td>
</tr>
<tr>
<td>1 minimum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate: Cement Ratio, by volume</td>
<td>N/A</td>
<td>N/A</td>
<td>2.25 to 3.00</td>
</tr>
<tr>
<td>Shrinkage, max, %</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

CAN3-A23.2-1B:
318.03.00 GROUT MATERIAL

318.03.01 General

All materials shall be obtained from the same source of supply or manufacturer for the duration of the project.

318.03.01 Cement

a. normal, type 10 Portland conforming to CSA A5.
b. high early strength, type 30 Portland cement.

318.03.02 Fine Aggregates

Fine Aggregate shall conform to Clause 5.3, CAN-A23.1-M77 (mortar sand free of excess rubble or stone material).

318.03.03 Pozzolanic Material

Pozzolanic materials shall conform to CAN3-A 266.1-M78 (as required)

318.03.04 Water

Water shall be clean and free from oil, alkali, organic matter or deleterious matter.

318.03.05 Admixtures

- Flake calcium chloride conforming to ASTM C494-71 as required.
- 4% to 6% air entrainment as required.
- Plasticizer as required.
- Derex pumping aid as required.
- Water reducer as required.
- Lime and or fly ash as required.
- The use of powdered bentonite shall be subject to the prior approval of the Engineer.
318.04.00 EQUIPMENT

318.04.01 General

All equipment required for mixing and injecting each type of grout mix shall be located at the site of the work. All grout shall be mixed on site.

318.04.02 Grout Mixers and Grout Pumps

Grout mixers shall be capable of thorough, homogeneous mixing.

For mixing, pumping and injecting fine particle grout (Type A), the following equipment shall be provided, as a minimum:

- High speed colloid mixer, or equivalent.
- Non-pulsing progressive cavity pump system, or equivalent with constant flow pressure up to 150 psi and controllable flow rate from 1 GPM to 25 GPM.
- Packer system to seal the zone between the injection probe and surrounding pavement, when applicable.
- Pumping of Types B and C grout shall be undertaken with a pump which shall be capable of applying up to 1,750 kPa (250 psi) pressure at the outlet end of the discharge pipe.
- The pump shall be of the positive displacement type and shall be equipped with a return line to the pump hopper so that the grout mixture can be continuously circulated during periods when no grout is being placed.

318.05.00 CONSTRUCTION

318.05.01 General

The Contractor shall be responsible for selecting the appropriate type of grout to commence stabilization/densification operations within the zone of installation, using evidence acquired by him during the development of the grouting holes by auguring or other hole-making techniques. He shall be prepared to change grout type immediately upon identifying the rate at which the initial grout injection rate, or "take", occurs.

318.05.02 Mudjacking

1) General
Mudjacking shall be done in small increments so as not to damage the pavement.

2) Grouting Holes
Grouting holes are to be carefully planned in strategic locations, and an attempt should be made, wherever possible, to use mudjacking grouting holes for subsequent soil stabilization/densification operations.
3) Water Injection
Water injection may be used to create voids beneath concrete slabs if necessary. The Contractor shall make the necessary arrangements for water supply.

4) Faulted Joints
Mudjacking at a faulted or misaligned joint shall continue until the vertical dimension across the joint, measured by a straightedge placed across the joint, is 6mm or less. If the Contractor causes a slab to uplift so that its edge is higher than the edge of the adjacent slab(s), he shall, at his own expense undertake corrective measures using approved grinding means to restore a maximum 6mm vertical dimension across the joint. Other joints may be repaired by use of approved grinding techniques at applicable Unit Rate.

5) Excessive Grout
If an excessive amount of grout is being used at a location, as determined by the Engineer, the Contractor shall suspend operations to allow the injected grout to set-up before resuming grouting.

6) Cracks
Cracks caused by the mudjacking operation which are greater than or equal to 3mm in width shall be repaired by the Contractor, at his expense, using materials and methods satisfactory to the Engineer.

318.05.03 Stabilization/Densification

1) Grouting Holes
Grouting holes for grout injection shall be established on a 2 meters horizontal grid within the area of work set out by the Engineer. Initial grouting shall be undertaken at each alternate hole location (i.e. 4 meters spacing) on the longitudinal axis of the work area, as well as on the transverse axis if necessary.

2) Initial Grouting
Initial grouting shall consist of the injection of sufficient grout to create a "plug" of stabilized soil, after which grouting at a location shall be suspended until that initial grout sets-up.

3) Infill Grouting
Infill grouting at the alternate core hole locations shall be permitted after grout has set-up at the initial injection locations and shall continue only until a "plug" has been created to abut the "plugs" created at the initial grout locations.

4) Completion Grouting
Completion grouting shall be permitted throughout the vertical dimension of each core hole to the underside of the concrete/pavement in a sequence which shall be consistent with the soil conditions which have been determined to exist, by the Contractor, at that location.
5) Grouting Pressure
Grout injection pressures shall be the responsibility of the Contractor, but should only be sufficient to ensure reasonable grout “take”.

318.06.00 INSPECTION AND TESTING

318.06.01 General

Grout sampling, inspection and testing shall be performed by an inspection and testing firm appointed and paid for by The City. Slump and spread testing may be performed regularly on site by the Engineer or his representative.

The Contractor shall provide the appointed testing firm with free access to all portions of the work site at all times.

318.06.02 Tests

Strength, shrinkage, density, slump and spread tests of the grout and/or materials in the grout shall be performed to ensure conformance with requirements stated herein.

To conform to the strength requirements of the Specifications, the results of tests performed on laboratory cured cylinders or cubes for each type of grout shall meet the following:

- The average of all tests shall exceed the specified strength.
- When five or more tests of the same type of grout are available, the average of any five consecutive tests shall be equal to or greater than the specified strength.
- No three consecutive tests shall fall below the specified strength.
- No individual strength test shall fall in excess of 0.5 MPa below the specified strength.

310.06.03 Additional Testing

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

- Changes in the mix proportions for the remainder of the work.
- After completion of the testing procedure, if the Engineer or his representative is not satisfied with the indicated quality or consistency of the grout, the Contractor may be required to strengthen or replace those portions which are deemed to be unsatisfactory, or an adjustment of grout used shall be made and deducted from submitted invoices, or a particular batch of grout may be rejected on site.

318.07.00 MEASUREMENT

The Contractor shall provide to the Engineer, at the end of each working day, a summary of all payment quantities claimed in accordance with the terms of this Contract.
DETAILED SPECIFICATIONS

319.00.00 Geotextiles and Geomembranes

319.01.00 Filter Fabrics
GEOTEXTILES AND GEOMEMBRANES

FILTER FABRICS

General

Filter fabrics are divided into separation membranes and drainage membranes.

1) Separation Membranes
Separation membranes shall be used to separate native soils from construction materials.

The fabric shall be woven polymer fibre having the following minimum properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength</td>
<td>890 N</td>
</tr>
<tr>
<td>Puncture Strength</td>
<td>420 N</td>
</tr>
<tr>
<td>Mullen Burst Strength</td>
<td>2,900 kPa</td>
</tr>
<tr>
<td>Trapezoidal Tear Strength</td>
<td>400 N</td>
</tr>
</tbody>
</table>

2) Drainage Membranes
Drainage membranes shall be used to filter excess water entering the drainage gravel and/or subdrain from the subgrade.

The fabric shall be non-woven polymer having the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength</td>
<td>800 N</td>
</tr>
<tr>
<td>Mullen Burst Strength</td>
<td>2,000 kPa</td>
</tr>
<tr>
<td>Trapezoidal Tear Strength</td>
<td>270 N</td>
</tr>
<tr>
<td>Permeability K.</td>
<td>0.1 cm/sec</td>
</tr>
</tbody>
</table>

Joints

All fabric joints shall be sewn using a thread having equal or greater tensile strength than the fabric. Seams (joints) shall be double stitched using the "J" seam with interlocking stitches. The strength of the finished joint shall meet the same Specifications required for the fabric.

Packaging and Storage

Each roll shall be packaged and stored in such manner as to be protected at all times until used. The fabric shall not be stored in direct sunlight.

Certification

Two copies of the Mill or Manufacturer's Certificate listing the mill number of each roll and verifying compliance with the Specifications shall be supplied with each shipment of geotextile materials. The Mill or Manufacturer's Certificate shall be signed by a duly authorized official of the manufacturing firm.
Prior to shipment one copy of the Mill or Manufacturer's Certificate shall be provided to the Engineer.

The specifications on the Mill or Manufacturer's Certificate shall be provided in the same units as specified in these Specifications.

Each roll shall be clearly marked indicating the manufacturer, product type, mill number, and roll number.
DETAILED SPECIFICATIONS

320.00.00 AGRICULTURAL CROSSINGS

320.01.00 General
320.02.00 Design
320.03.00 Construction
320.04.00 Inspection
320.05.00 Maintenance
320.00.00  AGRICULTURAL CROSSINGS

320.01.00  GENERAL

1) Definition
"Agricultural Crossing" means the driveway crossing to a property from a City roadway having drainage ditches.

2) Agricultural Crossing Agreement
An "Agricultural Crossing Agreement" between The City and the property owner shall be executed prior to any work being performed.

320.02.00  DESIGN

320.02.01  General
All agricultural crossings shall be designed and constructed to conform to the following minimum Specifications and Standard Drawing unless prior, written approval is obtained from the Engineer for construction to alternate standards.

320.02.02  Alignment
The agricultural crossing shall be aligned at right angles to the tangent of The City road.

320.02.03  Grade
A minimum grade of minus 10 percent and a maximum of plus 10 percent shall be maintained along the agricultural crossing from the shoulder edge of the intersecting City street to the property line.

320.02.04  Culverts
The minimum requirements for culverts, where they are required to be installed, shall be:

a)  450mm diameter;
b)  galvanized corrugated metal pipe with 4:1 tapered ends for local streets and 5:1 tapered ends for collector and/or major roads;
c)  1.6mm wall thickness;

Note: A corrugated polyethylene pipe of equivalent strength may be used.

