CITY OF REGINA

STANDARD CONSTRUCTION SPECIFICATIONS

2005

CITY OF REGINA

Engineering and Works Department

STANDARD

CONSTRUCTION

SPECIFICATIONS

Fourth Electronic Edition

March 2005

CITY OF REGINA
ENGINEERING & WORKS DEPARTMENT
STANDARD CONSTRUCTION SPECIFICATIONS

MANUAL REVISION RECORD

Please keep this Manual Revision Record in the Manual at all times. All future revisions will be numbered consecutively. The entry of each revision as it is placed into the manual will show at a glance whether the manual is up to date.

Revision No.*	Date	Remarks	Entered By
(1)	March 15, 1989	Manual Revised and Republished	
(2)	February 28, 1990	General Revisions	
(3)	January 10, 1991	General Revisions	
(4)	February 28, 1992	General Revisions	
(5)	November 26, 1992	General Revisions	
(6)	January 10, 1994 June 16, 1994	General Revisions Table of Contents**	
(7)	March, 1995	General Revisions	
8	March 1996	General Revisions	
9	January 1997	General Revisions	
10	February 1998	General Revisions	
11	January 2001	General Revisions	
12	January 2002	General Revisions	
13	January 2003	General Revisions	
14	February 2004	General Revisions	
15	March 2005	General Revisions	
16			
17			
18			

* Revisions dated March 15, 1989 to March 1995 inclusive were not numbered, although a number (in parenthesis) has now been assigned to them.

** Issued to holders of 2nd printing of Manual. Superseded by Revision No. 7.

City of Regina
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Specification Changes
2005

Section/ Drawing	Title	Article/ clause	Description of Updates
	Order Form		Deleted.
	Table of Contents	3 pages	Updated to show drawings new drawings added.
	Water Division		
01510	Temporary Water Supply	1.2	Expanded to clarify circumstances requiring provision of temporary water
		1.3	Article completely revised; specifies temperature limits and other conditions for temporary water supply.
		1.4	New article detailing requirements for acquiring temporary water supply (and incorporates parts of former article 1.3).
		1.5	New article detailing arrangement requirements for temporary systems (and incorporates a part of former article 1.3).
		2.2.2	Revised article allowing use of 'kamlok' style fittings on temporary water systems.
		2.3	Portable Water article renumbered (formerly clause 2.2.2).
		3.2	Revisions to temporary system disinfection requirements; Disposal requirements added.
		3.3	Clauses 3.3.4 and 3.3.5 deleted.
		3.3.2	Added traffic signing requirement for temporary systems crossing streets.
02315	Trench Excavation and Backfill	All	Entire section revised to eliminate inconsistencies and clarify responsibilities and requirements.
02511	Watermains	2.13	Title changed
		3.1	Title changed.
		3.1.1	Reference added.
		3.2.15	Clause deleted and incorporated into new clause 3.9.1.
		3.9	Revised to clarify use of approved corrosion protection options.

Section/ Drawing	Title	Article/ clause	Description of Updates
02516	Water Service Connections	1.2	Rewritten in command form.
		1.3.1	Reference to Standard Specifications added.
		2.2.1	Service size revised for Copper - Type K soft drawn pipe.
		2.3.4	Revised and expanded to include valves on 100mm and larger services.
		2.3.5.1	Model numbers revised pursuant to manufacturer's changes.
		2.3.5.2	New article specifying type of valves used as corporation stops.
		2.3.8.1	Revision to flange description.
		3.1.1	Suggested minimum clearance between service lines added.
		3.1.2	New clause specifying minimum clearance stipulation if water service is larger than 50mm
		3.1.3	Renumbered from 3.1.2.
		3.1.6	Expanded to specify service connection requirements.
		3.1.8	New clause specifying requirement on valves used as corporation stop.
		3.1.9	Renumbered from 3.1.8.
		3.2	Clauses within this article renumbered.
		3.4.2	Clause deleted. See revised clause 3.1.3.
		3.7.1	Revised to include reference to 50mm corporation stops and smaller.
		3.8.1	Revised to include gate valves 100mm and larger.
		3.8.4	Revised to include references to standard drawings showing gate valves.
		3.9.2	Former clause 3.9.3 renumbered and clarification made with respect to 'inside' property line.
		3.9.3	Clause deleted.

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Section/ Drawing	Title	Article/ clause	Description of Updates
02519	Disinfection and Flushing of Watermains	1.1	Scope revised
		1.2	New article on Bacteriological Sampling Requirements.
		3.1.4	NOTE added.
		3.1.6	Revised to stipulate two days minimum notice requirement.
		3.2	New article on Disinfection Methods and Requirements
		3.3	Renumbered from former article 3.2 and renamed; Revised to clarify conditions of water supply for disinfection and also high level testing requirements.
		3.4 et al	Former articles renumbered.
15999	Listing of Water Standards Drawings	2 pages	Updated to show drawings revised and new drawings added.
W-2	Hydrant Installation		Notes revised.
W-2A	Hydrant Installation in Narrow Streets		New drawing.
W-6	Detail for Watermain Crossing Beneath Sewermain		New drawing.
W-7	75mm Irrigation Meter-Kiosk and Equipment Installation Details		New drawing.
W-9	Above Grade Irrigation Kiosks Site Plan and Base Slab Details		Revised to apply to 75m kisok.
W-10	50mm Irrigation Service - Kiosk and Equipment Installation Details		Title changed; Revised enclosure arrangement, material and latch.

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Section/ Drawing	Title	Article/ clause	Description of Updates
W-11	100mm Irrigation Service - Kiosk and Equipment Installation Details		Title changed; Lockbox revised to match Standard Drawing W-10
	Sewer Division		
02997	Sewer Cleaning and CCTV Inspection		New specification.
02998	Trenchless Sewer Main Repairs – Thermosetting Resin		New specification.
02999	Trenchless Sewer Main Repairs – Fiberglass Reinforced Epoxy		New specification.
1499	Listing of Roadway Sewer Drawings	1 page	Updated to show drawing revised.
S-2	Precast Manhole 1050mm Dia.		Flat top option added.
	Roadways Division		
2550	Concrete Sidewalk, Crossings, Curb and Gutter	2550-3(a)	Granular depth below sidewalk increased to 150mm.
2600	Concrete Median, Boulevard and Island Paving	2550-1	Granular depth below concrete paving increased to 150mm.
2999	Listing of Roadway Standard Drawings	3 pages	Updated to show drawings revised.
R-9A	Typical Pedestrian Ramp		Reduced 15 mm lip above gutter to 10 mm.
R-9C	Typical Pathway Ramp at Mid-Block Crossing		Reduced 15 mm lip above gutter to 10 mm.
R-10	Combined Concrete Walk Curb and Gutter Crossing		Introduced 10 mm curb lip at fillet of gutter; Note revised.
R-10B	Concrete Curb and Gutter Crossing		Introduced 10 mm curb lip at fillet of gutter.
R-10C	Curb and Gutter Residential Crossing with Boulevard		Introduced 10 mm curb lip at fillet of gutter.
R-11B	Box-Out for Side Inlet Catch Basins (Barrier Curb)		Rebar added to curb section for collector and arterial streets.

About the Electronic Edition of the 2005 Standard Construction Specifications

The City of Regina converted its Standard Construction Specifications to an electronic form in 2002 so that it would be more convenient to you the user.

In producing this fourth edition, the City of Regina created a facsimile of the Standard Construction Specifications that contain revisions up to March 2005. However, the electronic version differs as follows:

- Signatures are not shown on the drawings. The drawings contain the name of the persons who approved the drawing.

- The electronic version contains additional pages such as "About the Electronic Edition" and a Feedback form.

The technical content in the electronic documents should be identical to the paper version. In the event of a discrepancy between the electronic version and the paper version, the paper original held by the City of Regina will be considered correct.

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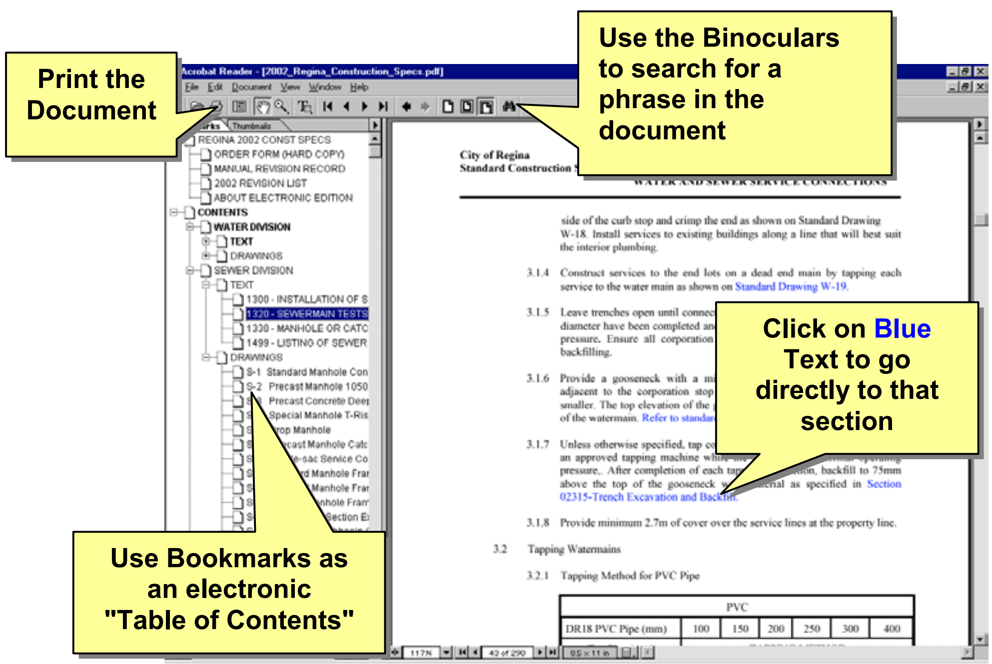

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CITY OF REGINA

STANDARD SPECIFICATIONS FOR UNDERGROUND AND SURFACE CONSTRUCTION

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CITY OF REGINA

Engineering and Works Department

WATER

SPECIFICATIONS

SECTION

1.0 GENERAL

1.1 Scope

1.1.1 This section refers to the supply of pressurized, temporary water service.

1.2 Interruption of Potable Water Service

1.2.1 Provide and maintain pressurized, temporary water supply to all services connected to watermains that must be or are depressurized for any reason. The only exception to this requirement is the performance of emergency repair and only if the repair interruption is expected to last less than eight consecutive hours. Provide temporary water supply if the repair interruption extends past eight consecutive hours. Whenever reasonable undertake emergency repairs while still maintaining minimum 70-100 kPa in the main to be repaired. If this is done, provision of temporary water supply is not required.

1.2.2 Maintain and operate temporary water supply until completion of required disinfection and flushing procedures and, receipt of confirmation of acceptable bacteriological test results for the section of watermain that was depressurized.

1.3 Temporary Water Service During Freezing Temperatures

1.3.1 Performance of work requiring temporary water service will not normally be approved if either daytime or night time temperatures are forecast to be below 0°C during the expected duration of the temporary supply requirement. In special circumstances the Engineering and Works Department may consider some latitude to this stipulation. The decision of the Engineering and Works Department is final in this regard.

1.3.2 In the event installation of temporary water supply is allowed to proceed when temperatures are forecast to be at or below freezing, provide all means to ensure continuous availability of temporary supply. This may include some or all of the following:

.1 Ensure that each temporary branch service is left partially or fully running continuously.
.2 Design, supply and installation of acceptable means to prevent supply hydrant(s) from freezing.
.3 Provision of personnel to continuously monitor the system and all equipment necessary to promptly reinstate flow to lines which do freeze.
.4 Provision of a system with means to heat and/or circulate water to maintain the water temperature at a minimum of 3°C at the furthest point in the system. Such system must be designed by a professional engineer and requires review by the Engineering and Works

Department before installation can proceed. Such system must employ components which are suitable for use with potable water and are completely disinfected prior to installation.

1.3.3 Where provision of temporary water supply during freezing conditions is approved, prepare and submit a detailed plan for review by Engineering and Works which shows the proposed installation and details all provisions that will be put in place to prevent freezing. Submit the plan at least two full working days in advance of the time the temporary system installation is desired.

1.4 Acquisition of Temporary Water Service

1.4.1 The use of a fire hydrant or hydrants as the source of temporary supply is permissible. To do so obtain a Hydrant Permit at Works, 2425-4th Ave. A Hydrant Permit Fee will be payable for all projects but it will be refundable if the project is either being done directly for the City of Regina on its water utility or, on the water system portion of any private project which necessitates an interruption of water service to existing customers. The Hydrant Permit Fee is not refundable for any project where the work requiring temporary water supply does not directly involve or impact the water utility.

1.4.2 Upon issuance of a Hydrant Permit, the City of Regina will supply and connect a portable water meter and backflow prevention (Hydrant Permit) assembly to the designated supply hydrant(s). A non-refundable Hydrant Connection Fee must be paid for each Hydrant Permit Assembly installed regardless of the nature of the project.

1.4.3 Refund of the Hydrant Permit Fee is conditional upon the Hydrant Permit assembly being returned undamaged and the conditions previously stated.

1.4.4 Ensure that the assembly remains continuously connected to the hydrant for the duration of the project or interruption.

1.4.5 There will be no charge for water used on projects which qualify for refund of the Hydrant Permit Fee. On all other projects water will be charged for at the prevailing City of Regina water rate as metered by the Hydrant Permit assembly or $44.80 per calendar week, whichever is the greater.

1.4.6 Be responsible for advising the City of Regina when the assembly is no longer required and for reimbursing the City for loss of or damage to Hydrant Permit assemblies provided.

1.4.7 Obtain a Hydrant Permit for every hydrant used as a supply connection.

1.5 Temporary Supply System Arrangement and Requirements

1.5.1 Provision of a suitable temporary water supply connection point is the responsibility of each property owner affected. The normal residential connection point will be the outside hose bibb on the residence. If a property owner refuses to or cannot provide a suitable connection point then provision of temporary supply to that property is not mandatory.

1.5.2 For normal residential areas provide minimum 50mm diameter main service line with minimum 20mm pipe into each individual property.

1.5.3 Each 50mm temporary main service line may supply a maximum of twenty-six (26) residential connections or have a maximum length of 175 metres, whichever is the lesser.