Culverts shall be installed along the ditch bottom in such manner that the existing drainage along the ditch is maintained. A larger diameter culvert may be required when drainage conditions dictate, as determined by Wastewater.
320.02.05 Minimum Cover

There shall be a minimum cover equal to the diameter of the culvert over the culvert.

320.02.06 Side Slopes

The agricultural crossing side slopes shall be 4:1 on local streets and 5:1 on collector and/or Major roads.

320.02.07 Crossing Surface

The finished traveling surface of the agricultural crossing shall be crowned and shall be a minimum of 6.1m in width.

320.03.00 CONSTRUCTION

320.03.01 Utility Locates

The Applicant shall be responsible for all utility locations and any costs for repair and/or relocation of utilities arising out of the construction of the agricultural crossing.

320.03.02 Embankment Material

Prior to any fill material being placed for the new agricultural crossing, all organic or otherwise deleterious materials shall be removed. The fill used for construction of the agricultural crossing shall not contain any organic, frozen or otherwise deleterious materials and shall be compacted to a minimum of 97.0 percent of Standard Proctor Density.

320.03.03 Construction Standard

The full width of the agricultural crossing, from the shoulder of The City street to the property line shall be constructed to be equivalent to, or better than the standard of the abutting City road.

320.03.04 Damage to City Property

Any damage to City property, including utilities and road surface shall be repaired at the expense of the applicant.

320.03.05 Ditch Rehabilitation

Any disturbed areas in the ditch shall be reclaimed including seeding and removal of rocks larger than 75mm.
320.04.00  **INSPECTION**

ROADS shall be notified within 72 hours of the completion of the agricultural crossing. An inspection will then be conducted to ensure compliance with these specifications.

320.05.00  **MAINTENANCE**

The construction of an agricultural crossing is for the sole benefit of the applicant. The applicant is therefore responsible for the maintenance of the agricultural crossing including the maintenance and cleaning of the culvert.
DETAILED SPECIFICATIONS

321.00.00  LANDSCAPING
321.00.00 LANDSCAPING

Refer to the current issue of the Standard Specifications City of Calgary Development Guidelines and Standard Specifications for Landscape Construction.
DETAILED SPECIFICATIONS

322.00.00 STANDARD DRAWINGS

322.01.00 Drawing Changes for 2009
322.02.00 List of Standard Drawings
322.01.00  DRAWING CHANGES FOR 2010

Please refer to the Front Page, Updates from 2009 to 2010
# List of Standard Drawings

## Roadway Design

### Asphalt Pavements (Sheets 1 to 10)

<table>
<thead>
<tr>
<th>Sheet</th>
<th>Description</th>
<th>File Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Typical Pavement Structure</td>
<td>454.1005.002</td>
</tr>
<tr>
<td>2.</td>
<td>Typical Pavement Structure</td>
<td>454.1005.009</td>
</tr>
<tr>
<td>3.</td>
<td>Full Depth Asphalt Paving</td>
<td>454.1005.013</td>
</tr>
<tr>
<td>4.</td>
<td>Full Depth Asphalt Paving for DTN &gt; 500</td>
<td>454.1005.014</td>
</tr>
<tr>
<td>5.</td>
<td>Pavement Road Crowns</td>
<td>454.1005.001</td>
</tr>
<tr>
<td>6.</td>
<td>Rural Roads Paving</td>
<td>454.1005.012</td>
</tr>
<tr>
<td>7.</td>
<td>Superelevation Development for Major and Collector Streets</td>
<td>454.1014.001</td>
</tr>
<tr>
<td>8.</td>
<td>Superelevation Tables</td>
<td>454.1014.002</td>
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<tr>
<td>9.</td>
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<td>10.</td>
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### Gravelled Roadway (Sheets 11 to 15)

<table>
<thead>
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<th>Sheet</th>
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<tbody>
<tr>
<td>11.</td>
<td>Graded and Gravelled Roads</td>
<td>454.1005.004</td>
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<td>12.</td>
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<td>13.</td>
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<td>14.</td>
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<td>15.</td>
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## Lane Design (Sheets 16 to 25)

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<th>Sheet</th>
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<tbody>
<tr>
<td>16.</td>
<td>Gravelled Lanes, 6.10 to 10.00 Metres Right of Way</td>
<td>454.1011.003</td>
</tr>
<tr>
<td>17.</td>
<td>Gravelled Lane Restoration Detail</td>
<td>454.1011.006</td>
</tr>
<tr>
<td>18.</td>
<td>Standard Lane Approach Stabilization</td>
<td>454.1011.004</td>
</tr>
<tr>
<td>19.</td>
<td>Grading Transition at Catch Basin in Gravel Dished Lane</td>
<td>454.1011.002</td>
</tr>
<tr>
<td>20.</td>
<td>Grading Transition at Catch Basin in Asphalt Dished Lane</td>
<td>454.1011.007</td>
</tr>
<tr>
<td>21.</td>
<td>6.10m Concrete Lane with Fibre Reinforced Concrete</td>
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<td>22.</td>
<td>Paved Lanes Commercial and Residential</td>
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<td>23.</td>
<td>Typical Design For Lane Speed Hump</td>
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## Curb and Gutter (Sheets 26 TO 45)

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<td>26.</td>
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<td>Low Profile Rolled Curb with 250mm Gutter</td>
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<td>Standard Curb with 250mm Gutter on Asphalt Base</td>
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<td>Low Profile Rolled Curb with 250mm Gutter on Asphalt Base</td>
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<td>Standard Curb and 250mm Gutter Crossing with 250mm Apron</td>
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<td>31.</td>
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<td>Standard Concrete Curb Wall on Existing and New Pavement</td>
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<td>Asphalt Curb Cross Sections</td>
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<td>Sidewalk and Boulevard Drainage Crossing for Sep. Walk</td>
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<td>Sidewalk Drainage Crossing for Mono Walk</td>
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<td>Typical Sidewalk Isolation Joints</td>
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<td>Typical Offset Gates</td>
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<td>Standard Chain Closure for Lane</td>
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<td>Typical Emergency &amp; Maintenance Vehicle Gate for Lane Closures</td>
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<td>Typical Mid Block Crossing Detail</td>
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RESIDENTIAL ROADS
CROSS SECTION

COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 12 %

MIX 'B' (50mm + 30mm = 80mm)
GRANULAR BASE (SEE NOTE #2)

SEE DETAIL BELOW

MIX 'B' (40mm MIN.)
MIX 'A' (110mm MIN.)

SEE NOTE #2

COLLECTOR ROADS
CROSS SECTION

COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 8 %

MIX 'B' (40mm MIN.)
MIX 'A' (110mm MIN.)

SEE NOTE #2

PRIMARY COLLECTOR ROADS
HALF CROSS SECTION

COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 8 %

TOLERANCE 0-5mm
STANDARD

THICKNESS OF ASPHALT TO CURB

NOTES:
1. FOR PAVEMENT ROAD CROWNS, SEE DRAWING FILE No. 454.1005.001.
2. SEE SECTION 308, 01.00. MIN. 150mm OF BASE COURSE GRAVEL (SECTION 303.02.00).
   INCLUDING MIN. 50mm OF 25mm BASE COURSE GRAVEL.
3. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.

DIMENSIONS ARE METRES (UNLESS OTHERWISE NOTED) METRIC
INDUSTRIAL ROADS
CROSS SECTION

MAJOR ROADS UNDIVIDED
CROSS SECTION

MAJOR ROADS DIVIDED
HALF CROSS SECTION

THICKNESS OF ASPHALT
TO CURB

NOTES:
1. FOR PAVEMENT ROAD CROWNS, SEE DRAWING, FILE No. 454.1005.001
2. IF ON ASPHALT MIN. MIX A-225mm SEE DRAWING, FILE No. 454.1005.010 & 454.1005.006
3. IF ON GRAVEL SEE DRAWING, FILE No. 454.1005.017 & 454.1005.015
4. SEE SECTION 303.01.00. MIN. 150mm OF BASE COURSE GRAVEL (SECTION 303.02.00), INCLUDING MIN. 50mm OF 25mm BASE COURSE GRAVEL.
5. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
FULL-DEPTH ASPHALT PAVING
For DTN > 500

Equivalent 80 kN Single Axle Load (EAL)
TOTAL OVER DESIGN LIFE
**UNDIVIDED ROADWAYS**

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**DIVIDED ROADWAYS**

The pavement shall be 2% slope. No crown permitted on superelevated or divided roadway.
9.00 m ROAD / 20.00 m RIGHT OF WAY

RURAL ROADS PAVING

NOTES:
- FOR ROAD CROWNS SEE DRAWING 454.1005.001
- CROSS-SLOPE TO BE DETERMINED IN FIELD
- IN LOCATIONS WHERE THE 3:1 MAXIMUM SIDESLOPE CANNOT BE
  ACHIEVED, ADDITIONAL GRAADING AND/OR GUARDRAILS MAY BE
  REQUIRED.
- WHEN R.O.W. GREATER THAN 20.0m, SHOULDER Rounding IS DESIREABLE.
ROADS WITH SPIRALS
(I.E. MAJORS, UNDIVIDED MAJORS)

AXIS OF ROTATION AT MEDIAN LIP OF GUTTER

ROADS WITHOUT SPIRALS
(I.E. DIVIDED & UNDIVIDED COLLECTORS AND LOCAL MAJORS)

THEORETICAL CENTERLINE

NOTES:
1. SMOOTHING CURVES:
   - 20 METRES FOR MAJOR STREETS
   - 15 METRES FOR COLLECTOR, PRIMARY COLLECTOR
     AND LOCAL MAJOR STREETS.
2. DESIRABLE SUPERELEVATION RUNOFF LENGTH IS 30 METRES.