1.5.4 For temporary supply of services larger than standard residential provide temporary branch service pipe no more than one nominal pipe size smaller than the permanent service to a maximum 100mm size. In these instances the required size and maximum length characteristics of the temporary main supply line size will be subject to the pre-approval of Engineering and Works.

1.5.5 In the event that it is not possible or feasible to provide temporary supply from a hydrant, obtain the Engineer's approval to use alternate means such as a portable tank. Provide the means to continuously and automatically pressurize the supply from the tank to consumers and to control the delivered pressure to a maximum of 490kPa (70 psi). Provide the Engineer with a detailed description of the proposed system for review well in advance of the date of proposed use. Disinfect all tanks and equipment to be used to AWWA standards and do not employ the equipment until bacterial samples taken from it have been tested at the Provincial Water Laboratory and declared satisfactory.

1.5.6 Use of any hydrant or standpipe to directly fill containers which contain chemicals or to which chemicals have previously been added is strictly prohibited. An exemption may be granted to this if the fill arrangement is approved by the Cross Connection Control Division, Engineering and Works Department, City of Regina.

2.0 PRODUCTS

2.1 Piping

2.1.1 High Density Polyethylene (HDPE), minimum series 100, certified PE3408, conforming to CSA B137.1 and certified for potable water service under NSF61.

2.2 Fittings

2.2.1 PVC, hose shank insert ends, approved for potable water service and having a working pressure rating of at least 700 kPa (100psi). Join to pipe using stainless steel band clamps or other method approved by the Engineer.

2.2.2 Aluminum or stainless steel body, hose shank end, over-centre, twin lever insert type with a working pressure rating of at least 700 kPa (100 psi), KAMLOK or as approved. Join to pipe using stainless steel band clamps or other method approved by the Engineer.

2.3 Portable Tanks

2.3.1 Portable tanks employed for the purpose of storing potable water must be constructed of materials suitable for direct contact with potable water. Tanks to be used must not have previously been used to transport petroleum, chemical or waste products of any description.

3.0 EXECUTION

3.1 Notification of Customers

3.1.1 Hand deliver written notification to all customers that will be affected by interruption of service a minimum of seven (7) days prior to the date of interruption.

3.1.2 Include the following information in the written notice:

.1 Start date and time and anticipated duration of the interruption to service.

.2 Instructions to close the isolation valve at the water meter and standard water service schematic.

.3 Names and phone numbers of Contractor and City of Regina project contacts.

3.1.3 In the event that seven days advance notice is not possible due to a short interruption developing into a longer one or where conditions dictate prompt action, attempt to provide all customers with a minimum of one hour's advance notice before discontinuing service. In these cases, provide verbal notice to each customer.

3.2 Disinfection and Disposal

3.2.1 Prior to connection to temporary connection points ensure that all temporary main and branch piping is disinfected with a minimum 1% chlorine solution held in contact in the pipe for at least 15 minutes and then flushed with City water for a minimum of 15 minutes.

3.2.2 Immerse service connection fittings in minimum 1% chlorine solution for a minimum of 15 minutes before installing in temporary service piping.

3.2.3 For portable tanks, fill the tank with potable water while adding sufficient chlorine chemical to obtain a 100 mg/l concentration in the full tank. Hold in contact for a minimum of 15 minutes.

3.2.4 Dispose of high strength chlorine solution in a manner that will not pose a threat to health or damage public or private property and in accordance with applicable regulations.

3.3 Placement and Operation of Temporary Water Service

3.3.1 Place supply lines parallel to each side of the street and as close as possible to the premises being serviced.

3.3.2 When a street must be crossed with temporary water supply piping either core under pavement and lay pipe in the cored hole or lay pipe on the surface of the pavement. Pipe installed on the road surface is to be protected from vehicular and pedestrian traffic with suitable ramps and provided with suitable traffic warning acceptable to the Engineer. Cuts in pavement may be made only with permission of the Engineer.

3.3.3 Only City of Regina personnel may operate a hydrant. Provide additional manual shutoff valves as may be required to control or isolate any temporary supply system.

1.0 GENERAL

1.1 Scope

1.1.1 This section refers to the permanent abandonment of watermain pipe by grouting the pipe interior.

1.2 Intent

1.2.1 The intent of the Work covered by this Division is that the entire interior void space in the designated section of pipe is to be completely filled with a grout product that will cure and harden in that physical environment and prevent future collapse of the pipe wall.

2.0 PRODUCTS

2.1 Grout

2.1.1 Grout will be Low Shrink or as recommended by the grouting specialist and approved by the Engineer.

2.2.1 For Low Shrink the maximum aggregate size shall be 6mm using sand and the proportions of materials shall produce a flowable concrete mixture that will meet the following standards:

Strength at 28 days	0.5 Mpa ± 0.25 (measured in accordance with CAN3-A23.2-9C
Slump	175 ± 25mm (measured in accordance with CAN3-A23.2-5C)

Note: Type 30 Portland cement may be used for winter construction.

3.0 EXECUTION

3.1 Codes and Standards

3.1.1 Perform the grouting operation while adhering to the requirements of the following codes and standards:

.1 Local codes and bylaws.
.2 *The Workers' Compensation Act, 1979* (Saskatchewan).
.3 National Building Code of Canada, 1995.

3.2 Injection Parameters and Requirements

3.2.1 Monitor the pressure being exerted on the interior of the 600mm cast iron trunkmain during the grouting operation.

3.2.2 Do not allow the monitored pressure exerted on the interior of the 600mm cast iron pipe to exceed 700 kPa (100 psi).

3.2.3 Provide whatever is required to allow the grouting procedure to proceed without exceeding the maximum allowable internal pressure.

3.2.4 Monitor the vents and standpipes provided to ensure that filling of the pipe to a point where the grout fills the vent pipes to a level at least 600mm above the top of the trunkmain.

3.8 Pipe Dewatering

3.8.1 Carry out any dewatering of the pipe necessary to allow the grouting operation to proceed as intended and without dilution of the grout mixture being installed.

3.8.2 Do not permit trench water to enter the pipe.

3.8.3 Ensure that the discharge from the dewatering equipment is disposed of in a manner that does not create a nuisance, cause injury to anyone, or cause damage to any property.

3.9 Area Cleanup

3.9.1 Remove all grouting materials and excess excavated materials from the site after grouting and backfilling is completed. Burning of rubbish and paper waste on the site is prohibited. Dispose of this material according to local ordinance requirements.

1.0 GENERAL

1.1 Scope

1.1.1 This specification refers to trench excavation and backfill.

1.2 Codes and Standards

1.2.1 Carry out all operations relating to excavation, shoring and backfill in strict conformance with all applicable Legislation, Codes, Standards and Ordinances of authorities having competent jurisdiction.

1.3 Definitions

1.3.1 Trench excavation is an excavation open from ground surface to the full depth of the pipe zone. A trench excavation may have vertical sidewalls for its full depth, maintained by bracing and sheeting or sloped sidewalls from a maximum of 1200mm above the bottom of the trench excavation to the ground surface.

1.3.2 The pipe zone is the portion of the trench excavation between the bottom level of the trench excavation to a height of 150mm above the top of the pipe. For more detail refer to standard Drawing W-04.

1.3.3 Foundation is over excavation in the pipe zone that is required to provide a stable foundation for the bedding.

1.3.4 Pipe bedding is that portion of the pipe zone that supports the pipe and other appurtenances.

1.3.5 Haunching is that portion of the pipe zone from the bottom of the pipe to the springline of the pipe.

1.3.6 Initial backfill occupies the area between the springline of the pipe and a maximum 300mm above the top of the pipe.

1.3.7 Unstable trench bottom is an inadequate bedding condition caused by organic material, "quick" sand or other similar material being present in the bottom of the trench.

1.3.8 Drainage ditch excavation is common excavation required for routing of surface or pumped water to a drainage course.

1.3.9 Standard Proctor Density (SPD) is the soil density achieved by application of compactive mechanical effort to a soil mass.

1.3.10 Classify excavation by the type of material as follows:

.1 Common excavation is the excavation of all materials other than rock and shall include hard pan, frozen materials and partially cemented materials that can be ripped and excavated by heavy equipment.

.2 Rock excavation is defined as boulders, pieces of concrete or masonry exceeding 1.0m^3 in volume or solid ledge rock, concrete or masonry which requires drilling and blasting or other mechanical means for its removal. No soft or disintegrated rock, concrete or masonry which can be removed with a hand pick or power-operated excavator will be considered rock excavation. No loose, shaken or previously blasted work will be considered rock excavation.

.3 Rubble excavation is the removal of broken material resulting from the decay or destruction of a building or other structure.

1.3.11 Classify backfill by the type of fill material as follows:

.1 Insitu material is defined as material excavated from the trench from which all boulders larger than 100mm in maximum dimension, large roots, stumps or other debris that would prevent consolidation of the backfill have been removed.

.2 Low shrink material is a sand/cement/water mixture.

.3 Granular material is material such as sand, natural gravel and reclaimed concrete aggregate. Granular material must be free of reclaimed asphalt.

.4 Coarse gravel is clean angular material required for stabilization of trench bottom due to over excavation of unsuitable trench bottom conditions.

.5 Topsoil is humus, peat, or other material containing organics, which make up the top layer of the soil.

2.0 PRODUCT

2.1 Insitu Backfill Material

2.1.1 Insitu Backfill Material is original trench material that does not contain boulders or rocks larger than 100mm diameter, organic soils, frozen lumps of earth, rubble or debris from trench excavation.

2.2 Low Shrink Material

2.2.1 Do not supply or place low shrink backfill until a mix design has been submitted to and approved by the Engineer.

2.2.2 Maximum aggregate size shall be 6mm using sand. The proportions of materials shall be such as to produce a concrete mixture that will meet the following standards:

Strength at 28 days	0.5 MPa ± 0.25 (measured in accordance with CAN3-A23.2-9C
Slump	175 ± 25mm (measured in accordance with CAN3-A23.2-5C)

Note: Type 30 Portland cement may be used for winter construction.

2.3 Bedding Material

2.3.1 Do not supply or place bedding material until a sieve analysis has been submitted to and approved by the Engineer.

2.3.2 Provide bedding material having the following gradation limits:

SIEVE SIZE	PERCENT PASSING
10mm	100
5mm	95-100
630μm	25-60
80μm	0-5

2.4 Granular Material

2.4.1 Provide granular material having the following gradation limits.

SIEVE	% PASSING
28mm	100
20mm	90-100
12.5mm	70-100
5mm	45-85
2mm	30-65
800μm	15-40
400μm	12-30
160μm	9-20
80μm	7-15

Maximum Permeability 1×10^{-4}cm/sec.

2.4.2 Do not supply or place imported material until a sieve analysis has been submitted to and approved by the Engineer.

2.5 Coarse Gravel

2.5.1 Do not supply or place coarse gravel until a sieve analysis has been submitted to and approved by the Engineer.

2.5.2 Provide clean angular rock material for stabilization of trench bottom with the following gradation limits:

SIEVE SIZE	PERCENT PASSING
80mm	100
50mm	95-100
25mm	20-100
20mm	0-80
10mm	0-10
5mm	2

2.6 Drainage Material

2.6.1 Do not supply or place drainage material until a sieve analysis has been submitted to and approved by the Engineer.

2.6.2 Provide material for drainage with the following gradation limits:

SIEVE SIZE	PERCENT PASSING
40mm	100
25mm	75-100
20mm	20-80
10mm	0-10
5mm	0-5

3.0 EXECUTION

3.1 Protection of Existing Utilities and Surface Features

3.1.1 Refer to Section 01001 – General Requirements

3.2 Site Preparation

3.2.1 Strip topsoil as shown on the drawings or as directed by the Engineer.

3.2.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.3 Excavation

3.3.1 Location of Excavation

.1 The Engineer will provide stakes offset from the centreline of the trench to indicate trench alignment.

.2 Excavate trenches only as far in advance as safety, traffic and weather conditions permit.

.3 Protect structures, piping and other manmade objects existing within the working area.

.4 Do not excavate more than 120m in advance of the pipe laying operation. Allow no more than 15 metres of trench to remain open at the end of each day.

3.3.2 Depth

.1 Excavate trench to dimensions shown on Drawing W04 or as required to provide sufficient space for pipe bedding and to permit erection of forms, shoring, waterproofing and inspection of foundations. Excavate to clean lines to minimize the quantity of fill required.

.2 Adhere to City of Regina standards for minimum bury depths unless specifically shown or directed otherwise in the Contract Documents or by the Engineer.

3.3.3 Excavated Trench Material

.1 Pile material along side the trench provided working space is adequate and by doing so it does not spill onto private properties disturbing fences, buildings, shrubs, lawns, crops or other items of value.

.2 Locate spoil pile to minimize blockage of traffic and drainage facilities.

.3 Where excavated material cannot be piled along the trench, stockpile at locations approved by the Engineer and return for backfilling as required.

3.3.4 Trench Alignment

.1 Prior to excavation of the trench, establish the pipe installation alignment by setting stakes at 20m intervals along a line offset from the centreline of the proposed alignment.

.2 Excavate the trench so that the pipe can be laid to the established alignment and depth with allowance made for specified trench wall clearance and bedding.

.3 Install the pipe to a predetermined grade according to a grade sheet showing the depth of cut to the invert or top of pipe relative to the grade stake elevation at the respective locations along the pipeline.

3.3.5 Trench Width

.1 Excavate to produce clearance of not less than 150mm between the outside of the pipe at its largest section and the trench sheeting or earth wall and not more than 300mm clearance between the pipe and earth wall regardless of trench support works. Refer to Drawing W04.

.2 The above condition governs from the trench bottom to 300mm above the top of the pipe.

.3 Excavate widths above this point in conformance with the requirements of the latest edition of the *Occupational Health and Safety Act.*

.4 Remove ledge rock, boulders and large stones to provide a minimum clearance of 150mm below the pipe.

.5 Where the maximum trench width is exceeded provide special bedding or other precautions as directed by the Engineer.

3.3.6 Bracing and Sheeting

.1 Shore the trench in a manner that conforms with the latest edition of the *Occupational Health and Safety Act*, and as necessary to protect life, property and structures adjacent to the Work, the Work itself, or to maintain trench widths within specified limits.

.2 Install shoring so that is does not extend below the springline of the pipe. Do not locate shoring closer than 150mm to the widest section of the installed pipe. When it is necessary to place the shoring below the pipe springline, raise the shoring in 600mm lifts and compact each lift to fill the void left by the raised sheeting.

.3 Cut off shoring left in place no higher than 900mm below the ground surface.

.4 Remove shoring in a manner which permits backfill compaction.

3.3.7 Dewatering

.1 Control entry of ground and surface water to the extent that excavation and pipe installation can proceed and the trench bottom condition is not compromised to the detriment of the pipe installation.

.2 Continuously pump or bail out water from the trench. Do not use the pipe being installed as a drain for such water.

.3 Ensure that dewatering operations do not compromise or damage the foundation of any structure in the vicinity.

.4 Locate and direct dewatering discharge such that loss, damage, nuisance or injury to the public does not occur. Direct discharge into natural drainage channels, drains or storm sewers.

3.3.8 Safety

.1 Excavate trench in conformance with the requirements of the latest edition of the *Occupational Health and Safety Act* and as is necessary to protect life, property and work.

.2 Sheet and brace open cut trenches in strict conformance with the latest edition of the *Occupational Health and Safety Act*, Municipal Ordinances and as necessary to protect life, property and Work.

.3 Blasting for excavation will not normally be permitted. When permitted, blasting methods and procedures must strictly conform to Provincial Statutes and Municipal Ordinances. If there are structures in the vicinity that may be affected by the blasting, engage and pay for the services of a structural engineer and carry out a comprehensive structural investigation with the property Owner(s), Sub-contractor and the Engineer to establish the existing condition of these structures. Provide all damage mitigation measures prescribed. Provide all additional insurance as may be directed by the Owner. Bear all costs for damage and injury resulting from blasting operations.

.4 Work between sunset and sunrise will be allowed only with prior written permission from the Engineer or if necessary to correct Work that is deemed to constitute an immediate hazard to the public or existing utilities. When any Work is carried out at night, supply a sufficient number of electric or other approved and efficient lights to enable the Work to be done in a safe, satisfactory manner. Operations will not be permitted if the Engineer believes there insufficient light to perform the Work safely and satisfactorily.

3.3.9 Trench Bottom Conditions

.1 Maintain trench conditions to facilitate pipe installation without water, muck, silt, gravel or other foreign material entering the pipe.

.2 Provide a firm trench bottom capable of supporting the pipe to be installed. Stabilize trench bottom by means of over excavation or special foundation designed to support the pipe.

.3 Remove all deleterious material from the trench bottom prior to pipe installation.

3.3.10 Over Excavation and Backfill

.1 Excavate the trench in a manner that provides a uniform and continuous support for the pipe and fittings on solid, undisturbed ground. Over excavate unstable trench bottom to a level at which stable material is encountered.

.2 Backfill over excavation with coarse gravel material to the level of normal bedding.

.3 Compact coarse gravel material in lifts having a maximum compacted depth of 300mm to provide a thoroughly consolidated pipe zone using approved mechanical compactors.

3.3.11 Unstable/Non-Uniform Ground Conditions

.1 Excavate loose or deleterious material to the width, depth and length as required and backfill with coarse gravel in 300mm compacted layers or with insitu backfill material in 150mm compacted layers. Compaction to 95% Standard Proctor Density.

.2 Provide and maintain minimum clearance between the pipe and trench walls of not less than 150mm for pipes up to and including 600mm O.D. and not less than 200mm for pipe larger 600mm O.D.

.3 Finish subgrade with hand tools to provide a uniform and continuous support for the pipe bedding.

3.3.12 Coring

.1 Provide straight walled shafts for coring.

.2 Provide proper shoring and any other means required to ensure safety of workmen and stability of surrounding soils.

.3 Obtain the prior approval of the Engineer for size, location and extent of coring shaft(s).

.4 Maintain a minimum 1.0 metre clearance from nearest edge of coring shaft to pavement or other structures, unless otherwise approved

.5 Carry out shaft excavation and backfill in accordance with the relevant section(s) of the specifications and all safety regulations.

.6 Provide cored hole that does not exceed the largest dimension of the pipe to be installed by more than 50mm.

.7 Carefully establish and maintain line and grade and provide a finished coring hole which does not vary more than 50mm vertically or 100mm horizontally from the established grade.

.8 Recore any hole that exceeds the specified deviation limits.

.9 Adequately plug the leading end of pipe inserted in a core hole to prevent damage or entrance of foreign material.

.10 Provide adequate support of pipe within the core hole as recommended by the pipe manufacturer and/or as detailed in the contract documents.

.11 Carry out pipe insertion into cored holes using techniques and equipment recommended by the pipe manufacturer and approved by the Engineer.

3.4 Trench Backfill and Compaction

3.4.1 Backfill Within the Pipe Zone

.1 Backfill with granular material placed in uniform layers and compacted by mechanical means for the full width of the trench. Backfill in layers not exceeding 150mm compacted thickness and compact to completely fill spaces under and adjacent to the pipe.

.2 Place bedding material to lines and depths required. Provide bell and coupling holes along the trench bottom so that the pipe barrel is evenly supported throughout the entire length.

.3 Mechanically compact the pipe bedding, haunching and initial backfill material to 95% Standard Proctor Density.

.4 Mechanically compact pipe haunching while exercising care not to contact or damage the pipe. For compaction of haunching on pipe 300mm and larger, employ pneumatically powered, single leg 'pogostik' tamper or as approved by the Engineer.

.5 Where specified, backfill with low shrink material such that the material flows into the excavation and fills the entire space under the pipe. Place low shrink material to the springline of the pipe. Ensure that the pipe or pipe bedding is not disturbed during backfill placement and air is not trapped beneath horizontal projections or the other locations within the pipe zone excavation.

3.4.2 Backfill Above the Pipe Zone

.1 Insitu Material

.1 Backfill in uniform layers not exceeding the thickness required to obtain the specified density. The maximum allowable compacted layer thickness shall be 150mm unless otherwise approved by the Engineer. Compact backfill to a minimum 95% Standard Proctor Density.

.2 Control the moisture content of the insitu backfill material to within ±3% of the insitu material in the adjacent trench walls. Supply and add water or dry the insitu backfill material as required to meet the moisture specification.

.3 Areas to be backfilled shall be free from debris, snow, ice, water or frozen ground. Backfill material shall not be frozen or contain ice, snow or debris.

.4 Haul and dispose of all material that is unsuitable for use as backfill. Import and place acceptable material.

.5 Import and place acceptable material to makeup any shortage of material caused by the construction operation or removal and disposal of rock, boulders or other material.

.6 Bear all costs for locating, providing and placing acceptable replacement backfill material.

.2 Granular Material

.1 Provide granular material having sufficient moisture content to prevent dust generation during handling.

.2 Backfill in uniform layers not to exceed the thickness required to obtain the specified density. The maximum allowable compacted layer thickness shall be 150mm for granular materials unless otherwise approved by the Engineer.

.3 Compact backfill to 95% Standard Proctor Density.

.4 Repair and pay for damage resulting from any subsidence or heaving of the backfill occurring within the maintenance period.

.3 Low Shrink Material

.1 Place low shrink backfill such that the material flows into the excavations and fills the entire space. Initial depth of material may not exceed one (1) metre. The initial depth must set to a point where the concrete is no longer fluid before additional material may be placed on top of it.

2. Ensure that the pipe or pipe bedding is not disturbed during low shrink placement and air is not trapped beneath horizontal projections or the other locations within the excavation.

.3 Where required, cover low shrink material with steel plates having sufficient strength to support traffic. Maintain this support until the Engineer advises that the low shrink material has developed sufficient strength to allow its removal. Where support of traffic is not required, cover and fence the excavation until the Engineer advises that the low shrink material has developed sufficient strength to allow placement of further material on top of it.

.4 Use of low shrink material above the pipe zone requires the approval of the Engineer unless it is specifically indicated on the drawings.

3.4.3 Backfilling of Structures

.1 Structures include buildings, manholes, vaults and buried valves.

.2 Backfill structures with insitu fill or granular material compacted to 95% Standard Proctor Density, in maximum compacted lifts of 150mm within 5m of structure. Excavations to be free of ice, snow, debris and water at the time of backfilling.

.3 Compact backfill adjacent to or under slabs, footings and pipes to 100% Standard Proctor Density. Use either hand operated tamper or pneumatically powered, single leg 'pogostik' tamper within 1000mm of structures. Place and compact backfill around structures so as to keep load distributed evenly around the perimeter.

.4 Place and compact pipe trench backfill under and within 4 metres of pipe vaults to 95% Standard Proctor Density.

3.4.4 Responsibility for Materials Testing - Private Consultant as Engineer

.1 In all instances where the 'Engineer' for the Work is <u>not</u> the City of Regina, Engineering and Works Department, materials testing is the responsibility of the Contractor.

.1 Retain and pay for a materials testing laboratory, satisfactory to the Engineer, to test materials compacted in place. Pay all costs for re-testing required as a result of initial or subsequent test results not conforming to the requirements of this specification.

.2 Inform the testing agency of the name and number of the Engineer for the project and instruct the testing agency to immediately advise the Engineer of the use of any material or procedure contrary to the specifications or good construction practice.

.3 Locations for density tests to be selected by the testing laboratory under the direction of the Engineer.

.4 Submit copies of test results to the Engineer within 24 hours of each test.

3.4.5 Responsibility for Material Testing – Engineering and Works as Engineer

.1 In all instances where the 'Engineer' for the Work is the City of Regina, Engineering and Works Department, materials testing will be the responsibility of the Engineering and Works Department.

3.4.6 Materials Testing Standards

.1 Standard for laboratory determination of SPD:

.1 ASTM D698 and ASTM D2216 - standard test methods for laboratory determination of density and of water (moisture) content of soil, rock and soil-aggregate mixtures.

.2 Standards for field determination of density and moisture.

.1 ASTM D2167 - standard test by the rubber balloon method for density and unit weight of material compacted in place.

.2 ASTM D1556 - standard test by the sand cone method for density and unit weight of material compacted in place.

.3 ASTM D2922 and/or D3017 - Nuclear methods testing for density and moisture content of material compacted in place.

.3 Testing firm to choose and employ the most appropriate field test method(s) for the specific conditions.

3.4.7 Materials Testing Requirements

.1 Materials testing requirements are as follow:

.1 Determination of Standard Proctor Density of each of the primary materials, such as clay, silty clay, silt, silty sand and sand.

.2 Perform density using method(s) appropriate for the conditions.

.3 Perform a minimum of one test per 1000 sqm/150mm compacted lift.

3.4.7 Disposal of Boulders

.1 Locate a suitable disposal site for boulders and bear all costs for hauling and disposing of them.

3.4.8 Disposal of Excess Common Excavation

.1 Spread excess material, other than rock, asphalt and concrete, over the entire right-of-way prior to replacement of topsoil. Do not interrupt or alter existing drainage. Remove any remaining material from site.

.2 Remove and dispose of all site excavated debris .

3.4.9 Surface Maintenance During Construction

.1 Maintain all trench surfaces and working surfaces affected by construction until the project is accepted by the Engineer.

.2 Finish berms over trenches as specified prior to acceptance. Provide and place material to fill depressions resulting from the settlement of backfill.

.3 Maintain gravelled surfaces free of potholes and washboard conditions. Promptly re-grade surfaces when irregularities occur.

.4 Provide approved traffic hazard warning signage and barricades at all locations which cannot be promptly reinstated to the specified standard. Maintain traffic protection until the defects are rectified.

3.5 Deep Trench Excavation and Backfill

3.5.1 Deep trench installations are defined as those with depth equal to or greater than 5.0m finished grade to pipe invert.

3.5.2 Deep Trench Excavation

.1 Unless otherwise noted, excavate trench in accordance with the requirements elsewhere in this section.

.2 Separate the excavated insitu material, by stock piling in a convenient location adjacent to the trench excavation, to the satisfaction of the Engineer.

.3 Separate excavated insitu materials by primary classifications, such as clay, silty clay, silt, silty sand and sand.

3.5.3 Deep Trench Backfill

.1 Unless otherwise noted, backfill trench in accordance with the requirements elsewhere in this section.

.2 Replace and compact the insitu material in the reverse order of removal, to the satisfaction of the Engineer.

.3 Compacted thickness of trench backfill not to exceed 150 mm per lift unless the Engineer specifically advises otherwise.

.4 Moisture condition backfill as required to achieve the density requirements.

1.0 GENERAL

1.1 Work Included

1.1.1 This section refers to the supply and installation of watermain piping, fittings and appurtenances.

1.2 Submittals

1.2.1 Submit shop drawings in accordance with the Section 01300 - Submittals.

1.2.2 Provide marked up field record drawings and sketches as necessary for the Engineer to produce accurate, complete office record drawings.

1.2.3 Provide detailed operating and maintenance instructions for all equipment installed.

1.2.4 For watermain valves, fittings, couplings, adaptors provide complete descriptions including specific model numbers, materials, end connection types and adaptive outside diameters. For pipes include specific material, class or dimension ratio, manufacturer identification code as it appears stamped on the pipe or supplier's invoice.

1.2.5 Provide detailed lists of any special or proprietary tools or equipment which are required to assemble, disassemble, operate or maintain any device installed on this project.

1.3 Scheduling of Work

1.3.1 Schedule and co-ordinate all work to minimize disruption to existing services.

1.3.2 Submit a proposed work schedule as may be stipulated within the Special Provisions.

1.3.3 Comply with any special service interruption or other scheduling requirements stipulated within the Special Provisions.

1.4 Testing of Materials

1.4.1 Provide necessary samples and bear all costs for testing of materials or provide certified test results for materials to be employed.

1.5 Handling and Storage of Materials

1.5.1 Provide all handling and storage facilities for materials as recommended by the manufacturer.

1.5.2 Seal both ends of each pipe length to prevent contamination during pipe transportation and storage. Use an ultra violet stable material having a minimum thickness of 0.15mm (6 mils). Install covers immediately following the pressure testing of the pipe at the manufacturing plant

1.5.4 Do not use PVC pipe that is more than 24 months old.

2.0 PRODUCTS

2.1 Pipe

2.1.1 Polyvinyl Chloride (PVC)

.1 Sizes 300mm and smaller - pipe certified to CSA B137.3 and NSF 61 and conforming in all respects to AWWA C900 latest edition Class 150 pipe.

.2 Sizes 350mm and larger - pipe certified to CSA B137.3 and NSF 61 and conforming to AWWA C905 latest edition for cast-iron outside diameter (C.I.O.D.), DR25 pipe or as may be amended by the Special Provisions.

.3 Gaskets shall be standard gaskets recommended for typical watermain applications where cast iron sized pipe is being used. Nitrile gaskets shall be used for watermains buried in soil with hydrocarbon contamination.