LEGEND
LOG = LIP OF GUTTER
* = RATE OF SUPERELEVATION
Ls = LENGTH OF SPIRAL
TS = TANGENT TO SPIRAL
SC = SPIRAL TO CURVE
TC = TANGENT TO CURVE

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED
### SUPERELEVATION TABLES

#### 50 km/h \( e_{\text{MAX}} = 0.060 \)

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<th>3.64 LANE</th>
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Minimum \( R \times 90 \)

#### 60 km/h \( e_{\text{MAX}} = 0.080 \)

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Minimum \( R \times 120 \)

#### 70 km/h \( e_{\text{MAX}} = 0.080 \)

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Minimum \( R \times 170 \)

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**Legend**

- \( A \) = SPIRAL PARAMETER IN METERS
- \( NC \) = NORMAL CROSS-SECTION
- \( RC \) = REMOVE ADVERSE CROWN & SUPERELEVATE AT NORMAL RATE
- \( e \) = RATE OF SUPERELEVATION

**Spiral Length Formula**

\[ L = \frac{A^2}{R} \]

- \( L \) = LENGTH OF SPIRAL (m)
- \( A \) = SPIRAL PARAMETER (m)
- \( R \) = RADIUS (m)
10.00 m ROAD / 17.00 m RIGHT OF WAY

10.00 m ROAD / 20.00 m RIGHT OF WAY

16.00 m ROAD / 30.00 m RIGHT OF WAY

NOTE:
FOR ROAD CROWNS SEE
DRAWING #454.1005.001
GENERAL NOTES:
1. LANES SHALL BE GRAVEL BASED WHEN THE FOLLOWING CONDITIONS EXIST:
   a. WHEN THE LANE GRADE IS 5% OR GREATER, IN EXCESS OF 75m FROM THE SOURCE OF LANE DRAINAGE, THAT PORTION SHALL BE BASED.
   b. WHEN A 5% OR GREATER GRADE COMES INTO A FLATTER GRADE, THE LATTER SHALL BE BASED FOR THE FOLLOWING LENGTHS UP TO 2% - 30m, 2% TO 3% - 45m, 3% AND OVER - TOTAL LENGTH
2. LANES ADJACENT TO COMMERCIAL ESTABLISHMENTS SHALL BE BASED TO THE PROPERTY LINE.
3. WHEN A SWALE DISCHARGES INTO A LANE, PAVEMENT SHALL BE PLACED DOWNGRADE TO A PERMANENT DRAINAGE COLLECTION LOCATION.
4. LANES SHALL BE DEEP BASED AT INTERSECTIONS FOR 5.0m IN ALL DIRECTIONS (SEE 305.00.02).

NOTES:
1. FOR GRAVEL SPECIFICATIONS SEE CHAPTER 303.
2. FOR 6.10m WIDE LANE, GRAVEL SHALL EXTEND FOR THE FULL WIDTH (P.L. TO P.L.)

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED.
NOTE: LANE WIDTHS COULD BE 6.10m, 8.00m, 9.00m, 10.00m
GRAVELLED LANE - VARIES
(FOR 6.10m WIDE LANE SEE NOTE 2 BELOW)

ACTUAL WIDTH OF EXCAVATION - VARIES

- 0.50m

LANE SURFACE

SLOPE 3.5%

- P.L.

50mm OF 25mm CRUSHED GRAVEL
(SEE NOTE 3)

100mm OF 50mm CRUSHED GRAVEL

PIPE ZONE (CLASS B' BEDDING)

300mm MIN.

75mm MIN.

W = PIPE O.D. x 75mm

GENERAL NOTES:
1. LANES SHALL BE OILED WITH 50:90 AT 1.5 LITRES/M IF THE ORIGINAL LANE WAS OILED OR WHEN THE FOLLOWING CONDITIONS EXIST:
   a. WHEN THE LANE GRADE IS 5% OR MORE;
   b. WHEN A 5% OR GREATER GRADE COMES INTO A FLATTER GRADE, THE LATTER SHALL BE OILED FOR THE FOLLOWING LENGTHS:

   UP TO 2%: 30m
   2% TO 3%: 45m
   3% AND OVER: TOTAL LENGTH

2. FOR 6.10m WIDE LANE, GRAVEL SHALL EXTEND FOR THE FULL WIDTH (P.L. TO P.L.)

3. IF EXISTING LANE IS CONSTRUCTED WITH RECYCLED CRUSHED ASPHALT, CRUSHED ASPHALT SHALL BE USED.
NOTES:
1. FOR CROSSING DETAILS
   SEE Dwg. 454.1013.005 MONOLITHIC SIDEWALK
   SEE Dwg. 454.1013.004 SEPARATE WALK
2. LANE WIDTHS COULD BE 6.10m,8.00m,9.00m
   ON 10.00m
3. FOR 6.10m WIDE LANE, GRAVEL SHALL EXTEND FOR
   THE FULL WIDTH (P.L. TO P.L.)

FILE: ESDESD37035+ EL: PERMANENT 381030 DEAK 181114004.00
DATE: 20-APR-1995 16:03

THE CITY OF CALGARY
PUBLIC WORKS DEPARTMENT

STANDARD LANE APPROACH
STABILIZATION

95 - 01 LANE WIDTH REVISED & NOTE ADDED
94-07-25 551 CHANGED TO 50 90

No. Date Revision
2

Scale N.T.S.

Sheet 18

FILE NUMBER
454.1011.004
NOTE:
ON "T" INTERSECTION EXTEND PAVEMENT 15.00
(23.00 IF C.B. AT VERTICAL LOW)
LANE WIDTHS COULD BE 6.10m, 8.00m, 9.00m
OR 10.00m.

PLAN

SECTION A - A

SECTION B - B
NOTE:
ON "T" INTERSECTION EXTEND PAVEMENT 15.00
(23.00 IF C.B. AT VERTICAL LOW)
LANE WIDTHS COULD BE 6.10m, 8.00m, 9.00m
OR 10.00m.

PLAN

SECTION A - A

SECTION B - B
NOTES:
1. REFER TO SIDEWALK SPECIFICATION FOR QUALITY CONTROL OF CONCRETE.
2. FOR JOINT DETAILS SEE Dwg. No. 454.1011.006.
3. FIBERGLASS CONCRETE WITH STEEL FIBERS
GRANULAR BASE CONSTRUCTION
SUBDIVISIONS ONLY

FULL DEPTH CONSTRUCTION
PLANN VIEW

25m - 35m FROM ENTRANCE (TYP.)

35m - 45m SPACING (TYP.)

CROSS - SECTION VIEW

LONGITUDINAL VIEW

LOCATIONS OF HUMPS MUST NOT CONFLICT WITH DRIVEWAYS, DRAINAGE OR UTILITY FACILITIES
SIGNAGE AND LINE PAINTING TO BE INSTALLED AS SPECIFIED BY TRAFFIC OPERATIONS
MAXIMUM LANE GRADE 8%
DESIABLE MINIMUM GRADE 1%

FOR INSTALLATION IN EXISTING PAVED LANES PLANE 25mm DEPTH

FOR INSTALLATION IN NEW LANE PAVING, OMIT TOP LIFT AT SPEED HUMP LOCATIONS

APPLY LIQUID ASPHALT TACK COAT

MIX 'B' ASPHALT

PARABOLIC SHAPE

0.30

0.30

0.30

0.30

0.30

0.30
NOTE:
'I' - REVERSE GUTTER TO BE USED ON HIGH SIDE OF COLLECTOR IN SUPERELEVATION. BASE GRADIENT TO MATCH CROSSFALL OF PAVEMENT. GUTTER PAN TO BE PARALLEL WITH SURFACE CROSSFALL - ACHIEVED BY ROTATING SECTION 'A'.
- MINIMUM GUTTER THICKNESS 175mm
ELEVATION

SECTION 'A'

SECTION 'B'

CURB CROSSING 'A'

CURB CROSSING 'B'

NOTES:

'1' - REVERSE GUTTER TO BE USED ON HIGH SIDE OF COLLECTOR IN SUPERELEVATION. BASE GRADIENT TO MATCH CROSSTRAIL ACHIEVED BY ROTATION OF SECTION 'A'. MINIMUM GUTTER THICKNESS 175 mm.
SECTION 'AA'

NOTE:

'1' - REVERSE GUTTER TO BE USED ON HIGH SIDE OF COLLECTOR IN SUPERELEVATION - ACHIEVED BY ROTATING SECTION 'AA'.
GUTTER PAN TO BE PARALLEL WITH SURFACE CROSSFALL.
- MINIMUM GUTTER THICKNESS 140mm

SECTION 'BB'

STANDARD CURB WITH 250mm GUTTER ON ASPHALT BASE

Sheet 28

File Number 454.1003.009

THE CITY OF CALGARY
ELEVATION

SECTION 'A-A'

SECTION 'B-B'

CURB CROSSING 'A-A'

CURB CROSSING 'B-B'

NOTES:

'1' - REVERSE GUTTER TO BE USED ON HIGH SIDE OF COLLECTOR IN SUPERELEVATION - ACHIEVED BY ROTATING SECTION 'A-A' GUTTER PAN TO BE PARALLEL WITH SURFACE CROSSFALL.

- MINIMUM GUTTER THICKNESS 140mm
NOTES:
1. FOR COMMERCIAL DRIVEWAYS WITH NO SIDEWALKS IN BOULEVARD
2. BASE GRADIENT TO MATCH CROSSFALL OF PAVEMENT
SECTION 'A'

NOTE:

'A' - NORMAL CROWN ROAD OR LOW SIDE OF MAJOR ROAD IN SUPERELEVATION - PLACED ON GRAVEL BASE.

'B' - REVERSE GUTTER TO BE USED ON HIGH SIDE OF MAJOR ROAD IN SUPERELEVATION. BASE GRADIENT TO MATCH CROSSFALL OF PAVEMENT. GUTTER PAN TO BE PARALLEL WITH SURFACE CROSSFALL - ACHIEVED BY ROTATING SECTION 'A'.

- MINIMUM GUTTER THICKNESS 175mm
ELEVATION

SECTION 'A'

SECTION 'B'

CURB CROSSING 'A'

CURB CROSSING 'B'

NOTES:

'A' — NORMAL CROWN ROAD OR LOW SIDE OF COLLECTOR IN SUPERELEVATION - PLACED ON GRAVEL BASE.

'B' — REVERSE GUTTER TO BE USED ON HIGH SIDE OF COLLECTOR IN SUPERELEVATION. BASE GRADIENT TO MATCH CROSSFALL OF PAVEMENT. GUTTER PAN TO BE PARALLEL WITH SURFACE CROSSFALL - ACHIEVED BY ROTATION OF SECTION 'A'; MINIMUM GUTTER THICKNESS 175 mm.
NOTE:

'AA' - NORMAL CROWN ROAD OR LOW SIDE OF MAJOR ROAD
IN SUPERELEVATION - PLACED ON ASPHALT BASE.
'B' - REVERSE GUTTER TO BE USED ON HIGH SIDE OF MAJOR ROAD
IN SUPERELEVATION, GUTTER PAN TO BE PARALLEL WITH
SURFACE CROSSFALL - ACHIEVED BY ROTATING SECTION 'AA'.
- MINIMUM GUTTER THICKNESS 140mm.
NOTES:

'A-A': normal crown road or low side of collector in superelevation - placed on asphalt base.
'B-B': reverse gutter to be used on high side of collector in superelevation, gutter pan to be parallel with surface crossfall - achieved by rotating section 'A-A'.

Minimum gutter thickness 140 mm.
NOTES:

BASE OF CURB MATCHES NORMAL CROWN ROAD AND LOW SIDE OF SUPERELEVATION ON A COLLECTOR WITH e max. = 0.04.
STANDARD CONCRETE CURB WALL ON EXIST. ASPHALT PAVEMENT

NOTE: THIS DETAIL IS USED WHERE MEDIAN OR ISLAND IS CONSTRUCTED ON TOP OF EXISTING PAVEMENT

STANDARD CONCRETE CURB WALL ON FULL DEPTH ASPHALT PAVEMENT

NOTE: DOWELS NOT REQUIRED WHEN CURB WALL IS PLACED ADJACENT TO A WALL
PLAN

ELEVATION

SECTION

NOTES:
CONCRETE 24 Mpa
CURB TO BE SECURED BY 50mm - 15mm DIAMETER ANCHORS 450mm LONG.
PLAN OF INVERT CROSSING

NOTE: 1. START FLATTENING CROWN 15.0m FROM CONCRETE INVERT CROSSING
2. CONCRETE INVERT IS TO BE USED WHEN DROP ACROSS INTERSECTION IS BETWEEN 0.4% AND 2% SLOPE; ASPHALT INVERT IS TO BE USED ABOVE 2% SLOPE.

SECTION

NOTE: BASE TO CONFORM WITH ROAD STANDARDS
NOTE:
1) DESIGN ALSO APPLIES TO MEDIANS LESS THAN 3m IN WIDTH.
2) ADD IOM REBAR TO THE ENDS OF ALL BULLNOSES, MEDIAN, & TRAFFIC ISLANDS.
3) A MINIMUM OF 2.0m CLEARANCE FROM ANY FACE OF CURB IS REQUIRED FOR ANY POLES ON AN ISLAND (i.e. MAST ARM).
COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 12%
CROSS SECTION FOR RESIDENTIAL ROADS

COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 8%
CROSS SECTION FOR COLLECTOR ROADS

COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 8%
HALF CROSS SECTION FOR PRIMARY COLLECTOR ROADS

NOTES:
1. ONLY CROSS SECTIONS SHOWN. FOR JOINTING DETAILS REFER TO SHEET No. 454.1015.006
2. SECTIONS BASED ON MINIMUM CBR VALUES OF 5.0 (3.5 FOR RESIDENTIAL)
3. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 10 %
CROSS SECTION FOR
INDUSTRIAL ROADS

COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 7 %
CROSS SECTION FOR
MAJOR ROADS
UNDIVIDED

COMPACTED SUBGRADE
GRADE LIMITS 0.6 - 7 %
HALF CROSS SECTION FOR
MAJOR ROADS
DIVIDED

NOTES:
1) ONLY CROSS SECTIONS SHOWN. FOR JOINTING DETAILS REFER TO SHEET NO. 454.1015.006
2) SECTIONS BASED ON MINIMUM CBR VALUES OF 5.0
3) SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE
   GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR
   GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.

THE CITY OF CALGARY

Sheet 47

FILE: UFE\5540295; V:\PERMANENT\031030\0\REVISED\ROAD\SPEC\EN\454.1015.002.DGN
DATE: 15-APR-2004 13:08
ELEVATION

SECTION 'A'
SEPERATE CURB & GUTTER

SECTION 'B'
INTEGRAL CURB & GUTTER

CURB CROSSING 'A'

CURB CROSSING 'B'

NOTES:
1. 'A' - NORMAL CROWN ROAD OR LOW SIDE OF COLLECTOR IN SUPERELEVATION - PLACED ON GRAVEL BASE.
2. 'B' - REVERSE GUTTER TO BE USED ON HIGH SIDE OF COLLECTOR IN SUPERELEVATION. BASE GRADIENT TO MATCH CROSSFALL OF PAVEMENT. GUTTER PAN TO BE PARALLEL WITH SURFACE CROSSFALL - ACHIEVED BY ROTATION OF SECTION 'A'.
3. MINIMUM GUTTER THICKNESS 175mm.
NOTE: FOR JOINTING DETAILS SEE DWG. No. 454.1015.006
TYPE A
EXPANSION JOINT

TYPE D
SAWED OR PREMOLDED STRIP
LONGITUDINAL OR TRANSVERSE

TYPE A
ALTERNATE EXPANSION JOINT

TYPE E
PLANNED TRANSVERSE CONSTRUCTION JOINT
(USED AT NORMAL JOINT SPACING)

TYPE C
TIED BUTT Longitudinal Construction Joint
LOW PROFILE ROLLED

STANDARD

NOTES:
1. CROSSFALL ON WALK PORTION NOT TO EXCEED 2%.
2. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THicker SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTES:

1. 30mm DEEP TOOLEO CONTRACTION JOINT EVERY 1500mm
2. SEE CHAPTER 311
3. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTES:

1. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.

SLOPE 2%
NOTES:

1. THIS DRAWING ONLY APPLIES IF BLVD. WIDTH IS GREATER THAN 10.0m.
   WHEN BLVD. WIDTH IS 10.0m OR LESS, THE APRON AND SIDEWALK ARE TO
   BE POURED AS ONE WITH 30mm DEEP TOOLED JOINT ALONG FACE OF WALK
   OR AS SPECIFIED BY THE FIELD ENGINEER.

2. SEE CHAPTER 311

3. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE
   GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR
   GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTES:
1. FIBROUS CONCRETE MIX WITH SYNTHETIC FIBRE
2. NO INSULATION WHEN SIDEWALK > 3.0m FROM BUILDINGS
3. THE DOWNTOWN AREA IS DEFINED AS THE AREA BOUNDED BY AND INCLUDING 14 ST S.W. ON THE WEST, 17 AVE S.W. ON THE SOUTH, 6 ST S.E. ON THE EAST AND THE BOW RIVER ON THE NORTH
4. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTES:
1. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
MID-BLOCK WHEEL CHAIR RAMP

PLAN

1100 MONO WALK

1500 MONO WALK

ELEVATION

SECTION A-A

NOTES:
1. LOCATE RAMP IN CENTER OF CORNER UNLESS CONFLICT WITH CATCH BASIN
2. MINIMUM WIDTH OF RAMP 1500
3. MAXIMUM SLOPE OF RAMP 8% (12.5:1)
4. RAMP SURFACE TO BE TEXTURED CONCRETE
5. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTES:
1. LOCATE RAMP IN CENTER OF CORNER UNLESS CONFLICT WITH CATCH BASIN
2. MINIMUM WIDTH OF RAMP 1500
3. MAXIMUM SLOPE OF RAMP 8% (12.5:1)
4. RAMP SURFACE TO BE TEXTURED CONCRETE
5. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTES:
1. LOCATE RAMP IN CENTER OF CORNER UNLESS CONFLICT WITH CATCH BASIN
2. MINIMUM WIDTH OF RAMP 1000
3. MAXIMUM SLOPE OF RAMP 8% (12:5:1)
4. DESIREABLE SLOPE OF RAMP 12:1
5. RAMP SURFACE TO BE TEXTURED CONCRETE
6. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
TYPICAL CROSS SECTION WITH INSULATION WHERE B.O.W. = 3.0 m FROM BUILDING

TYPICAL CROSS SECTION WITH NO INSULATION WHERE B.O.W. ≥ 3.0 m FROM BUILDING

LAYING PATTERN SUBJECT TO APPROVAL BY THE CITY ENGINEER

NOTES:
1. BLOCKS SHALL MEET THE REQUIREMENTS OF A.S.T.M. C936-82
2. USE OF THIS TYPE OF SIDEWALK REQUIRES A MAINTENANCE AGREEMENT TO BE IN PLACE
3. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTES:

1. ON ROAD WITH GRADE > 3%, THE SWALE MUST BE "OFFSET" TO ALLOW BETTER FLOW.
2. TYPE IV CONSTRUCTION DETAIL REQUIRED WHEN TYING DRAINAGE GUTTER TO SIDEWALK AND OR CUBS & GUTTER REFER TO DRAWINGS 454.1005.066.
3. CONCRETE AS SET OUT UNDER STANDARD SPECIFICATIONS - SEWER CONSTRUCTION SECTION 463.1508 OR UNDER STANDARD SPECIFICATION - STREETS CONSTRUCTION CHAPTER 315.

SECTION A - A TYPICAL
NOTES:

(1) ON ROAD WITH GRADE > 3% "ANGLED" SWALE MUST BE CONSTRUCTED TO ALLOW BETTER FLOW.

(2) TYPE 'B' CONSTRUCTION DETAIL REQUIRED WHEN TYING DRAINAGE GUTTER TO SIDEWALK AND CURB & GUTTER. REFER TO DRAWING 454.1015.006.

SECTION A - A TYPICAL

CROSS - SECTION
ELEC., AGT BOX ETC.

POLE

MANHOLE

CONTRACTION JOINT

EXPANSION JOINT MATERIAL
- SEE CHAPTER 311

OUTSIDE EDGE OF MANHOLE BARREL

MANHOLE OPENING

50mm MIN.

EXPANSION JOINT MATERIAL
- SEE CHAPTER 311

B.W.

F.W.