.4 Push-On joint gasket lubricant acceptable to the pipe manufacturer shall be non-toxic, water soluble and approved for use in contact with potable water by the National Sanitation Foundation (NSF).

.5 Approved pipe manufacturers are:

- IPEX
- Royal Pipe Systems
- Rehau
- approved alternate

.6 PVC double bell end pipe certified to CSA B137.3 and conforming in all respects to AWWA C900 latest edition for Class 150 pipe. Manufacture pipe with integral wall thickened bell ends complete with factory installed gaskets in one continuous process. Modification of normal bell and spigot pipe to double bell pipe is not allowed.

.1 Pipe laying lengths of 3.05 or 6.1 metres.

.2 Bell ends machined to ensure right angles with the inside and outside walls of the pipe and uniform contact between adjoining double bell end pipes.

.3 Short lengths of PVC pipe to act as connection spools for joining double bell end pipe sections. Length of connection spools to be twice the normal insertion length for spigot end of standard bell and spigot pipe. Bevel on both ends of spools to be standard 15º chamfer angle. Insertion stop mark on the end of each connection spool.

2.1.2 High Density Polyethylene (HDPE)

.1 Pipe certified by the manufacturer as having been produced from raw resin which meets or exceeds the requirements of ASTM D-1248 for Type III, Class C, Category 5, Grade P34 Polyethylene Material and which qualifies as a PE3408 material by the method of determining and validating the Long Term Hydrostatic Stress (LTHS) of the Plastic Pipe Institute. Without compromising the foregoing, provide pipe of iron pipe sizing configuration (IPS) in conformance with ASTM F714 and to AWWA C906 latest edition.

.2 75mm and smaller - Dimension Ratio (DR) 11.

.3 Greater than 75mm - refer to special provisions.

.4 Use of this pipe will be approved only on a location by location basis and will not be approved in locations where service connection are or may be required.

2.1.3 Steel Pipe

.1 Sizes 50mm and smaller - pipe which conforms to ASTM A53B, seamless or welded, Schedule 80.

.2 Sizes 65mm through 600mm - mill pipe produced as double submerged arc spiral weld or ERW, standard weight, manufactured to CSA CAN3-Z245.1-latest edition or ASTM A53B and having a maximum yield stress of 317 MPa.

.3 650mm and larger – Double submerged arc weld (DSAW), spiral weld mill pipe, 9.5mm wall thickness, manufactured to CSA CAN3-Z245.1 latest edition or ASTM A53B and having a maximum yield stress of 317 MPa.

2.1.4 Concrete Cylinder Pipe

.1 Where this pipe is required it will be definitively specified in the Special Provisions.

2.2 Fittings

2.2.1 Cast Iron

.1 Cast or ductile iron conforming to the latest edition of AWWA/ANSI C110 and complete with integral tie rod lugs. Where fittings are used with mechanical joint restraints, ensure that the lug pattern on the fittings is compatible with the lug pattern of the restraint manufacturer being used.

.2 Push-on joint fully compatible with the pipe being joined and having a working pressure rating of 1.74 MPa (250 psi).

.3 Gasket material suitable for potable water in accordance with AWWA C111-latest edition.

.4 Exterior asphaltic coated per AWWA/ANSI C110, Latest Edition.

.5 Interior lined to a minimum thickness of 400 microns (16 mils) using products and procedures which meet or exceed the interior lining requirements for buried steel pipe outlined elsewhere in this section.

2.2.2 PVC

.1 200mm and smaller - injection-moulded PVC tees, crosses, wyes and bends certified to CSA B137.2 latest revision and in full compliance with AWWA C907 latest revision for a working pressure of 1500 Kpa (220 psi).

.2 Fittings shall be manufactured by IPEX Inc. or Harrington Corporation (HARCO) or approved equal.

2.2.3 HDPE Pipe Fittings

.1 Moulded HDPE, sizes as available, manufactured in accordance with ASTM D2683 for socket type or ASTM D3261 for butt fusion type and all in accordance with ANSI/AWWA C906 Latest Edition. Fitting pressure rating must be at least equivalent to the pipe to which it is being attached.

.2 Backing flanges to be ductile iron epoxy coated or minimum grade 304 passivated stainless steel.

.3 Fabricated HDPE fittings are not acceptable.

2.2.4 Steel Pipe Fittings

.1 Sizes 50mm and smaller - threaded 300 LB. banded malleable iron conforming to ANSI B16.3.

.2 Sizes 65mm through 750mm - standard weight, butt welding type conforming to ASTM A234, Gr. WPB. Grooved or fabricated fittings only where called for on the drawing(s).

.3 Flanges sizes 100mm through 750mm - 150 lb. forged steel, weld neck type conforming to ANSI B16.5, material to ASTM A105-1 or A181-1. Flat-Faced when mating to cast iron fittings/valves or wafer bodied valves.

2.2.5 Joint Restraints

.1 Restraint devices shall incorporate a series of machined serrations on the inside diameter to provide proper restraint and contact with the pipe.

.2 Restraint bodies shall be manufactured of high strength Ductile Iron, ASTM A356, Grade 64-45-2.

.3 Bolts shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11.
.4 Restraint systems shall meet or exceed the requirements of UNI-B-13-92.
.5 Models 1300, 1350, 1360 and 1390 as manufactured by Uni-Flange or approved equal.

2.3 Thread Compound

2.3.1 Teflon tape or a Teflon based liquid approved for use in contact with potable water by the National Sanitation Foundation (NSF).

2.4 Nuts and Bolts

2.4.1 Stainless steel bolts and nuts on direct buried or submerged applications conforming to ASTM A193 Grade B8 or B8M.

2.4.2 Exposed service - carbon steel bolts conforming to ASTM A193 Grade B7. Carbon steel nuts conforming to ASTM A194 Grade 2H, semi-finished hex head. Bolts and nuts to be electroplated with zinc per ASTM B633-latest edition, Type I coating. Hot dip galvanizing is not acceptable.

2.5 Steel Pipe Coating/Lining

2.5.1 Interior Lining
.1 Standard
.1 All materials to be approved for direct contact with potable water by the National Sanitation Foundation - Standard NSF61
.2 Exposed pipe 300mm and smaller - none required.
.3 Exposed pipe 350mm and larger and buried pipe 100mm and larger:
.1 Finished system – materials and procedures to meet or exceed the requirements of AWWA C210-latest edition.
.2 Lining Materials
.1 Liquid, chemically cured epoxies
.2 Curing agents: amine, amine-adduct or polyamide.
.3 Epoxy modifiers: coal tar, phenolic or other acceptable modifier.
.4 Weldable primer for cutback areas as recommended by the lining manufacturer.
.5 All materials to be from one manufacturer.

.4 Shop apply lining in strict accordance with the manufacturer's recommendations for: surface cleaning and preparation; atmospheric conditions, product preparation, application equipment requirements and curing times and conditions. Without limiting the foregoing, re-blast surfaces which exhibit unsatisfactory finish or flaws such as burrs or slivers after initial blast cleaning. Remove flaws by grinding or filing prior to re-blasting.

.5 Provide a finished lining system having a minimum finished dry film thickness of at least 400 microns (16 mils). Apply multiple coats of products having a solids content of 75% or less unless a single coat, pinhole-free finish is guaranteed by the manufacturer or applicator for the product being used. Finished lining color to be white or near white.

.6 Preferred system 80% solids, heavy duty epoxy, ICI Devoe Bar-Rust 233H or as approved.

2.5.2 Exterior Coating

.1 Exposed Pipe - finish exterior in accordance with relevant section(s) for painting or as specified in the Special Provisions.

.2 Buried Pipe 900mm and smaller- standard system:

.1 External continuous sheath of extruded polyethylene covering "yellowjacket" specification YJ1 as supplied and installed by Shaw Pipe Protection. Grind smooth welded joints and cover with CANUSA or equivalent heat shrink sleeves or tape. Cutback of covering on pipe ends to be 75mm.

.3 Buried Pipe 900mm and smaller - 0ptional system.

.1 Use on pipe 900mm and smaller only with the approval of the Engineer.

.2 Standard system for pipe larger than 900mm.

.1 Minimum three layer polyolefin tape coating system conforming to or exceeding the requirements of AWWA C214-latest edition and having a minimum finished thickness of 50 mils for a machine applied system or 70 mils for a hand applied system.

.2 First layer – liquid adhesive primer.

.3 Second layer-tape layer for corrosion protection

.4 Outer layer-tape for mechanical protection.

.3 Standards

.1 Pipe surface preparation and coating application to meet or exceed the coating manufacturer’s recommendations. Apply tape systems with a minimum spiral overlap of 12.5mm (0.5”).

.2 Inner layer tape backing material to be polyolefin only containing greater than 1% but less than 3.5% by weight of nonpolyolefinic material consisting of carbon black and antioxidants.

.3 Outer tape backing material to be polyolefin only containing greater than 3% but less than 7% by weight of nonpolyolefinic material consisting of pigments, antioxidants and stabilizers.

2.6 Couplings and Adaptors

2.6.1 For coupling 200mm diameter or less PVC to PVC or PVC to asbestos-cement pipe use moulded PVC couplings originally produced under the certification of CSA B137.2. For PVC to asbestos-cement use these couplings as modified by the manufacturer to adapt to the asbestos cement pipe OD while still retaining full test pressure capability. Couplings to be manufactured by IPEX Inc., HARCO or approved equal.

2.6.2 For pipe sizes larger than 200mm use a compression sleeve coupling to join asbestos cement pipe to steel pipe, PVC pipe to steel pipe, steel pipe to steel pipe or PVC to PVC. Couplings to have a rigid steel or ductile iron center sleeve sized to suit the pipe types and to provide a water tight compressive gasket seal on each pipe. Coupling design and construction methods and materials must or exceed all requirements of the latest edition of AWWA C219 and all additional requirements specified in these documents. Unless otherwise specified, coupling design working pressure to be at least 1050 kPa (150 psi) with a minimum safety factor of 2.0 using the minimum yield stress of the material used.

.1 For exposed locations:

Interior lining - minimum 300 microns (12 mils) epoxy NSF approved for direct contact with potable water. Preferred colour, white or off white.

Exterior coating - lead free, rust inhibitive prime coat compatible with final paint system specified.

Nuts and bolts - stainless steel or alloy steel, zinc plated to ASTM B633, Type I (not galvanized), material per AWWA C219.

.2 For direct buried submerged locations:

Interior lining - as above

Exterior Coating - minimum 300 microns (12 mils) epoxy as recommended by the coating manufacturer for the service. Coating must be NSF potable approved if submerged in potable water.

Nuts and bolts - stainless steel material either per AWWA C219 or as specified elsewhere in this section.

2.6.3 Compression sleeve couplers as manufactured by Smith-Blair, Robar, Romac, Dresser, Mueller "MaxiFit" or Canada Pipeline Accessories.

2.7 Valves

2.7.1 Gate Valves - 75 to 600mm inclusive to be iron body, resilient seated with materials, manufacturing and performance in full compliance with the latest edition of AWWA 509.

.1 End connections and operators to be fully compatible with the service, location of installation and pipe to which the valve is being attached.

.2 Direct buried valves to have a non-rising stem with a 50mm sq. AWWA standard wrench nut and open with a counter clockwise rotation.

.3 Direct buried valves to have stainless steel bolting and exterior asphaltic or fusion bonded epoxy coating suitable for direct bury service.

.4 All bronze or brass components to conform to Section 2, Table 1, Grade A, D or E with stem material of Grade E as published within AWWA C509 latest edition.

.5 Approved manufacturers:
- Mueller
- Clow
- As approved

2.7.2 Butterfly Valves

.1 For sizes 75mm to 500mm - resilient seated wafer body constructed as follows:

.1 Body - cast or ductile iron

.2 Disc - aluminium bronze or nickel edged cast iron

.3 Stem - Grade 316 Stainless Steel shall be a minimum of 300mm below ground elevation to prevent heavy loads being transmitted to the curb stop. Curb stops shall be left closed.

.4 Stem Fasteners - 316 stainless or 17-4 pH stainless.

.5 Seat - EPDM or BUNA-N

.6 Shaft seal - double 'U' cup or double 'O' ring

.7 Hydrostatic test capability which meets or exceeds ANSI 150 and a certified bubble tight differential working pressure rating of at least 1050 kPa (150 psi)

.2 For sizes 600mm and larger - same as valves sizes 75mm to 500mm with the following revisions:

.1 Body - cast of ductile iron through tapped flange wafer body.

.2 Meet or exceed the performance requirements of ANSI/AWWA C504 and CSA B16.1.

.3 Operators - Buried or Vault installation

.1 All buried valves and all valves 150mm and larger installed in valve vaults to be equipped with an enclosed, sealed and grease packed gear operator with stainless steel bolting and epoxy coating. Operators sized for a maximum 27.5 kg rimpull assuming a 600mm diameter handwheel. Valve vaults smaller that 150mm to be equipped with notch plate type lever operator.

.4 Operators - Exposed Service

.1 All valves 150mm and larger standard enclosed type gear actuator with a handwheel operator. Actuators sized per 2.7.2.3.1. Valves smaller than 150mm to be equipped with notch plate type lever operator.

.5 Butterfly Valve Manufacturers

- K-Flo Wolverine Series 500 and Series 47
- DeZurik - RS632
- Mueller/Pratt – Groundhog
- As approved

2.8 Flange Gaskets

2.8.1 Flange gaskets to be cloth inserted red rubber or other material conforming to the latest edition of AWWA C207 and approved for use with potable water.

2.8.2 Ring type gaskets for raised face flanges

2.8.3 Full face gaskets for flat-faced surfaces

2.8.4 Gasket thicknesses as follow:

.1 100mm to 600mm - 1.6mm thick.

.2 750mm to 1800mm - 3.2mm thick

2.8.5 Where petrolatum primer may be in contact with gasketed fittings, gaskets shall be BUNA-N, NEOPRENE or as recommended by the pipe manufacturer.

2.9 Valve Boxes and Covers

2.9.1 127 I.D. x 6 W.T. Schedule 40 PVC lower section as manufactured by IPEX Inc. or approved equal**.**

2.9.2 1200 or 760 long x 150 I.D. x 11 W.T. “Type A” cast iron upper valve box section and appurtenances as detailed on Std. Dwg. W-01.

2.9.3 Cast iron upper valve box, covers, extensions and lifter rings as manufactured by:
- Titan Foundries
- Norwood Foundries
- WD Valve Boxes Ltd.
- Sigma Corporation
- approved equal

2.10 Hydrants

2.10.1 Dry-barrel, compression type hydrants which are designed, manufactured and tested in full compliance with the latest edition of AWWA C502.

2.10.2 Pentagonal operating nut and nozzle cap nuts which open counter clockwise. Cap chains are not required.

2.10.3 Hydrants to have the following:
.1 Minimum 133mm diameter opening lower valve.
.2 Two (2) - 65mm x 6 threads per 25mm hose nozzle.
.3 One (1) – replaceable bronze pumper nozzle threaded to mate with and securely connect to City of Regina Fire Department pumper hose connection which is threaded 120.65mm (4.75") ODM x 5 threads per inch. Nozzle to have a preferred inside bore of 101.6mm (4.00") but is not to be less than 97.75mm (3.85").
.4 150mm bell inlet compatible with C900 Class 150 PVC pipes.
.5 Tapped drain outlet - 6mm NPT.
.6 Barrel length as required but to provide a minimum of 2.3m bury to top of inlet.
.7 Breakaway style flange and mainstem.
.8 Permanently lubricated stem thread (stuffing box construction is not acceptable).

2.10.4 Hydrant Finishes
.1 Finish on all exterior surfaces below the hydrant flange to be asphaltic coated as recommended by the coating manufacturer.
.2 Exterior finish colour - yellow to match City of Regina requirements.

2.10.5 Hydrant Manufacturers and models:
- Canada Valve – Century Model B-50-B-18
- Mueller – Modern Centurion
- Clow – Brigadier Series M-67
- approved alternative

2.11. Concrete for Thrust Blocks

2.11.1 Provide a Concrete Mix Design prior to the placement of any concrete.

2.11.2 Cement to conform to CSA A5, Type 50.

2.11.3 Air entraining admixtures to conform to CSA A266.1 and ASTM C494.

2.11.4 Water reducing admixtures to conform to CSA A222.2 and ASTM C494.

2.11.5 Retarding admixtures, which require approval for use, to conform to ASTM C494.

2.11.6 Minimum concrete design strength to be 20 MPa at 28 days. Higher design strength concrete may be substituted to obtain shorter curing time.

2.12 Puddle Flanges

2.12.1 Use minimum 6.35mm thick steel plate as puddle flange material with diameters as follows:

Pipe Diameter	Puddle Flange Diameter
75mm to 300mm	Pipe diameter plus 50mm
350mm to 550mm	Pipe diameter plus 100mm
600mm and larger	Pipe diameter plus 150mm

2.13 Sacrificial Anode Materials

2.13.1 Anode(s) to be 5.4 kg (12 lb.) packaged zinc anodes complete with #6 three metre lead.

2.13.2 Cadweld to be 25 gram “Erico” specification CS25XF-19 or as approved. A #6 copper sleeve crimped to anode lead is required prior to cadwelding. Cadweld mould “Erico” specification CAHBA-1H or as approved.

2.13.3 Eyelets to be 16mm (5/8”) or 20mm (3/4”) copper stud #6 cable eyelet.

3.0 EXECUTION

3.1 Trench Excavation and Backfill

3.1.1 Refer to Section 02315-Trench Excavation and Backfill. Carry out trench excavation and backfill in full compliance with that section.

3.1.2 Comply with all safety requirements of:
- .1 Local codes and bylaws.
- .2 *Occupational Health and Safety Act, 1993*
- .3 *National Building Code of Canada 1995*

3.1.3 Maintain trench excavation and bedding preparation a sufficient distance in front of the pipe installation operation to avoid interference with the pipe installation.

3.2 Pipe Installation

3.2.1 Obtain Engineer's approval of backfill and bedding materials and installation procedures prior to pipe installations.

3.2.2 Prevent dirt or other foreign material from entering installed pipe with temporary blocking.

3.2.3 Install pipe true to line and grade as staked by the Engineer to within 100mm horizontally and 50mm vertically.

3.2.4 Keep contamination protection cover on pipe ends until just prior to jointing to the previously installed pipe.

3.2.5 Handle, install and joint pipe in accordance with the manufacturer's instructions.

3.2.6 Install push-on joint pipe such that the spigot ends are inserted into bell ends.

3.2.7 Modify pipe ends to be installed into push-on fittings as recommended by the pipe manufacturer.

3.2.8 Clean pipe ends of all foreign materials and substances prior to joint makeup.

3.2.9 Remove any pipe, which has floated due to trench flooding and reinstall only after acceptable trench and bedding conditions have been re-established.

3.2.10 Provide any pipe or joint deflections required in a manner recommended by the pipe manufacturer and/or as approved by the Engineer.

3.2.11 Install all special structures such as air release valves, drains, blowoffs, hydrants, swabbing facilities and valve chambers at the locations indicated and in accordance with the contract documents.

3.2.12 Install, bed and backfill pipe such that deflection of pipe is within the manufacturers' tolerances for long term service.

3.2.13 Protect pipe and fittings from excessive exposure to direct sunlight or other damage. Replace any pipe or fittings which have become discoloured, cracked or otherwise marred or damaged.

3.2.14 Ensure proper operation of all fittings and appurtenances having moving parts both prior to and after installation.

3.3 Thrust Blocks

3.3.1 Provide only cast-in-place concrete thrust blocks that are sized and located as shown on Standard Drawing W-13 on all push-on and mechanical joint fittings.

3.3.2 Cut bearing soil wall to the proper angle for the fitting and ensure an undisturbed soil bearing face.

3.3.3 Obtain approval of the Engineer for all thrust block formwork prior to concrete placement.

3.3.4 Place a minimum 200 micron (8 mil) polyethylene sheet between the full contact face of the fitting and the thrust block.

3.3.5 Remove all wooden formwork prior to backfilling.

3.3.6 Use mechanical thrust restraint devices only with the approval of the Engineer.

3.3.7 Use mechanical thrust restraints or poured in place concrete thrust blocks with cast iron fittings. Use poured in place concrete thrust blocks only with PVC plugs and ends caps.

.1 Restrain all joints that fall within the lengths of horizontal pipes as shown on Standard Drawing W-14

.2 Restrain all joints that fall within the lengths of vertical of pipes as shown on Standard Drawing W-14.

.3 Restraints for appurtenances 400mm and larger as recommended by the manufacturer.

3.4 Connection to Existing Watermains

3.4.1 Adhere to the scheduling stipulations for service interruptions contained in these specifications.

3.4.2 Provide notice in accordance with Section 01510 to all customers whose water service will be interrupted by the connection. Standard notices may be obtained from the City of Regina, Engineering and Works Department.

3.4.3 Adhere to standard or special tie-in details contained in the contract documents and confirm acceptability with the Engineer prior to proceeding.

3.4.4 Carefully inspect exterior surface of asbestos cement pipe where couplers will contact the pipe. Ensure that the surface is free of pitting, cracks or other imperfections that could compromise proper sealing of the coupler gasket to the pipe surface.

3.4.5 In the event that the surface of asbestos cement pipe is judged to be questionable to provide proper sealing, replace the entire section of asbestos cement pipe with PVC pipe back to the first available joint at the direction of the Engineer.

3.4.6 Make good at no expense to the Owner all damages resulting from an unsuccessful tie-in or failure of materials installed to complete tie-in or damage to existing structures or works caused during performance of the tie-in.

3.5 Hydrant Installation

3.5.1 Install hydrants in accordance with Standard Drawing W-02.

3.5.2 Install hydrants and leads straight and plumb.

3.5.3 Install pumper nozzle facing the street.

3.5.4 Install hydrants such that the hydrant flange is 50mm above top of curb, walk or finished grade of lot as directed by the Engineer.

3.5.5 Install gate valve on all hydrant leads as shown on Drawing W-02

3.6 Valve Installation

3.6.1 Install valves in accordance with Standard Drawing W-01. Use slings manufactured of nylon or other suitable material for hoisting valves in and out of trench excavations.

3.6.2 Provide a valve box on each valve that is direct buried. Valve box to be installed straight and plumb.

3.6.3 Install PVC bottom section to within a maximum of 150mm of finished grade.

3.6.4 Minimum overlap between the top and bottom sections of the valve boxes shall be 150mm.

3.6.5 Install thrust blocks or mechanical thrust restraints at all valves.

3.7 Valve Box Adjustment

3.7.1 Where valve boxes are being rebuilt, constructed, raised or lowered and/or adjusted in conjunction with surface construction or renewal, adjust valve boxes in accordance with Section 2350 – Specification for the Placement of Asphaltic Concrete Surface Course or Full Depth Structure.

3.7.2 Adjust top section of valve box by excavating to below collar on bottom section of valve box and raising top section to finished grade. Minimum overlap between top and bottom sections shall be 150mm. If adjustment required is less than 75mm then “lifter rings” may be used (maximum of 1).

3.7.3 Place and compact granular material under collar of valve box to grade required.

3.7.4 Where top section of valve box cannot be raised use top extension piece.

3.8 Puddle Flanges

3.8.1 Provide a puddle flange at each point where a pipe passes through a buried concrete wall.

3.8.2 For pipes 65mm and smaller, use a full coupling as a puddle flange.

3.8.3 Provide continuously welded annular plates as puddle flanges on all pipes 75mm and larger.

3.8.4 Centre puddle flanges in walls unless directed otherwise.

3.8.5 Repair damage done to internal linings caused by welding of puddle flange. Remove any exterior pipe coatings, except galvanizing, from surface area which will be embedded in concrete or grout.

3.8.6 Fill new penetrations through existing walls or slabs with a non-shrink, non-metallic grout to within 25mm of the face of the surface. Fill the remaining depression with Portland Cement grout and finish neatly.

3.8.7 Provide proper atmospheric conditions for curing of grout as recommended by the grout manufacturer. Do not backfill or load grouted penetrations until curing is complete.

3.9 Corrosion Protection

3.9.1 Provide corrosion protection on all buried metallic objects. With the exception of hydrants, provide protection using a physical encapsulation system as specified in Section 02516. Use this method unless the air temperature at the time of installation is less than 5° C or, in the opinion of the Engineer, other conditions make its use impractical. In those instances only, use a sacrificial anode system to provide corrosion protection. Equip all hydrants with sacrificial anodes.

.1 Anode Installation

.1 Install anode(s) as shown on the applicable Standard Drawing.

.2 Securely crimp anode lead(s) to eyelet connectors when used.

.3 Re-torque hydrant bolts after eyelet connection is made.

.4 Prior to cadwelding, clean the metal surface to bare shiny metal by filing or grinding, Remove any dust and dry thoroughly.

.5 Cadwelding to be performed only by personnel who have been formally trained to carry out the procedure. Provide all required safety apparel and strictly adhere to all applicable safety procedures when carrying out this procedure.

.6 Remove slag from cadweld by tapping with a chipping hammer.

.7 After the weld has completely cooled apply a mastic protection system to the cadweld and adjacent areas affected by the procedure.

.8 Remove any plastic bags from zinc anodes. Cut slits in cardboard tubes.

.9 Install anodes as shown on Standard Drawings and pour water over anodes prior to backfilling.

.10 Ensure slack is left in anode leads so that they are not pulled out or damaged during backfilling.

1.0 GENERAL

1.1 Scope

1.1.1 The work covered by this section involves the installation of water and sewer service connections and all other associated work.

1.2 Authorization

1.2.1 Do not install service connections until written authorization, giving location and size of services required, has been obtained from the owner of the private property being serviced. Be responsible for confirming that this authorization has been given and, for ensuring that the services are installed as indicated.

1.3 Regulations

1.3.1 Install all services in compliance with regulations governing plumbing and drainage issued by Saskatchewan Health as well as City of Regina Building Bylaws and Standard Construction Specifications.

2.0 PRODUCT

2.1 Sewer Service Pipe

2.1.1 Sanitary and storm service connection pipe and fittings to be minimum 150mm nominal diameter and conform to the following specifications:
.1 Polyvinyl Chloride Pipe to ASTM D3034 - SDR35 and in full compliance with CSA B182.2.

2.2 Water Service Pipe

2.2.1 Piping for building water services shall be in accordance with the following table and be CSA certified:

Service Size (mm)	Material	Standard	Minimum Rating
All sizes 50 and smaller	Copper-Type K soft Drawn	CSA HC66 AWWA C800	1100 kPa (160 psi)
40,50	HDPE	AWWA C901 PE3408	1100kPa (160psi)
100mm and larger	Refer to Section 02511-Watermains		

2.2.2 When the property being serviced is to be used or has been used for the underground storage of petroleum products or other hazardous materials, approved water service pipe materials are Type K soft drawn copper or "Hyprotec" ductile iron (exterior coating – fibre reinforced, polymer concrete and interior cement mortar lined to AWWA standards.)

2.3 Water Service Appurtenances

2.3.1 Service Saddles

.1 Full circle type, constructed of fully passivated T304 stainless steel with BUNA-N or EPDM gaskets and T304 stainless steel bolts with rolled threads and nuts. ROBAR Series 2600 or as approved.

2.3.2 Repair Clamps

.1 Constructed of fully passivated T304 stainless steel with BUNA-N or EPDM gaskets and 304 stainless steel bolts with rolled threads and nuts. ROBAR Series 5600, ROMAC Style SS2 or as approved.

2.3.3 Unions

.1 Standard brass compression type, adaptable to the size and type of pipe used. Ford, Mueller, Cambridge Brass or as approved.

2.3.4 Curb Stops and Boxes

.1 50mm and smaller

.1 Bronze or brass body, stop and waste design, globe or ball valve style, with compression type end connections designed for the specific pipe type(s) being joined. Mueller Type H 15219, Mueller Type H15182, Ford Model B44, Cambridge Brass Model 203 or as approved.

.2 Curb boxes and top extensions - asphaltic dipped, Sch. 40 steel Pipe.

.3 Curb box covers - Mueller Type A808 ribbed cover complete with standard pentagon plug No. 143469 or as approved.

.4 Curb box rods - Type 304L stainless steel, 13mm diameter with standard pigtail to fit standard 25mm I.D. curb box.

.5 Cold forge u-shape complete with hole for brass cotter pin to fit 20mm to 50mm curb stops.

.2 100mm and larger

.1 Resilient seated gate valve complete with valve box as specified in Section 02511.