L.G.

TYPICAL SIDEWALK ISOLATION JOINTS

68

FILE NUMBER 454.1013.018
NOTES:

1. ON ROAD WITH GRADE - 3% THE SWALE MUST BE "OFFSET" TO ALLOW BETTER FLOW.
2. TYPE 'C' CONSTRUCTION DETAIL REQUIRED WHEN TYING DRAINAGE GUTTER TO SIDEWALK AND OR CURB & GUTTER. REFER TO DRAWING 454.1015.006.
3. CONCRETE AS SET OUT UNDER STANDARD SPECIFICATIONS - SEWER CONSTRUCTION SECTION 403.1098 OR UNDER STANDARD SPECIFICATION-STREETS CONSTRUCTION CHAPTER 310.

SECTION A-A

REINFORCEMENT OPTIONS:
- ACCEPTABLE REINFORCEMENT FIBRE CONCRETE OR STEEL BARS

10M BARS 230mm

600mm MIN

560mm MAX

175mm MIN

175mm MAX

CONC DRAINAGE GUTTER

CATCH BASIN GRATE

PLAN VIEW

PROFILE VIEW

CROSS SECTION

VARES

VARES

LIP OF GUTTER

LIP OF GUTTER

FACE OF CURB

FACE OF WALK

PROPERTY LINE

BACK OF WALK

STD SEPARATE WALK

FLOW

FLOW

BACK OF WALK

SIDE INLET

CONC DRAINAGE GUTTER

CATCH BASIN GRATE

TOP OF CURB

FRONT OF WALK

FLOW

0.30m

0.25m

0.60m

0.25m
ELEVATION

PLAN

TYPICAL PILE:
225 DIA., 750 DEEP,
25 MPa CONCRETE

NOTES:

1. CHARACTERISTICS OF ASPHALTIC HOT MIX IDENTICAL AS DESCRIBED UNDER MAIN CONTRACT FOR THE CONSTRUCTION OF ASPHALT PAVEMENTS
2. THE MAX. ALLOWABLE GRADE FOR ASPHALT WALKWAYS IS 12% ABOVE THIS GRADE.
3. APPROVED CONCRETE STEPS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE NATIONAL BUILDING CODE.
4. PAINTING - INSTALLED BARRICADE TO RECEIVE ONE COAT METAL PRIMER & TWO COATS OF BRIGHT YELLOW PAINT. ANY DEVIATION FROM THE ABOVE SPECIFICATION TO BE APPROVED IN WRITING BY THE CITY ENGINEER.
5. MIN. SIDE SLOPE TO BE 3:1 OR APPROVED RETAINING WALL.

CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
NOTE
1. POSTS TO RECEIVE ONE COAT METAL PRIMER, TWO COATS WHITE PAINT.
2. ALL JOINTS TO BE WELDED.
3. ALL PIPE TO BE STANDARD WEIGHT.
4. CHAIN TO BE 1 DM LONGER THAN OPENING.
5. SIGN TO BE SUPPLIED BY TRAFFIC OPERATIONS.
NOTES:
1. WHEN PATH WIDTH EXCEEDS 3000mm LOCATE BOLLARDS AT 1500mm ON CENTRE.
2. PATHWAYS THAT LEAD TO A PARK SPACE MAY REQUIRE A REMOVABLE BOLLARD.
3. PATHWAYS (WALKWAY) THAT CONNECT ROADWAYS REQUIRE A FIXED BOLLARD.
4. PATHWAYS IN AN OPEN AREA REQUIRE FIXED BOLLARDS.
5. PATHWAY / EMERGENCY ACCESS (4.0m OR GREATER) USE BREAK-AWAY POSTS (454.1001.015).
6. FOR SEP WALK: CONCRETE PATH CONNECTION REQUIRED FROM SEP WALK TO WCR.

TYPICAL PATHWAY

FOR 1100 MONO WALK WITH STANDARD CURB DIP B.O.W. TO ACHIEVE MAX. 8% SLOPE FOR MID BLOCK W.C.R.

dimensions are kilometres

METRIC

THE CITY OF CALGARY

Sheet 75

TYPICAL PATHWAY

File Number 454.1001.023

1 060823 ADDITIONAL NOTES ADDED
2 060823 CHANGED LOCATION OF BOLLARD TO PL
3 060823 CONCRETE APRON AND DIMENSIONING ADDED
4 970410 BOLLARD DETAIL REMOVED

Drawn D.L.: Date 09-04
Scale N.T.S.

App’d

City Engineer
LEVEL GROUND

ADD 100mm of 25mm crushed gravel and compact it to 98% min.

REMOVE ORGANIC SOILS, RECOMPACT EXPOSED SOILS TO 98% MIN.

INSTALL ROOT BARRIER (POLYSPUN 300 OR APPROVED EQUIVALENT) IN AREAS WHERE ROOT BARRIER IS REQUIRED. FOR ROOT BARRIER REQUIREMENTS REFER TO PARK SPECIFICATIONS.

SIDE SLOPES

ADD 100mm of 25mm crushed gravel and compact it to 98% min.

REMOVE ORGANIC SOILS, RECOMPACT EXPOSED SOILS TO 98% MIN.

INSTALL ROOT BARRIER (POLYSPUN 300 OR APPROVED EQUIVALENT) IN AREAS WHERE ROOT BARRIER IS REQUIRED. FOR ROOT BARRIER REQUIREMENTS REFER TO PARK SPECIFICATIONS.
DETAIL 1
CHAIN ATTACHMENT
[ONLY IF CHAIN SPECIFIED]

DETAIL 2
STEEL CAP

NOTES:
1. FOR REMOVABLE BOLLARD DETAIL REFER TO PARK SPEC.
2. SPACING BTWN BOLLARDS TO BE DETERMINED IN FIELD.
3. EXTERIOR OF PIPE TO BE BRUSH BLASTED TO SSPC-SP7 STANDARD.
   PRIME COATED WITH CARBOLINE RUSTBOND PENETRATING SEALER
   TO 1.5mils DFT. INTERMEDIATE COATED WITH CARBOLINE 893 EPOXY
   TO 3.0mils DFT. TOP COATED WITH CARBOLINE 134HG POLYURETANE
   TO 2.0mils DFT. COLOUR TO BE DETERMINED.
4. CHAIN TO BE 0.25 LONGER THAN PIPE SPACING.
PROPOSED 5.00m WALKWAY/EMERGENCY ACCESS WITH C&G

PROPOSED 4.00m WALKWAY/EMERGENCY ACCESS WITH POCKET EASEMENT

NOTES:
1. WATER RESOURCES WILL PERMIT ZERO HORIZONTAL SEPARATION BETWEEN AN ENCASED WATERMAIN ALIGNMENT AND WALKWAY/EMERGENCY ACCESS STREETLIGHTING WHERE NECESSARY TO MINIMIZE THE EASEMENT ENCUMBRANCES ON ADJOINING LOTS.
2. SPECIFICATIONS ARE TO MIN. STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ACCESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
LEVEL GROUND

1. ADD 100mm of 25mm crushed gravel and compact it to 98% min.
2. REMOVE ORGANIC SOILS, RECOMPACT EXPOSED SOILS TO 98% MIN.
3. INSTALL ROOT BARRIER (POLYSPUN 300 OR APPROVED EQUIVALENT) IN AREAS WHERE ROOT BARRIER IS REQUIRED. FOR ROOT BARRIER REQUIREMENTS REFER TO PARK SPECIFICATIONS.

SIDE SLOPES

1. ADD 100mm of 25mm crushed gravel and compact it to 98% min.
2. REMOVE ORGANIC SOILS, RECOMPACT EXPOSED SOILS TO 98% MIN.
3. INSTALL ROOT BARRIER (POLYSPUN 300 OR APPROVED EQUIVALENT) IN AREAS WHERE ROOT BARRIER IS REQUIRED. FOR ROOT BARRIER REQUIREMENTS REFER TO PARK SPECIFICATIONS.
1. Handrail texture to change in final 300mm to warn users with visual impairments that they are approaching the end.
2. For cross-falled walkways handrails to be located on high side / one side of a crowned walkway.
3. 200mm min. clearance req'd from handrail to property line.
4. Crowned walkway design to be used where handrail & light pole are required.
5. Painting-install barricade to receive one coat metal primer & two coats paint.
6. Any deviation from the above specifications to be approved in writing by the City Engineer.
7. Specifications are to minimum standards. Consideration must be given to address actual soil conditions and assess the need for gravel base, thicker slab, reinforcement or sub-drainage system.
8. Where bollard is required on regional pathway refer to Parks Spec.
NOTE 1: STRAIN POST SHALL BE INSTALLED AT A SPACING OF 1500 OR LESS WITH BRACES SIMILAR TO THOSE USED AT END AND CORNER POSTS (SEE TABLE 'C').
THE PILES SHALL BE THE SAME AS FOR CORNER OR END POSTS.
FENCING SHALL BE GALVANIZED STEEL.

NOTE 2: FOR FENCE APPLICATIONS IN MEDIAN ON DIVIDED ROADWAYS, TOP RAIL TO BE REPLACED WITH 6 GAUGE SINGLE STRAND TENSION WIRE, FASTENERS # 450, CABLE TO BE FASTENED TO STRAIN POST BY LOOPING CABLE AND USING APPROPRIATE SIZE CABLE CLAMP (SEE DETAIL).
NOTES:

1. WHEN A=250mm, B=685mm
2. WHEN C=1500, POST SPACING 1905
   C=1500, POST SPACING 950
   C=850, POST SIZE 250 x 250
3. WHENEVER GUARDRAIL IS INTRODUCED, INITIAL SECTION IS OFFSET 1200 AS SHOWN ABOVE. MINIMUM LENGTH OF TAPER 12m
4. BOTH GUARDRAIL INTRODUCTION AND TERMINAL END TREATMENT TO CONSIST OF SLOPING RAIL DOWNWARD AND FASTENING TO ANCHOR BLOCK.
5. FOR C=850 SEE DWG. SPECIFICATION NO. 454.1001.026
6. REFER TO "TAC" MANUAL FOR REQUIRED APPROACH LENGTHS
7. FOR ROADWAYS WITHOUT CURB AND GUTTER, OFFSETS REQUIRED (FROM EDGE OF PAVEMENT) SHALL BE IN ACCORDANCE WITH LATERAL OFFSETS OUTLINED IN ROADSIDE SAFETY SECTION OF "TAC" MANUAL.
1. WHEN A=250mm, B=685mm
2. WHEN C=1500, POST SPACING 1905
   C=1500, POST SPACING 950
   C<850, POST SIZE 250 x 250
3. WHenever guardrail is introduced, initial section is offset 1200 as shown above. Minimum length of taper 12m
4. FOR ROADWAYS WITHOUT CURB AND GUTTER, OFFSETS REQUIRED (FROM EDGE OF PAVEMENT) SHALL BE IN ACCORDANCE WITH LATERAL OFFSETS OUTLINED IN ROADSIDE SAFETY SECTION OF "TAC" MANUAL.