2.3.5 Corporation Stops

.1 Corporation stops shall be: Mueller Type H 15008, for sizes 25mm and smaller and 25008 for sizes 40mm and 50mm; Ford Model F1000 or FB1000; Cambridge Brass Model 301; or as approved. Standard brass or bronze construction with Mueller tapping thread and compression type joint compatible with type of pipe used.

.2 Corporation stops on service sizes 100mm and larger shall be resilient seated gate valves as specified in Section 02511 and shall be the same size as the service line.

2.3.6 Protective Tape Coating

.1 Petrolatum primer and cold applied petrolatum tape conforming to AWWA C217 latest edition - (Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipeline).

.2

Primer	Tape
Denso Paste	Densol
Polyken 927	Polyken 932
Trenton	Trenton Tec-Tape
PetroWrap Primer	PetroWrap LT
or as approved	

2.3.7 Gaskets as specified in Section 02511 - Watermains

2.3.8 Tapping Sleeves and Valves.

.1 Tapping sleeves - split body, full circle type with body, stub pipe and flange constructed of fully passivated T304 stainless steel with BUNA-N ringseal and BUNA-S liner. Inside diameter of outlet connection to be at least equivalent to that of standard weight steel pipe of the same nominal size. Sleeve bolts and nuts to be stainless steel to ASTM A193/A194-B8 or B8M. Threads to be teflon coated. Outlet flange 150lb ANSI, flat-faced. ROBAR Series 6606 or ROMAC SST or as approved.

.2 Tapping valves - resilient seated gate valve as specified in Section 02511, having a clear passage at least equivalent to the inside diameter of the connecting stub on the tapping sleeve being used and, certified by the manufacturer as suitable for use as a tapping valve.

2.4 Tapping Machine

2.4.1 Tap watermains using a Mueller Model B-100, Model B-101, Model A3, Ford Model 77 or as approved.

3.0 EXECUTION

3.1 Water Service Connections

3.1.1 Water services piping up to and including 50mm may be installed in a common trench with the sanitary sewer service line. It is desirable that a clear separation of at least 300mm is maintained between these lines.

3.1.2 Water service piping larger than 50mm must be installed in a separate trench from the sewer service pipe. Maintain a minimum clear separation of 1.0 metres of undisturbed soil between these lines.

3.1.3 Whenever common trenched service lines must be installed at different elevations, install the higher service on a shelf of undisturbed ground. If shelving the higher service line is not possible, re-establish the foundation of the higher utility with compacted backfill.

3.1.4 Construct services to the end lots on a dead end main by tapping each service to the water main as shown on Standard Drawing W-19.

3.1.5 Leave trenches open until connections up to and including those 25mm in diameter have been completed and visually inspected while they are under pressure. Ensure corporation stops are in the open position before backfilling.

3.1.6 Install residential service connections on the property line at the locations shown on the drawings. Install a short length of copper pipe on the private side of the curb stop and crimp. Install services to existing buildings along a line that will best suit the interior plumbing. Provide a gooseneck with a minimum radius of 600mm immediately adjacent to the corporation stop on all service connections 40mm and smaller. Refer to Standard Drawing W-17 for arrangement details.

3.1.7 Unless otherwise specified, tap corporation stops into the watermain using an approved tapping machine while the main is under normal operating pressure,. After completion of each tapping connection, backfill to 75mm above the top of the gooseneck with material as specified in Section 02315-Trench Excavation and Backfill.

3.1.8 For valves 100mm and larger installed as corporation stops, provide and install a lower section of PVC valve box on the valve and cut it off at 600mm below finished surface. Suitably cap the PVC section. Thoroughly encapsulate the valve except the operating nut.

3.1.9 Provide minimum 2.7m of cover over the full length of service lines.

3.2 Tapping Watermains

3.2.1 Conditions for Tapping Asbestos Cement Pipe
- .1 Use an approved tapping sleeve.
- .2 Tapping size shall be at least two (2) nominal pipe sizes smaller than the watermain being connected to.

3.2.2 Conditions for Tapping Ductile Iron, Cast Iron or Steel Pipe

.1 Where tapping of ductile iron, cast iron, or steel pipe is required, it will either be definitively specified in the Special Provisions or as directed by the Engineer.

3.2.3 Conditions for Tapping PVC Pipe
.1 Use an approved tapping sleeve.
.2 Tapping size used on PVC pipe shall be at least one (1) nominal pipe size smaller than the watermain being connected to.

PVC					
DR18 PVC Pipe (mm)	150	200	250	300	400
Tap Size (mm)	TAPPING METHOD				
20	1	1	1	1	1
25	1	1	1	1	1
40	2	2	2	2	2
50	2	2	2	2	2
100	3	3	3	3	3

Where: 1 = Direct tap
2 = Tap through an approved service saddle
3 = Tap through an approved tapping sleeve

3.3 Protective Tape Coating

3.3.1 Surface shall be clean, dry and at least 5º C before any coating materials are applied.

3.3.2 Store, handle and apply coating materials according to the manufacturer instructions and climatic and substrate condition requirements.

3.4 Service Pipe Positioning

3.4.1 Position the service pipe in the trench as follows when facing the building.

Left	Centre	Right
Storm	Domestic	Water

3.5 Sewer Service Installation

3.5.1 Minimum acceptable continuous grade for 150mm sewer service pipe is 10mm/metre (1.0%).

3.5.2 Whenever sewer service pipe is installed but not connected to the sewer service from the building, plug the pipe with an approved watertight plug.

3.5.3 Connect to the sewer main with tees or wye branches installed during construction of the sewer main.

3.6 Sewer Service Connections to Existing Mains

3.6.1 Make new connections by tapping into the upper half of the sewer main and installing a tee or wye saddle. Ensure the existing sewer main is not fractured by the tapping operation. Remove all broken pipe, mortar and debris from inside the sewermain.

3.6.2 Make holes for tee or wye saddles approximately 10mm larger than the outside diameter of the service pipe to ensure a snug fit in the hole.

3.6.3 Connect fitting saddles to the main with stainless steel straps and clamps.

3.7 Water Service

3.7.1 Direct Tapping of Watermain with Corporation Stops–50mm and smaller

.1 Refer to Standard Drawing W-17. Install the corporation stop in the top quadrant of the watermain at an angle of between 30° to 60° above the horizontal unless noted otherwise.

.2 Do not tap corporation stops into watermains within 600mm of a pipe joint, fitting or valve. Space multiple taps a minimum of 450mm on centre.

.3 Tighten corporation stops into asbestos-cement and ductile iron watermains with 70 to 80 Newton-meters of torque with 1 to 3 threads showing. Tighten corporation stops into PVC watermains (cast iron O.D. only) with 35 to 40 Newton-Meters of torque.

.4 Wrap the thread of the corporation stops used on PVC and ductile iron watermains with three to four wrappings of teflon pipe thread tape before installation of the corporation stop.

3.8 Curb Stops

3.8.1 On services 50mm and smaller install a curb stop and waste at the property line. On services 100mm and larger, install a resilient seated gate valve at the property line.

3.8.2 Install curb stop and waste valves with the drain port on the private property side, extend a short length of copper pipe from it and crimp the end. Refer to Standard Drawing W-17.

3.8.3 Install services to existing buildings along a line that will best suit the interior plumbing.

3.8.4 Support each curb stop and waste on a 75mm x 200mm x 250mm concrete block as shown on Standard Drawing W-17. Install gate valves as shown on

Standard Drawings W-01 and W-15.

3.8.5 In fine-grained or clay soils construct a $0.2m^3$ volume drainage sump below and around each curb stop and waste.

3.8.6 When curb stops or valves are installed and the boxes are to be installed later, mark the curb stop or valve above ground as shown on Standard Drawing W-17.

3.8.7 Adequately secure the curb extension rod to each curb stop and waste. Set the service box plumb with the upper sections of the service box adjusted to grade elevation. Install the lower section of the service box and the extension rod a minimum 300mm below ground elevation to prevent heavy loads being transmitted to the curb stop. Leave the curb stops closed.

3.9 Water Service - Multi-Unit Buildings

3.9.1 Install water services to multiple unit buildings as shown on Standard Drawing W-19.

3.9.2 Install a curb stop and waste complete with box on each individual service connection at 2.5 metres inside the property line and with a minimum of 500mm between each service. Multiple service lines and curb stops may be deleted if water meters and shut off valves are located in a common room, not accessible to the public, in accordance with the *Water Bylaw*.

3.10 Utility Services - Underground Tank Storage Sites

3.10.1 Install a trench plug of impermeable plug of bentonite clay or other approved material as shown on Standard Drawing S-28. Plug to be not less than the width of the utility trench at the property line on all utility service trenches on all properties used for the underground storage of liquid hazardous materials and/or petroleum products. Utility services include domestic and storm sewers, water connections, natural gas piping, telephone and cable.

1.0 GENERAL

1.1 Scope

1.1.1 This section refers to the hydrostatic testing of all new and modified watermains.

1.2 Definitions

1.2.1 Leakage is defined as the amount of water required to maintain the test pressure in the mains over the duration of the test period.

1.2.2 Pressure test is the process to locate defects in material or workmanship, thereby permitting proper repair.

1.2.3 Leakage test is to establish that the section of line tested, including all joints, fittings and other appurtenances will not leak or that leakage is within the limits of the applicable allowance.

2.0 PRODUCTS

2.1 Supply all necessary labour, materials and equipment for the tests.

2.2 Provide evidence that pressure gauges used for watermain tests have been calibrated within current calendar year prior to undertaking the tests.

3.0 EXECUTION

3.1 Water used for disinfection of watermains may be used for leakage test.

3.2 Complete watermain leakage test prior to the installation of service connections.

3.3 Notify the Engineer at least twenty-four (24) hours in advance of all proposed tests. Perform tests in the presence of the Engineer.

3.4 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.

3.5 Control rate of filling of pipes to a velocity of less than 0.45m/sec (1.5 ft/sec).

3.6 Prior to pressure testing ensure that thrust blocks attain minimum 15 Mpa compressive strength.

3.7 Ensure that all air is purged from the watermain before performing leakage or pressure tests on the system.

3.8 For pipe materials other than PVC or HDPE, calculate leakage from formulas in the appropriate sections of AWWA Standards for that type of pipe.

3.9 If the leakage exceeds the allowable, locate and repair leaks and defects. Repeat the test after repairs until the leakage does not exceed the allowable. Visible leaks must be repaired even when the leakage is below the allowable limits.

3.10 Where new watermain sections cannot be isolated from existing mains, the Contractor may apply to the Engineer to establish an alternate test pressure or have the leakage-testing requirement waived. Warranty obligations of the Contractor remain fully in effect in either event.

3.11 Disinfection and coliform bacteria test requirements are covered in Section **02519** - Disinfection and Flushing of Watermains.

3.12 Testing

3.12.1 Leakage Test - PVC Pipe

.1 After backfilling is completed, carry out leakage test on all PVC watermains at an initial test pressure of 692 kPa (100 psi).

.2 Maintain test pressure for at least one hour. At the end of one hour, repressurize the main to 692 kPa with water pumped from a tank. Measure the amount of water used to repressurize the main to the initial test pressure to determine the leakage in the test section. The test will not be accepted if the leakage exceeds the quantity determined by the following formula from the latest edition of AWWA C605.

for PVC Pipe $L = \frac{ND\sqrt{P}}{130,400}$

L = the allowable leakage (litres per hour)
N = number of joints in the pipeline tested
D = nominal diameter of the pipe (mm)
P = the average test pressure during leakage tests in kilopascals (kPa)

3.12.2 Pressure Testing - High Density Polyethylene (HDPE) Pipe

.1 Pressure test all HDPE pipes, couplings, joints and other appurtenances under a hydrostatic pressure in compliance with ANSI/AWWA C906 latest edition.

.2 Test pressure shall be 692 kPa (100 psi).

.3 Testing with compressed air is strictly forbidden.

.4 Begin test after completion of backfilling and at least 7 days after the last concrete bearing pad has been cast.

.5 Expose all mechanical joints for visual inspection during testing.

.2 The test shall consist of two parts:
- .1 Initial Expansion Phase
  - .1 After the initial pressurization of the pipe add sufficient make-up water at hourly intervals to return the pipe to the original test pressure.
  - .2 Repeat pressurization a maximum of three times after the original pressurization of the pipe.
  - .3 Test Period
    - .1 After completion of the expansion phase (3 hours after initial pressurization) begin the pressure test.
    - .2 Test period shall not exceed three hours.
    - .3 The total time under test shall not exceed 8 hours at 692 kPa. If the test is not completed within this time frame, the test section shall be permitted to "relax" for an additional 8-hour period prior to starting the next test sequence.
    - .4 At the end of the test period repressurize the pipe to the original test pressure. Measure the amount of water required to repressurize the system. The amount of water shall not exceed the allowance shown in the following table for the size of pipe being tested.

ALLOWANCE FOR EXPANSION (litres per 30.5m of pipe @23°C)
HIGH DENSITY POLYETHYLENE PIPE

Nominal Pipe Size (mm)	1 Hour Test	2 Hour Test	3 Hour Test
150	1.14	2.27	3.40
125	0.81	1.61	2.46
200	1.89	3.78	5.68
250	2.65	4.92	7.94
300	4.16	8.70	12.87
350	5.30	10.22	15.88
400	10.22	12.49	18.92

1.0 GENERAL

1.1 Scope

1.1.1 This section presents requirements and procedures for disinfecting, flushing and bacteriological testing of all new or modified watermain and, existing watermain that is depressurized for any reason, excluding only emergency repairs, before it may be put into service or returned to service.

1.2 Bacteriological Sampling Requirements

1.2.1 As stipulated by Saskatchewan Environment, a minimum of two (2) sets of three (3) bacteriological samples must be taken from the watermain and submitted to the Provincial Water Laboratory.

1.2.2 Each set of three (3) samples must be taken and submitted a minimum of 24 hours apart. Wherever practicable, samples are to be collected from different points along the watermain section.

1.2.3 Watermain may not be placed into service or returned to service until two consecutive sets of three samples have been analyzed and all found to be acceptable.

1.2.4 If a positive (unacceptable) test result occurs in both of the two consecutive sets of samples, then repeat of disinfection, flushing and sampling procedures is required.

2.0 PRODUCT

2.1 Disinfection Chemical dry form

2.1.1 Calcium hypochlorite tablets, manufactured to the requirements of AWWA B300 - latest revision and having seventy percent (70%) available chlorine by weight.

2.1.2 Olin Matheson HTH-70 or approved equal.

2.2 Disinfection Chemical liquid form

2.2.1 Sodium hypochlorite manufactured to AWWA B300 - latest revision and having 5 to 15 percent available chlorine by volume. Care must be taken to control conditions and length of storage to minimize its deterioration.

2.3 Adhesive

2.3.1 Waterproof, food grade, one component glue, compatible with disinfection chemical, "Permatex Form-A-Gasket No. 2", "Permatex Clear RTV Silicon Adhesive Sealant", or approved equal.

3.0 EXECUTION

3.1 General

3.1.1 Disinfect new watermains and any new branch connections to the requirements of AWWA C651. Become familiar with and strictly adhere to all safety requirements relating to the handling of concentrated chlorine chemicals and solution.

3.1.2 Caution - do not use calcium hypochlorite in powder form in PVC piping as an explosive reaction may result. Use of this chemical in tablet or solution form is safe in PVC piping.

3.1.3 Attach calcium hypochlorite tablets to the inside top surface of the pipe or fitting. Apply adhesive to only one surface of the tablet.

3.1.4 The number of 5g tablets required per 6.0m length of pipe for each size of pipe is shown on the following list:

- 150mm diameter pipe - 2 tablets
- 200mm diameter pipe - 2 tablets
- 250mm diameter pipe - 3 tablets
- 300mm diameter pipe - 4 tablets
- 350mm diameter pipe - 5 tablets
- 400mm diameter pipe - 7 tablets
- 450mm diameter pipe - 8 tablets
- 500mm diameter pipe - 10 tablets
- 600mm diameter pipe - 14 tablets

NOTE: The ‘tablet method’ described in AWWA C651 may not be used in pipes larger than 600mm. Use either the continuous feed or slug flow methods for pipes larger than 600mm.

3.1.5 Protect installed tablets from moisture.

3.1.6 For the use of sodium hypochlorite liquid, submit a detailed written procedure to the Engineer for review at least two working days prior to date of disinfection. The submission must describe proposed equipment and procedures. Ensure full compliance with all provisions within the latest edition of AWWA C651.

3.1.7 Inject the sodium hypochlorite solution as near as possible to the tie-in(s) to the existing system as the pipe is being filled.

3.1.8 Provide minimum 20mm injection and/or discharge points where there are no existing facilities within 3.0m of the terminal points of the main(s) to be disinfected. Use corporation stops as specified in Section 02516 for these points. Close and cap stops after use.

3.1.9 Employ a shorter contact time using a higher chlorine dosage where, in the opinion of the Engineer, conditions make the 24-hour contact time impractical or unmanageable. Alternate dosage/contact time options are described in AWWA C651. Submit a detailed written description for use of an alternate option to the Engineer for review and approval prior to date of disinfection. Obtain approval from Saskatchewan Environment (SE) regarding proposed disposal processes and locations.

3.1.10 Following the contact period, ensure operation of all valves and hydrants on the main to ensure that all parts have been in contact with the chlorine solution. Only City of Regina personnel may operate existing valves and hydrants

3.2 Disinfection Methods and Requirements

3.2.1 Tablet Method

.1 Slowly fill main to be disinfected with water. Try to limit fill velocity to less than 0.3 m/s (1.0 ft/sec).

.2 Once the section to be disinfected is confirmed as being full of water, discontinue filling and leave the main in a static condition for at least one hour if the water temperature is over 5°°C and two hours if the water temperature is below 5°°C. At the end of this time period obtain a sample from a location on the main close to where the fill water was introduced and a second location at the end furthest from that point. Demonstrate that a minimum 25 mg/l residual concentration has been achieved at both locations.

.3 Maintain the high strength solution in the main for at least 24 hours if the water temperature is above 5°°C and at least 48 hours if the water temperature is less than 5°C.

.4 At the end of the contact period obtain a sample at each of the previous locations. A minimum 10 mg/l residual must be present at both locations or the disinfection must be repeated.

.5 After successful disinfection, flush the main to waste until the chlorine residual reading is less than 1.0 mg/l. Comply with all requirements for dechlorinating the flushing water being discharged.

3.2.2 Continuous Feed Method

.1 Flush to waste the section of main to be disinfected using chlorinated, potable quality water. Flush at a flowrate that will achieve a velocity of at least 0.75 m/s (2.5 ft/sec). Use a volume of water that is at least equivalent to the volume contained in the section to be disinfected.

.2 Continue to flush to waste, slow the flow of water through the main to less than 0.3 m/s (1.0 ft/sec) and begin to introduce high strength disinfection solution into the main at the water inlet end.

.3 Continue the flow and disinfection solution introduction and conduct frequent residual tests on the water being discharged until the residual reading achieved is a minimum of 25 mg/l. Ensure that the water being discharged is dechlorinated as required while waiting for the required residual to reach the discharge point.

.4 Maintain the high strength solution in the main for at least 24 hours if the water temperature is above 5°°C and at least 48 hours if the water temperature is less than 5°C.

.5 At the end of the contact period obtain a sample at each of the previous locations. A minimum 10 mg/l residual must be present at both locations or the disinfection must be repeated.

.6 After successful disinfection, flush the main to waste until the chlorine residual reading is less than 1.0 mg/l. Comply with all requirements for dechlorinating the flushing water being discharged.

3.2.3 Slug Method

.1 Use this method only with the pre-approval of the Engineer. Prepare and submit a detailed plan to the Engineer for the use of this method.

3.3 Watermain Disinfection, Flushing and Sampling

3.3.1 Water for Disinfection and High Level Testing

.1 The initial fill of water for watermain flush and/or disinfection will be supplied by the Owner at no cost to the Contractor. However, any subsequent volume required due to failure to meet the requirements of the disinfection or hydrostatic tests will be charged to the Contractor at standard City of Regina water rates.

.2 Perform high-level Total residual chlorine tests at a minimum of two locations as previously described or as directed by the Engineer.

3.3.2 Flushing

.1 Upon completion of the 24 hour disinfection period, thoroughly flush the main until the Total Residual Chlorine concentration in the water being discharged is less than 1.0 mg/l.

3.3.3 Bacteriological Sample Collection and Notification of Results

.1 Bacteriological samples may only be taken and submitted by authorized City of Regina personnel. Test results will be forwarded to the City of Regina, Engineering and Works Department from the Provincial Water Laboratory. The City of Regina Engineering and Works Department will subsequently advise the designated party of the test results.

3.4 Disposal of Water

3.4.1 Dispose of highly chlorinated water to the existing sanitary sewer system or, where this is not possible, to other receiving facilities, approved by the Engineer, at rates that do not exceed the available capacity of the system at the time of disposal.

3.4.2 Provide and apply the chemicals necessary to de-chlorinate this water to a level below 5.0 mg/l or as may be required by Saskatchewan Environment (SE) at the point of discharge to the storm drainage channel or receiving location.

3.4.3 Provide additional chemical and temporary dike works necessary to ensure that the Free residual chlorine content of this water is less than 1.5 mg/l or as may be dictated by SE before it reaches Wascana Creek or Lake or other receiving body.

3.4.4 Carry out residual monitoring in coordination and co-operation with the City of Regina, Engineering and Works Department or the Engineer where they are not one and the same.

3.4.5 Chemicals that may be employed to lower chlorine residuals are listed in AWWA C651.

3.5 Plan, co-ordinate, supervise and provide all labour and Product to carry out all aspects of the disinfection, testing, dechlorination, monitoring and disposal operations.

3.6 Provide the Engineer with a minimum of forty-eight (48) hours advance notice of requirement for water.

3.7 Availability of water for disinfecting and flushing is subject to the demands on the City's distribution system at the time and its delivery may be delayed at no additional cost to the Owner. Co-ordinate operation of the fill valves with the Supervisor of Water Distribution to obtain the correct fill rate.

3.8 Provide any additional connections that may be necessary to ensure the complete removal of air from the pipe being filled/tested.

3.9 Watermain Swabbing

3.9.1 In all locations where it is not possible to disinfect new waterlines, as described previously in this section, use the following method:

.1 Disinfect each length of pipe by pulling a chlorine-soaked swab through the inside of the pipe after it has been placed in its final position.

.2 The configuration of the swab must be of the proper dimensions to ensure firm contact with all portions of the interior of the pipe.

.3 Place watermain(s) in service only after completion of required procedures and receipt of satisfactory laboratory results for the bacteriological test(s).

3.10 Chlorine Concentrations in Disinfected Sections

3.10.1 Prior to returning the watermain to potable service the concentrations of Total and Free residual chlorine shall conform to the Saskatchewan Water Regulations, 2002.

3.10.2 Minimum Free residual chlorine concentration shall be greater than 0.1 mg/l.

3.10.3 Maximum Total residual chlorine concentration shall be less than 1.0 mg/l.

1.0 GENERAL

1.1 Scope

1.1.1 This section refers to the supply of 16mm (5/8”) to 50mm (2”) positive displacement water meters with encoder registers for the measurement of cold water flowing in one direction.

2.0 PRODUCTS

2.1 Water Meters

2.1.1 Water meters to conform to AWWA C700 latest revision.

2.1.2 Water meter outer case to be non-corroding waterworks bronze with cast iron bottom plates and stainless steel bolts threaded into the body of the water meter. Bottom plate to be designed to break under normal freezing conditions when subjected to freezing pressure of 85 to 125 kPa. Water meters with frost plugs will not be accepted.

2.1.3 Water meters 16mm to 25mm to have externally threaded ends. Water meters 40mm and 50mm to have flanged ends.

2.1.4 Water meters to have a serial number permanently stamped on either the inlet or outlet port side or on either side of the body. Maincase markings to be raised and include the size, model and “IN” on the top of the inlet port. On the maincase outlet port an arrow shall be affixed on top of the maincase to indicate the outlet port.

2.1.5 Measuring chamber to be a positive displacement flat using a nutating disk or oscillating piston type element made of corrosion resistant thermoplastic material suitable for service in aggressive water conditions.

2.1.6 The manufacturer or vendor shall furnish a certificate showing that each meter was tested for accuracy of registration and that it complies with the accuracy and capacity requirements of AWWA C700 when tested in accordance with AWWA C705.

2.1.7 The City of Regina retains the right to test all meters submitted to confirm operating characteristics and to approve those that meet the City’s specifications.

2.1.8 Water meters shall be SENSUS TECHNOLOGIES SRII or SCHLUMBERGER T10 and shall be supplied with an encoder type register as specified in this section.

2.2 Encoder Registers

2.2.1 Encoder registers to conform to AWWA C707 latest edition.

2.2.2 Water meter register to be hermetically sealed to eliminate dirt and moisture contamination, tampering and lens fogging. Register to include a straight reading, odometer type totalization display, 360º test circle with center sweep hand and a low flow leak detector. Gears to be self-lubricating molded plastic for long life and minimum friction. Registers to be equipped with a press fit plastic seal pin and have provision for seal wires to prevent tampering.

2.2.3 Registers must continuously encode the six most significant digits of the volume registration in digital format compatible with remote interrogation or automatic meter reading. The most significant meter registration digits are defined as those digits on the register wheels that denote the highest recorded values of water consumption. A quick referencing mechanism shall be employed to prevent ambiguous readings.

2.2.4 All number wheels used in the register assembly shall be provided with bifurcated spring type meter contacts.

2.2.5 Measurement and registration to be in cubic metres.

2.2.6 The operation of the unit shall not induce drag that causes accelerated wear of the meter, volume registration below the accuracy requirements of the applicable AWWA standard or excessive headloss.

2.2.7 The materials used in the construction of the register shall be compatible with the normal water meter environment and with each other:

Housing -	Translucent polycarbonate
Retainer or base -	Copper
Reduction gearing -	Acetyl
Odometer wheel -	ABS material
Flexible circuit boards -	Fiberglass and epoxy with gold plated copper conducting strips

2.2.8 The operation of the register shall not be affected by temperature variations from 0° to 55° Celsius.

2.2.9 Registers using pulse generation or conversion of pulses to digital output are not permitted. Batteries shall not be required.

2.3 Remote Receptacle

2.3.1 Remote receptacle to be designed for wall mounting and shall be corrosion resistant, resistant to ultraviolet degradation, unaffected by rain or condensation and provide rugged service and long life.

2.3.2 Wall mounted receptacle to be designed for terminal screw connection after being fastened to the wall.

2.4 Electrical Construction

2.4.1 The materials employed in contacts and connections shall inhibit corrosion and shall suffer minimal effect from any environmental conditions to which they may be exposed.

2.4.2 The grounding of one conductor shall not affect the unit's electrical performance.

2.4.3 A custom-programmed CMOS (Complimentary Metal Oxide Semiconductor) chip shall be used to effect parallel to serial signal conversion for meter reading data transmission. The encoder register must utilize CMOS circuitry fully compatible with Meter Interface Units currently manufactured by Schlumberger, Sensus and Base 10.

2.4.4 Encoder register shall have three screw type terminals welded to the top of the register cover. The three terminals are to be labeled "B", "G", and "R". A polycarbonate port cover will be installed after the wiring to the terminals is completed.

1.0 GENERAL

1.1 Scope

1.1.1 This section refers to the supply of backflow prevention devices.

2.0 PRODUCTS

2.1 Vacuum breakers – hose bibb (sill cock) type

2.1.1 Hose bibb mounted vacuum breakers to be of bronze, brass or reinforced thermoplastic construction with internals suitable for long-term use in contact with potable quality water. Ends to be standard hose thread male x female.

2.1.2 Hose bibb type vacuum breakers must meet or exceed CSA B64.2 and ASSE 1011 requirements and be listed by IAPMO.

2.1.3 Hose bibb type vacuum breakers to have a working pressure rating of at least 875 kPa (125 psi).

2.1.4 Vacuum breakers shall be as manufactured by:
.1 Conbraco
.2 Febco
.3 Watts
.4 Zurn/Wilkins
.5 As approved

2.2 Double Check Valve Assembly

2.2.1 An “assembly” is deemed to be a one piece factory assembled unit which includes an upstream and downstream shutoff valve factory mounted to the double check valve design backflow prevention valve module with required test cocks and, which can be tested in-line.

2.2.2 Double check valve style backflow prevention assemblies shall meet or exceed the materials of construction and capacity vs. pressure drop requirements of the latest edition of AWWA C510 and must carry a current certification from one or more of the following agencies:
.1 CSA
.2 USC-FCCCHR

2.2.3 The assembly and all components of the assembly must have a minimum rated working pressure of 1050 kPa (150 psi) at temperatures up 82°C (140°F).