THE CITY OF CALGARY
W-BEAM BARRIER TERMINAL TREATMENT

File Number 454.1001.020

THE CITY OF CALGARY
NOTE:
1) ALL DETAILING APPLIES TO PRECAST CONCRETE GUARDRAIL.
2) MIN 150mm OF ASPHALT BEHIND CONCRETE BARRIER AND 0.5m ROUNDING.
3) EXTRUDED CONCRETE GUARDRAIL
   - NO REINFORCING STEEL
   - ELIMINATE LIFT HOLES
   - SAWING OR DEEP TOOL MARKING OF CONTRACTION JOINTS EVERY 3.0m IS REQUIRED
   - CROSS DRAIN SLOTS AS REQUIRED ARE TO BE FORMED WITH STYROFOAM WHICH WILL BE REMOVED AFTER CONCRETE IS CURED.
NOTE:
1) ALL DETAILING APPLIES TO PRECAST CONCRETE GUARDRAIL.
2) MIN 150mm OF ASPHALT BEHIND CONCRETE BARRIER AND 0.5m ROUNGING
3) EXTRUDED CONCRETE GUARDRAIL
   - NO REINFORCING STEEL
   - ELIMINATE LIFT HOLES
   - SAWING OR DEEP TOOL MARKING OF CONTRACTION JOINTS EVERY 3.0 m
   IS REQUIRED
   - CROSS DRAIN SLOTS AS REQUIRED ARE TO BE FORMED WITH STYROFOAM WHICH WILL BE REMOVED AFTER CONCRETE IS CURED.
NOTES:
1) ALL DETAILING APPLIES TO PRECAST CONCRETE GUARDRAIL.
2) MIN 0.15m OF ASPHALT BEHIND CONCRETE BARRIER AND 0.5m ROUNDED.
3) EXTRUDED CONCRETE GUARDRAIL
   - NO REINFORCING STEEL
   - ELIMINATE LIFT HOLES
   - SAWING OR DEEP TOOL MARKING OF CONTRACTION JOINTS EVERY 3.0 m IS REQUIRED.
   - CROSS DRAIN SLOTS AS REQUIRED ARE TO BE FORMED WITH STYROFOAM WHICH WILL BE REMOVED AFTER CONCRETE IS CURED.

SECTION 'A-A'
NOTE: ALL LUMBER SHALL BE ROUGH CUT, NO. 2 CONSTRUCTION GRADE, KILN DRIED AND PRESSURE TREATED TO C.S.A. S60 WITH ALKALINE COPPER QUAT (A.C.Q.).

ALL STEEL CABLES AND CLAMPS SHALL BE HOT DIPPED GALVANIZED TO C.S.A. GS64 OR AS SPECIFIED PROVIDE SUFFICIENT TENSION ON STEEL CABLE TO ELIMINATE SAG. TREAT ALL NEW CUTS WITH A.C.Q.

COLOR OF REPLACEMENT POSTS SHALL BE CONSISTENT WITH THE REMAINDER OF THE POSTS.
NOTES:
1. EMERGENCY BREAK-AWAY POST IS COMPOSED OF TWO SEPARETE WOOD POSTS, EACH 900 LONG.
2. ALL WOOD TO BE PRESSURE TREATED.
3. DO NOT NOTCH END POSTS.
4. INSTALL POSTS AT 1500 O.C. UNLESS OTHERWISE SPECIFIED.
5. USE BREAK-AWAY POSTS FOR EMERGENCY ACCESS / WALKWAY.
1. **Concrete Strength:** Concrete shall have a minimum compressive strength of 25 MPa at 28 days.

2. **Steel:**
   - Structural steel shall conform to CSA Spec. G40.21M Grade 300W.
   - Hollow structural sections shall conform to CSA Standards G40.21M Grade 350W.
   - All welding shall conform to CSA Spec. W 59.
   - All welding to be ground smooth.
   - All exposed open ends to be capped.
   - Posts and CATE shall be galvanized in accordance with CSA Spec. G 164.
   - All galvanizing shall be done after fabrication.
   - All steel members to be painted red and white in alternate bands 300 wide.
   - Prime coat & finish coat with high solids epoxy paint.

3. For lane closure provide min. 1m opening for pedestrian on the side.
0.15 WIDE RED REFLECTOR TAPE ON ALL POSTS AND TOP RAIL OF GATE

EXTRA POST NOT REQUIRED FOR 6.00 WIDE LANES OR LESS

LANE WIDTH VARIES

NOTES:
- ALL POSTS TO BE DN100 STD (114.3mm DIA)
- HOT DIP GALVANIZED PIPE
- GATE TO BE DN50 STD (60.3mm DIA)
- HOT DIP GALVANIZED AFTER FABRICATION
- ALL WELDING TO BE GROUND SMOOTH

POST CLAMP 100mm thick (SEE DETAIL)

HINGE DETAILS - ELEVATION

CLAMP DETAILS - PLAN VIEW

LATCH DETAILS - PLAN VIEW

32 dia. EYELET FOR PADLOCK

FIELD WELD LATCH CATCH TO ENSURE MATCH

22 dia. NUT WELDED TO GATE

LATCH DETAILS - ELEVATION

LOCKING PIN: 19 dia X 140mm long

CHAIN WELDED TO GATE & PIN

POST

GATE

LATCH CATCH 10mm thick

300 mm EX GROUND

25 mm

22 dia. NUT

19 dia X 130mm long

NUT SIZE:

19mm

1.00 MIN.

1.50 MAX.

CHECKERBOARD WARNING SIGNS ON BOTH SIDES OF GATE (CONTRACTOR TO SUPPLY AND INSTALL)

PEDESTRIAN OPENING

3.75

LOCKING LATCH FOR PADLOCK

PEDESTRIAN OPENING

450mm, 25MPA CONCRETE PILE TYP.

PROPERTY LINE

PROPERTY LINE

VARI ES 1.50 MAX.
NOTES:

1. LOCATION OF WHEEL CHAIR RAMPS TO LINE UP WITH EXISTING OR PROPOSED CROSS WALKS.
2. DESIGN OF CORNER BULBS IS SITE SPECIFIC AND MUST BE CONFIRMED WITH CITY OF CALGARY ROADS.
3. CORNER RADIUS SHALL ACCOMMODATE ANTICIPATED DESIGN VEHICLE TURNING PATH.
4. DRIVEWAY ACCESS ADJACENT TO CORNER BULBS MAY BE RESTRICTED.
NOTES:

1. SIGNAGE LOCATION TO BE CONFIRMED WITH TRAFFIC ENGINEERING.
2. BULB OUT TO BE HARD SURFACED FOR MONOWALKS AND GRASSED FOR SEPARATE WALK DESIGNS.
3. CROSSING LOCATION SHALL BE CENTERED ON BULB OUT.
4. PAVEMENT WIDTHS AS PER ROAD CLASSIFICATION:
   - RESIDENTIAL
     7.00m (MIN) LG TO LG
   - UNDIVIDED COLLECTOR
     8.60m (MIN) LG TO LG
   - SINGLE LANE FOR ROADWAY
     6.00m (MIN) FC TO FC
   WITH A CENTER MEDIAN
GENERAL CONSTRUCTION NOTES

1. CONCRETE MATERIALS, QUALITY, MIXING, PLACING & OTHER CONSTRUCTION PRACTICES TO CONFORM TO CSA STANDARD CAN-423.1 CURRENT EDITION.
2. USE TYPE 50 PORTLAND CEMENT MEETING THE REQUIREMENTS OF C.S.A. STANDARD A5. CONCRETE STRENGTH TO BE A MINIMUM 25 MPa AT 28 DAYS WITH A MAXIMUM SLUMP OF 100mm.
3. AIR ENTRAINMENT TO BE 4 - 7% Conforming to the requirements of C.S.A. STANDARDS.
4. REINFORCING STEEL TO BE DEFORMED BARS MEETING THE REQUIREMENTS OF C.S.A. STANDARD G30.11M GRADE 400.
5. ALL LUMBER, SUBJECT TO APPROVAL OF THE ENGINEER WITH RESPECT TO QUALITY, MOISTURE CONTENT & APPEARANCE TO BE SPECIFIED IN ACCORDANCE WITH C.S.A. STANDARD U 141.
6. BOARDS TO BE TONGUE & GROOVE NO. 2 OR BETTER STRUCTURAL GRADE S-P-F DESIGNATION CSA-168-WMB.  
7. POST TO BE NO. 2 OR BETTER STRUCTURAL GRADE S-P-F DESIGNATION CSA-168-WMB AND PRESSURE TREATED.
8. All lumber to be KILN DRIED TO 14% MOISTURE CONTENT PRIOR TO ENCRYPTION.
9. FOR SPECIFICATIONS ON PRESSURE TREATED WOOD REFER TO WOOD PROCT SPECIFICATIONS AND APPLICABLE CODES AND STANDARDS.
10. ALL NAILS TO BE GALVANIZED SCREW NAILS.
11. ALL STEEL TO CONFORM TO C.S.A. G40.21.
12. ALL STEEL AND BOLTS C/W NUTS AND WASHERS TO BE GALVANIZED.
13. GALVANIZING TO CONFORM TO C.S.A. G64.

ANCHOR STRAPS DETAIL

NOTES FOR ANCHOR STRAPS DETAIL:
1. ANCHOR STRAPS TO BE HOT DIPPED GALVANIZED.
2. 4 - 1/4" x 2 1/2" OEL BOLTS C/W NUTS & WASHER REQUIRING PER ANCHOR STRAPS.
3. TIE STRAPS TOGETHER WITH RE-BAR.
NOTES FOR ANCHOR STRAPS DETAIL:
1. Anchor straps to be hot DIP galvanized.
2. 4 - 16mm x 5/8" dia. bolts req'd per anchor strap.
3. Use structural grade steel.
4. Tie straps together with re-bar.

GENERAL CONSTRUCTION NOTES
1. Concrete materials, quality, mixing, placing & other construction practices to conform to CSA standard C23.1, current edition.
2. Use Type 50 Portland cement meeting the requirements of CSA Standard A23.1 CONCRETE STRENGTH TO BE A MINIMUM 25 MPa AT 28 DAYS WITH A MAXIMUM SLUMP OF 100mm.
3. Air entrainment to be 4% conforming to the requirements of CSA standards.
4. Reinforcing steel to be deformed bars meeting the requirements of CSA standard 23.1, Grade 400.
5. All lumber subject to approval of the engineer with respect to quality, moisture content & appearance to be specified in accordance with CSA Standard 0141.
6. All lumber to be kiln dried to 19% moisture content prior to erection.
7. For specifications on pressure treated wood refer to wood product specifications and applicable codes and standards.
8. All nails to be galvanized screw nails.
9. All steel to conform to CSA O400-21-
10. Galvanizing to conform to CSA G164.
COLORS
SIGN SURROUND AND SEPARATOR LINES  7512 ORANGE F 65 E 1
BACKGROUND  7523 FLAT BLACK F 65 BG 1
LEGEND  7521 TINTING WHITE F 65 W 4
FOR PAINT COLORS REFER TO SHERWIN WILLIAMS KEM LUSTRAL ENAMEL
THE CITY OF CALGARY
ENGINEERING AND ENVIRONMENTAL SERVICES DEPARTMENT

PLACE DIVISION NAME HERE
USE 30mm BLUE LETTERS

30 mm BLUE LETTERS
30 mm RADIUS - TYPICAL

25 mm RED LETTERS

WORKING TO IMPROVE YOUR CITY

40 mm BLUE LETTERS

PLACE DIVISION PHONE NO. HERE

25 mm RED LETTERS

CITY SIGN
( FOR USE BY CITY STAFF ONLY )

PLACE COMPANY NAME AND LOGO HERE
USE 25mm BLUE LETTERS

WORKING TO IMPROVE YOUR CITY

25 mm RED LETTERS

INFORMATION
PLACE COMPANY PHONE NUMBER HERE
USE 25mm BLUE LETTERS

THE CITY OF CALGARY
ENGINEERING AND ENVIRONMENTAL SERVICES DEPARTMENT

EMERGENCIES
268 - PLACE DIVISION PHONE NO. HERE

CONTRACTORS SIGN
( FOR USE BY CONTRACTORS ONLY )

NOTE:
- OVERALL DIMENSIONS APPLY TO BOTH SIGNS
- THE BORDER IS TO BE BLUE
- THE BACKGROUND IS TO BE WHITE

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED

PORTABLE OR FREE STANDING CONSTRUCTION SIGN
PREFERRED WOOD SCREEN FENCE

GENERAL CONSTRUCTION NOTES

1. CONCRETE MATERIALS, QUALITY, MIXING, PLACING & OTHER CONSTRUCTION PRACTICES TO CONFORM TO CSA STANDARD CAN3-A23.1 CURRENT EDITION.

2. USE TYPE 50 PORTLAND CEMENT MEETING THE REQUIREMENTS OF C.S.A. STANDARD A5. CONCRETE STRENGTH TO BE A MINIMUM 25 MPa AT 28 DAYS WITH A MAXIMUM SLUMP OF 100mm.

3. AIR EXTRAVASATION TO BE 4 - 7% CONFORMING TO THE REQUIREMENTS OF C.S.A. STANDARDS.

4. REINFORCING STEEL TO BE DEFORMED BARS MEETING THE REQUIREMENTS OF C.S.A. STANDARD G30.1(1) GRADE 400.

5. ALL LUMBER, SUBJECT TO APPROVAL OF THE ENGINEER WITH RESPECT TO QUALITY, MOISTURE CONTENT & APPEARANCE TO BE SPECIFIED IN ACCORDANCE WITH C.S.A. STANDARD G141.

(a) BOARDS TO BE TONGUE & GROOVE NO. 2 OR BETTER STRUCTURAL GRADE S-P-F DESIGNATION CSAI-H84-WBB.

(b) POST TO BE NO. 2 OR BETTER STRUCTURAL GRADE S-P-F DESIGNATION CSAI-H84-1MB AND PRESSURE TREATED.

(c) ALL LUMBER TO BE KILN DRIED TO 19% MOISTURE CONTENT PRIOR TO ERECTION.

6. FOR SPECIFICATIONS ON PRESSURE TREATED WOOD REFER TO WOOD PRODUCT SPECIFICATIONS AND APPLICABLE CODES AND STANDARDS.

7. ALL NAILS TO BE GALVANIZED SCREW NAILS.

8. ALL STEEL TO CONFORM TO C.S.A. S440.21-M.

9. ALL STEEL AND BOLTS C/W NUTS AND WASHERS TO BE GALVANIZED.

10. GALVANIZING TO CONFORM TO C.S.A. G644.

ELEVATION

SECTION A-A
ELEVATION

SECTION A - A

GENERAL CONSTRUCTION NOTES
1. CONCRETE MATERIALS QUALITY MIXING PLACING IS OTHER CONSTRUCTION
   PRACTICES TO CONFORM TO CSA STANDARD C23.1-94.1 CURRENT EDITION.
2. USE TYPE 50 PORTLAND CEMENT MEETING THE REQUIREMENTS OF C.S.A.
   STANDARDS AS CONCRETE STRENGTH TO BE A MINIMUM OF 25 MPa AT 28
   DAYS WITH A MAXIMUM SLIP OF 400 MM.
3. ARE ENRAINTMENT TO BE 4 - 7% CONFORMING TO THE REQUIREMENTS OF
   C.S.A. STANDARDS.
4. REINFORCING STEEL TO BE DEFORMED BARS MEETING THE REQUIREMENTS
   OF C.S.A. STANDARD 036.3M GRADE 400.
5. ALL LUMBER SUBJECT TO APPROVAL OF THE ENGINEER WITH RESPECT TO
   QUALITY, MOISTURE CONTENT & APPEARANCE TO BE SPECIFIED IN
   ACCORDANCE WITH C.S.A. STANDARD 014.
   a) BOARDS TO BE TONGUE & GROOVE NO. 2 OR BETTER STRUCTURAL
      GRADE TO 900 - 2000 M.M. OR 3000 - 4000 M.M. GRADE 2 TO 5.
   b) DESIGNATION CL-360 W/P AND PRESSURE TREATED.
   c) ALL LUMBER TO BE DRY CURED TO 12% MOISTURE CONTENT PRIOR TO
      ERECTION.
6. FOR SPECIFICATIONS ON PRESSURE TREATED WOOD REFER TO WOOD
   PRODUCT SPECIFICATIONS AND APPLICABLE CODES AND STANDARDS.
7. ALL NAILS TO BE GALVANIZED SCREW NAILS.
8. ALL STEEL AND BOLTS C/W NUTS AND WASHERS TO BE GALVANIZED.
9. ALL STEEL TO CONFORM TO C.S.A. 046.21M.
10. GALVANIZING TO CONFORM TO C.S.A. 064.

SECTION B - B

NOTES FOR ANCHOR STRAPS DETAIL:
1. ANCHOR STRAPS TO BE HOT DIP
   GALVANIZED.
2. 3 = (8mm(5/32)) Dia. BOLTS C/W NUTS &
   WASHERS REQD PER ANCHOR STRAP.
3. TIE STRAPS TOGETHER WITH RE-BAR.

ANCHOR STRAPS DETAIL
SEPARATE SIDEWALK

15mm EXPANSION JOINTS

CONTRACTION JOINT 30mm DEEP, 5mm WIDE, 1500mm SPACING

Curb & Gutter

PLAN VIEW

CONTRACTION JOINT 30mm DEEP, 5mm WIDE

1500mm 1500mm 1500mm 1500mm 1500mm 1500mm

9000mm (UNLESS OTHERWISE STATED)

SECTION A

15mm EXPANSION JOINT

ROLLED EDGE R=15mm

15mm EXPANSION JOINT

ROLLED EDGE R=15mm

SLOPE 2%

1500 mm TO 3000mm

(WHERE SIDEWALK EXISTS)

1100mm

(WHERE NO SIDEWALK EXISTS)

SECTION B

STANDARD BUS STOP APRON

TYPE 'A'

FILE NUMBER 454.1012.001
50mm TROWELLED EDGING

CONTRACTION JOINT 30mm DEEP, 5mm WIDE, 1500mm SPACING

MONOLITHIC SIDEWALK

CURB & GUTTER

PLAN VIEW

CONTRACTION JOINT 30mm DEEP, 5mm WIDE

9000mm (UNLESS OTHERWISE STATED)

SECTION A

15mm EXPANSION JOINT

ROLLED EDGE R=15mm

SLOPE 2%

MONOLITHIC SIDEWALK

SECTION B

NOTES:
1. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE, THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM.
BUS ZONE APRONS
TYPE A, B, C

TYPE A
WHERE SIDEWALK IS LESS THAN 3.00m FROM CURB AND WHERE NO SIDEWALK EXISTS

- SIDEWALK
- MAX. 3.00m
- ROUTE IDENTIFICATION SIGN (SEE NOTE)
- BOULEVARD
- TANGENT TO CURVE
- 5.00m
- 9.00m
- 10.00m STANDARD CURB
- VARIES [MIN. 25.00m]
- TRAFFIC FLOW

TYPE B
WHERE SIDEWALK IS MORE THAN 3.00m FROM CURB

- SIDEWALK
- MIN. 3.00m
- ROUTE IDENTIFICATION SIGN (SEE NOTE)
- BOULEVARD
- TANGENT TO CURVE
- 11.0m
- 7.00m
- 5.00m
- 9.00m
- 10.00m STANDARD CURB
- VARIES [MIN. 25.00m]
- TRAFFIC FLOW

TYPE C
WHERE THERE IS MONOLITHIC CURB AND SIDEWALK

- SIDEWALK
- 9.00m
- ROUTE IDENTIFICATION SIGN (SEE NOTE)
- BOULEVARD
- TANGENT TO CURVE
- 5.00m
- 9.00m
- 10.00m STANDARD CURB
- VARIES [MIN. 25.00m]
- TRAFFIC FLOW

NOTE:
POSTS TO BE PLACED AT: 0.6m FROM FOC FOR SEPARATE WALKS
0.3m FROM BOW FOR MONO WALKS.

SITE SPECIFIC - PAD REQUIREMENTS TO BE SPECIFIED BY THE TRANSPORTATION DEPARTMENT.
STANDARD BUS ZONE DIMENSIONS
FAR - SIDE ZONE

STANDARD BUS ZONE DIMENSIONS
NEAR - SIDE ZONE

NOTE: RESTRICTIVE COVENANT
(NO VEHICULAR ACCESS) THROUGH STANDARD CURB.

NOTES:
1. ROUTE IDENTIFICATION POST & PLATE
   ARE LOCATED AT:
   - 0.6m FROM FOC FOR SEP. WALKS
   - 0.0m FROM BOW FOR MONO WALKS
2. IF THIS DIMENSION IS LESS THAN 20.0m CENTER
   THE STANDARD CURB ON NEXT LOT LINE
3. ROUTE IDENTIFICATION POST & PLATE
   ARE LOCATED AT PROPERTY LINE:
   - 0.6m FROM FOC FOR SEP. WALKS
   - 0.0m FROM BOW FOR MONO WALKS

FAR SIDE BUS ZONE / DRIVEWAY ACCESS
GUIDELINE FOR FRONT DRIVE GARAGES
CROSSFALL DESIGN

INVERT DESIGN

NOTES:
1. SEE SECTION 308.01.00. MIN 150mm OF 50mm COURSE GRAVEL.
2. SPECIFICATIONS ARE TO MINIMUM STANDARDS. CONSIDERATION MUST BE GIVEN TO ADDRESS ACTUAL SOIL CONDITIONS AND ASSESS THE NEED FOR GRAVEL BASE.
3. THICKER SLAB, REINFORCEMENT OR SUB-DRAINAGE SYSTEM
4. FOR CONCRETE PAVEMENT SPECIFICATIONS REFER TO 312.00.00.
5. INVERT DESIGN TO BE CONSIDERED ON A SITE BY SITE BASIS.
6. WHEREVER POSSIBLE "CROSSFALL DESIGN" SHALL BE USED.
STANDARD RESIDENTIAL
(SEE NOTE 2 & 3)

COMMERCIAL & MULTI FAMILY
- TWO WAY TRAFFIC
- FOR USE WITH PARKADE STRUCTURES

DETAIL - MINIMUM REQUIREMENTS FOR RAMP TO
UNDERGROUND PARKADE OR GARAGE

NOTE:
1. MAXIMUM GRADE CHANGE = 12%
2. ANY PROPOSED DRIVEWAY GRADES NOT CONFORMING
   TO THE ABOVE CRITERIA FOR THE STANDARD
   RESIDENTIAL PROFILE ARE SUBJECT TO THE REVIEW
   AND APPROVAL OF THE STREETS DIVISION.
3. MINIMUM 6.0 m TO GARAGE FROM BACK OF SIDEWALK
   OR FROM BACK OF CURB (IF NO SIDEWALK EXISTS).

THE CITY OF CALGARY
DRIVEWAY GRADES

FILE: C:\cyber\perm\sd\drawings\interstation\files\454188\454188003.dgn
DATE: 25-Mar-88 14:09
RESIDENTIAL SINGLE

RESIDENTIAL DOUBLE

7.20m COMMERCIAL
- FOR USES SUCH AS SMALL PARKING LOTS, & STRIP COMMERCIAL.
- PRIMARILY PASSENGER VEHICLES.
- TWO WAY TRAFFIC

10.00m COMMERCIAL
- FOR USES SUCH AS LARGE DEVELOPMENTS, SHOPPING CENTRES, APARTMENT COMPLEXES ETC.
- FOR TRUCK ACCESS.
- TWO WAY TRAFFIC.

7.20m ENTRANCE DIRECTIONAL
- ONE WAY INBOUND TRAFFIC ONLY
- FOR USES AS ABOVE

10.00m ENTRANCE DIRECTIONAL
- ONE WAY INBOUND TRAFFIC ONLY
- FOR USES SUCH AS LARGE DEVELOPMENTS, SHOPPING CENTRES, APARTMENT COMPLEXES ETC.

GENERAL NOTES:
1. ALL SIGNALIZED DRIVEWAYS SHALL HAVE CURB RETURNS.
2. ALL DRIVEWAYS ARE TO TIE TO BACK OF WALK.
   IF NO WALK IS REQUIRED THEN THE DRIVEWAY IS TO TIE TO BACK OF CURB. THE ADJACENT
   DEVELOPMENT IS RESPONSIBLE FOR THE TIE.
3. THE DRIVEWAY FLARE SHALL NOT EXTEND BEYOND
   THE PROJECTION OF THE COMMON PROPERTY LINE.
4. EXIT DIRECTIONAL TO BE REVERSE OF
   7.20m OR 10.00m ENTRANCE DIRECTIONAL.
5. DRIVEWAY DIMENSIONS INDICATED ARE MINIMUMS.
6. DRIVEWAY FLARES CAN BE INCREASED TO
   FACILITATE MOVEMENT OF LARGE TRUCKS.
GENERAL NOTES:

1. ALL SIGNALIZED DRIVEWAYS SHALL HAVE CURB RETURNS.
2. ALL DRIVEWAYS ARE TO TIE TO BACK OF WALK. IF NO WALK IS REQUIRED THEN THE DRIVEWAY IS TO TIE TO BACK OF CURB. THE ADJACENT DEVELOPMENT IS RESPONSIBLE FOR THE TIE. THE DRIVEWAY FLARE SHALL NOT EXTEND BEYOND THE PROJECTION OF THE COMMON PROPERTY LINE.
3. EXIT DIRECTIONAL TO BE REVERSE OF 7.20m OR 10.00m ENTRANCE DIRECTIONAL.
4. DRIVEWAY DIMENSIONS INDICATED ARE MINIMUMS.
5. DRIVEWAY FLARES CAN BE INCREASED TO FACILITATE MOVEMENT OF LARGE TRUCKS.
CROWNED

MIN. EQUA TO DIAMETER OF PIPE

DITCH BOTTOM

MIN. 450 mm DIA. CULVERT

SLOPE VARIES (MAX. 4:1)

DRIVEWAY SIDE SLOPE: 4:1 FOR LOCAL ROADS
   : 5:1 FOR COLLECTOR AND/OR MAJOR ROADS

TYPICAL CROSS-SECTION
SIDEWALK OR PATH ALONGSIDE A ROAD

HALF CROSS SECTION

NOTES:
1. CURB ENDS WHEREVER CURB INTERSECTS RAILWAY X-ING.
2. CONCRETE CROSSING PLANKS WITH RUBBER SEAL TO BE IN ACCORDANCE WITH CP/CN RAIL SPECIFICATIONS.
3. ALL MATERIALS SHALL COMPLY WITH THE CURRENT CITY AND CP/CN RAIL SPECIFICATIONS.
NOTE

A. ANY CONSTRUCTION INVOLVED WITHIN 3m OF SURVEY MONUMENTATION WHICH MIGHT ENDANGER THAT MONUMENTATION, SHOULD CONTACT THE LEGAL SURVEY SECTION, FIVE (5) WORKING DAYS IN ADVANCE FOR LOCATION, AND AFTER THE WORK IS COMPLETED FOR POSSIBLE MOVEMENT. (268-9799 or 268-2723)

B. IF TRENCH WORK IS GOING TO BE CLOSER THAN 1.5m, REMOVAL AND BACKFILLING, MUST BE CARRIED OUT MANUALLY.

C. NOT MORE THAN 0.30m OF A SURVEY CONTROL MONUMENT IS TO BE EXPOSED, IF SO REFER TO NOTE A ABOVE.

D. IF THE SURVEY CONTROL MONUMENT IS GOING TO BE TEMPORARILY COVERED WITH FULL OR ANY OTHER MATERIAL, A SEWER TYPE 'L' BARREL & LID OR COVER (SEE DWG. 452-1001-004 SEWER DIVISION) SHOULD BE PLACED TO PROTECT MONUMENT.

E. IF ANY HEAVY EQUIPMENT WORKING WITHIN 10m OF A SURVEY CONTROL MONUMENT, THE JOB FOREMAN IS REQUIRED TO LOCATE A GUARD POST AND A SEWER TYPE 'L' BARREL (SEE NOTE 'D'), TO PROTECT THE SURVEY CONTROL MONUMENT DURING CONSTRUCTION.
MANHOLE INSTALLATION
PLAN VIEW

LEGAL SURVEY CONTROL
MANHOLE COVER
(From 481-1009 001)

LEGAL SURVEY CONTROL
MANHOLE FRAME
(From 481-1001 001)

LEGAL SURVEY CONTROL
CONCRETE MANHOLE COLLAR
(From 481-1002 001)

ASC BRASS CAP
(From)

ASC MARKER (ELVES)
FILLED WITH GROUT, GRAVEL
AND LOCAL EARTH
(From 481-1003 001)

SECTION 'A-A'

THE CITY OF CALGARY
ENGINEERING DEPARTMENT

LEGAL SURVEY CONTROL
TYPICAL ROADWAY
MANHOLE INSTALLATION

Sheet

No.

Date

Revision

App'd

for City Engineer

481-1008-001