2.2.4 Shutoff valves on assemblies 50mm and smaller to be resilient seated, quarter turn, ball style valves with female NPT end connections. Shutoff valves on assemblies 65mm and larger to be resilient seated, non-rising stem, cast iron body gate valves with 125lb ANSI flanged end connections. Note: if the preventor is to be mounted in a fire system, the shutoff gate valves must be rising stem.

2.2.5 Test cocks to be quarter turn bronze body ball style valves.

2.2.6 Assemblies must be certified by the manufacturer to operate when mounted in either the horizontal or the vertical position.

2.2.7 Assemblies shall be as manufactured by:
.1 Conbraco
.2 Febco
.3 Watts
.4 Zurn/Wilkins
.5 As approved

2.3 Reduced Pressure Backflow Prevention Assembly

2.3.1 An "assembly" is deemed to be a one piece factory assembled unit which includes an upstream and downstream shutoff valve factory mounted to the reduced pressure, double check/relief valve design, backflow prevention module with required test cocks and, which can be tested in-line.

2.3.2 Reduced pressure type backflow prevention assemblies shall meet or exceed the materials of construction and capacity vs. pressure drop requirements of the latest edition of AWWA C511 and must carry a certification from one or more of the following agencies:
.1 CSA
.2 USC-FCCCHR

2.3.3 The assembly and all components of the assembly must have a minimum rated working pressure of 1050 kPa (150 psi) at temperatures up 82°C (140°F).

2.3.4 Shutoff valves on assemblies 50mm and smaller to be resilient seated, quarter turn, ball style valves with female NPT end connections. Shutoff valves on assemblies 65mm and larger to be resilient seated, non-rising stem, cast iron body gate valves with 125lb ANSI flanged end connections. Note: if the preventor is to be mounted in a fire system, the shutoff gate valves must be rising stem.

2.3.5 Test cocks to be quarter turn bronze body ball style valves.

2.3.6 Assemblies must be certified by the manufacturer to operate when mounted in either the horizontal or the vertical position.

2.3.7 Assemblies shall be as manufactured by:

- .1 Conbraco
- .2 Febco
- .3 Watts
- .4 Zurn/Wilkins
- .5 As Approved

2.4 Other types of prevention devices

2.4.1 Other types of devices not specified herein may be submitted to the Engineer for consideration and approval on a specific application basis. In all such instances the decision of the Engineer will be final.

2.4.2 All other types of devices submitted for consideration must meet or exceed the requirements of the applicable section of CSA B64 and other relevant standards.

3.0 EXECUTION

None in this section

1.0 GENERAL

1.1 Scope

1.1.1 This specification covers the installation of domestic water meters on existing water services, including all labour, equipment, and materials necessary to complete the work. Work includes all co-ordination and customer contact, removal of existing water meter and delivery to the City of Regina Public Works Meter Shop and the installation of a new water meter and meter interface unit.

1.1.2 Water meters are located within the City of Regina corporate boundaries.

2.0 PRODUCTS

2.1 Water Meters

2.1.1 Water meters will be new, conforming to American Water Works Association (AWWA) C700 latest revision, and will be supplied by the City of Regina. Meters will be available for pickup at the Public Works Meter Shop Monday to Friday from 7:30 a.m. to 4:30 p.m. on an as required basis.

2.2 Encoder Registers

2.2.1 Encoder registers will conform to AWWA C707 latest revision and will be an integral part of the water meter.

2.3 Meter Interface Units

2.3.1 Meter interface units (MIU) shall be compact data collector and radio units in a plastic case complete with mounting brackets and tamper pins. MIU will be supplied by the City of Regina and will be available for pickup at the Public Works Meter Shop, 2425-4th Avenue, Monday to Friday from 7:30 a.m. to 4:30 p.m. on an as required basis.

2.4 Electrical Cable

2.4.1 Electrical cable for connecting the meter encoder register to the MIU shall be solid wire, three conductor, #22 AWG with coloured wires being black, green and red.

2.5 Copper Wire

2.5.1 Copper seal wire to be AWG 20. Sealing tool will be supplied by the City of Regina.

2.6 Washers

2.6.1 Washers for water meters to be 3mm thick leather or rubber suitable for potable water systems.

2.7 Specialty Tools and Materials for Invensys MIU Installation

2.7.1 SRII security screw socket, supplied by Invensys.

2.7.2 3M Scotchlok UY-2 butt connector gel caps.

2.7.3 3M Scotchlok E-9Y stepped jaw crimping tool with wire cutter.

3.0 EXECUTION

3.1 Workmanship

3.1.1 Complete all plumbing work in conformance with the current edition of the Saskatchewan Plumbing and Drainage Regulations.

3.1.2 Repair any damages resulting from the installation of the water meter and appurtenances at no additional cost to the Owner.

3.1.3 Repair any leaks or other defects caused by the installation work within twenty-four (24) hours of being notified. Any leak or defects reported by the Customer to either the Contractor or the Owner within fourteen (14) calendar days after the completion of the installation will be considered a result of faulty installation. Repair at no additional cost to the Owner. This presumption does not apply to leaks or other pre-existing conditions noted by the Contractor and acknowledged in writing by the Customer, as being in existence prior to the installation.

3.1.4 Conform to all applicable laws and regulations of the City of Regina, Province of Saskatchewan and Government of Canada.

3.2 Water Meter and Meter Interface Unit Installation Lists

3.2.1 The City of Regina will provide the names, addresses, contact phone numbers and current water meter sizes for all locations where the water meters and MIU are to be installed.

3.2.2 Notify the City of Regina immediately if errors are found in the meter and MIU installation lists.

3.3 Customer Contact

3.3.1 In order to expedite the installation of the water meters and MIU the City of Regina will provide a letter for presentation to the Customer. The letter will introduce the Contractor and the project to the Customer.

3.3.2 Contact the Customer to arrange for entry to the premise for the purposes of installing a water meter/MIU by making a maximum of three (3) telephone calls and at least one (1) site visit on consecutive days. If access to premise is not gained after all attempts to contact the Customer have been made, provide an "Incomplete Water Meter/MIU Installation" form to the City. The City will then attempt to make arrangements to obtain access to the premise. The City will advise the Contractor of all successful contacts so that the Contractor can proceed with installation of the new water meter.

3.4 Hours of Work

3.4.1 Regular hours of work are 8:00 a.m. to 5:00 p.m. Monday to Friday except for Statutory Holidays.

3.4.2 Installation of water meters and MIU may be required outside of regular days and hours and must be coordinated with the Customer.

3.5 Contractor's Personnel

3.5.1 Use only persons who are technically competent and who are of acceptable character for the work involving unsupervised entry into Customer locations as meter installers.

3.5.2 Meter installers shall not accept payment for work performed during the water meter installation. Installers shall not perform work in any premise other than that necessary to complete the installation of the water meter and the MIU.

3.5.3 Train all meter installers of the technical and procedural requirements of the work. Training shall include safety awareness and public relations skills as well. Safety training to meet applicable Occupational Health and Safety requirements.

3.5.4 Appoint a Project Manager familiar with the work and having authority to make decisions. The Project Manager shall work in conjunction and close cooperation with the City's representative.

3.6 Information Tracking and Records

3.6.1 Maintain accurate records of the water meter installations. Complete a Water Meter/MIU Installation form for each location as supplied by the City of Regina.

3.6.2 Be responsible for providing proper information tracking and records for all meter and MIU installations to the City.

3.6.3 Provide the following information:
- ♦ Customers name and address of premise
- ♦ Meter reading and serial number of the installed water meter
- ♦ Date of installation
- ♦ Meter reading and serial number of removed water meter and remote register if applicable
- ♦ Other information as applicable

3.6.4 Return accumulated data on meter and MIU installations to the City of Regina Municipal Engineering Department on the 7th Floor of City Hall on the first day of each week.

3.7 Installation of Water Meters

3.7.1 Confirm pipe sizes and operation of isolation valves prior to beginning water meter removal and installation.

3.7.2 Disconnect all wiring for remote reading receptacles, if so equipped, prior to the removal of the water meter. Remove existing remote reading receptacle and abandon wiring.

3.7.3 Disconnect electrical ground wires which are attached to the water piping and interfere with the work or are attached to the Customer side of the water meter. Wire disconnection and reconnection to be performed by qualified personnel in accordance with all electrical regulations in force. Use a jumper wire when cutting copper pipe to install a water meter to ensure that grounding continuity is not compromised.

3.7.4 Install new water meters in accordance with the manufacturer specifications and AWWA C700 latest edition.

3.7.5 Deliver existing water meters and remote reading receptacles removed from service to the City of Regina Public Works Water Meter Shop for salvage.

3.8 Installation of Meter Interface Units

3.8.1 Install meter interface units (MIU) in strict accordance with manufacturer’s instructions and recommendations.

.1 Schlumberger – MIU is pre-attached to meter encoder register by a bracket. Wiring is completed. Ensure there is sufficient space around the MIU to completely open access panel for servicing or battery replacement and there is no interference with shut off valves. Use supplied magnet to activate the MIU in accordance with manufacturer's instructions.

.2 Invensys – Use pipe brackets supplied to mount MIU to adjacent water piping in vertical, upright position. Ensure there is sufficient space around the MIU to completely open access panel for servicing or battery replacement and there is no interference with shutoff valves. Make wiring terminations to meter encoder register and MIU and secure wiring to water piping in accordance with manufacturer's instructions (attached). Install security screw in MIU cover. No activation procedure is required.

3.9 Difficult Installations

3.9.1 Installation requirements for difficult installations shall be as follows:

Description	Action
Building inaccessible for any reason	♦ Provide "Incomplete Water Meter Installation" form to City.
Existing meter inaccessible	♦ Request Customer to provide 450mm clear space around meter in accordance with water bylaw. ♦ Upon access being provided by Customer, complete meter installation ♦ If Customer does not provide access to meter, provide "Incomplete Water Meter Installation" form to City.
Valves not operable or service pipe in poor condition	♦ Attempt to use piping freezing kit to complete installation. ♦ If not possible to freeze piping, request Customer to repair plumbing in accordance with water bylaw. ♦ Upon completion of plumbing repairs by Customer, return to site and complete installation. ♦ If Customer does not make plumbing repairs, provide "Incomplete Water Meter Installation" form to City.

3.9.2 Under no circumstances shall the Contractor or any of his/her employees threaten or intimidate a Customer in any manner whatsoever including mention of legal action, fines, penalties or water supply termination for refusing to co-operate.

3.10 Sealing the Meter

3.10.1 Seal all water meters after installation with seal wire and sealing tool supplied by the City of Regina. Seal wire to be installed through upstream meter coupling, register head, and downstream meter coupling.

3.10.2 If bypass valve seal is broken before or during installation seal with copper wire in a manner that requires the seal to be broken to operate the valve. Ensure bypass valve is in the "off" position prior to sealing.

3.11 Curb Stop Operations

3.11.1 If the water meter replacement requires that the curb stop at the property line be used to isolate the premises notify the City of Regina for curb stop operation.

3.11.2 Confirm the curb stop is shutoff by operating an internal plumbing fixture before proceeding with the meter installation.

3.11.3 Upon completion of the meter installation and opening of the curb stop by City forces, confirm full valve opening by once again operating an internal plumbing fixture.

3.12 Testing Installation

3.12.1 After the installation is complete, open all valves and check for leaks. Immediately correct any leaks. Run water through the meter to make sure that the meter register functions properly and to test the meter for leakage.

3.12.2 Use hand held radio meter reading unit (supplied by meter manufacturer) to check operation of MIU. Verify that correct register serial number and meter reading are displayed on reading unit. Correct wiring problems or replace MIU if necessary and retest before leaving the premises.

3.13 Emergency and Maintenance Measures

3.13.1 Provide a 24-hour emergency repair service for those premises where water meters have been installed. Provide the name, address, and telephone number of the Project Manager or other qualified person to the Customer prior to leaving the premises. Provide this information to the City.

3.13.2 Have a tradesperson and equipment on site within one (1) hour of notification of a problem.

3.13.3 Should the Contractor be unable to carry out immediate remedial measures the City will arrange to have the repair done by others. Bear all costs for repairs done by others.

3.13.4 For leak repair the foregoing will only apply for fourteen (14) days after the completion of meter installation.

3.14 Maintenance Period

3.14.1 Rectify at no cost to the Owner all defects in labour and Product which occur within twelve months from the date of Substantial Completion. Cost for replacement of defective Product supplied by the Owner, specifically water meters and MIU, will not be the responsibility of the Contractor.

3.14.2 Upon notification by the Owner, make repair or replacement within 24 hours. Failure to comply with the foregoing may result in the Owner issuing a notice of default to the Contractor. If repairs are not undertaken within 24 hours of such notice, the Owner may perform the necessary work or have the Work performed by others. If, in the sole opinion of the Owner, the situation constitutes an emergency, the Owner reserves the right to immediately perform the Work or have the Work performed by others. In all cases, the full cost of the Work will be the responsibility of and assigned to the Contractor.

SECTION 15408
INSTALLATION REQUIREMENTS FOR WATER METERS AND BACKFLOW PREVENTERS IN BUILDINGS

1.0 GENERAL

1.1 Scope

1.1.1 This specification covers the installation requirements for domestic water meters, backflow prevention equipment and isolation valving within buildings having a water service connected to either the City of Regina distribution or supply systems.

2.0 PRODUCTS

2.1 Water Meters and Meter Transceiver Units

2.1.1 Water meters and meter transceiver units (MXU) are supplied and installed by the City of Regina

2.2 Meter Spacers

2.2.1 Upon completion and submission of a Meter Sizing Form by the Applicant for Service or his representative to the Engineering and Works Department of the City of Regina, a meter size and type will be determined for installation in the facility. To facilitate the fabrication of piping for this installation a meter spacer will be provided to the Applicant or his representative by the City of Regina. Spacers are available at the City of Regina Meter Shop (777-7672) located at 2425- 4th Ave. The meter spacer is to be left in place in the piping for retrieval by the City of Regina at the time of meter installation.

2.3 Isolating Valves

2.3.1 Provide isolating valves, lockable type where indicated, in accordance with the requirements stated on the applicable Standard Drawing(s) and in the Standard Construction Specifications.

2.4 Backflow Preventer

2.4.1 Provide and install backflow prevention equipment when directed to do so by the City of Regina, Cross Connection Control Coordinator under the authority of the *City of Regina Water Bylaw 8942*. Refer to Section 15403 – Backflow Prevention Devices.

3.0 EXECUTION

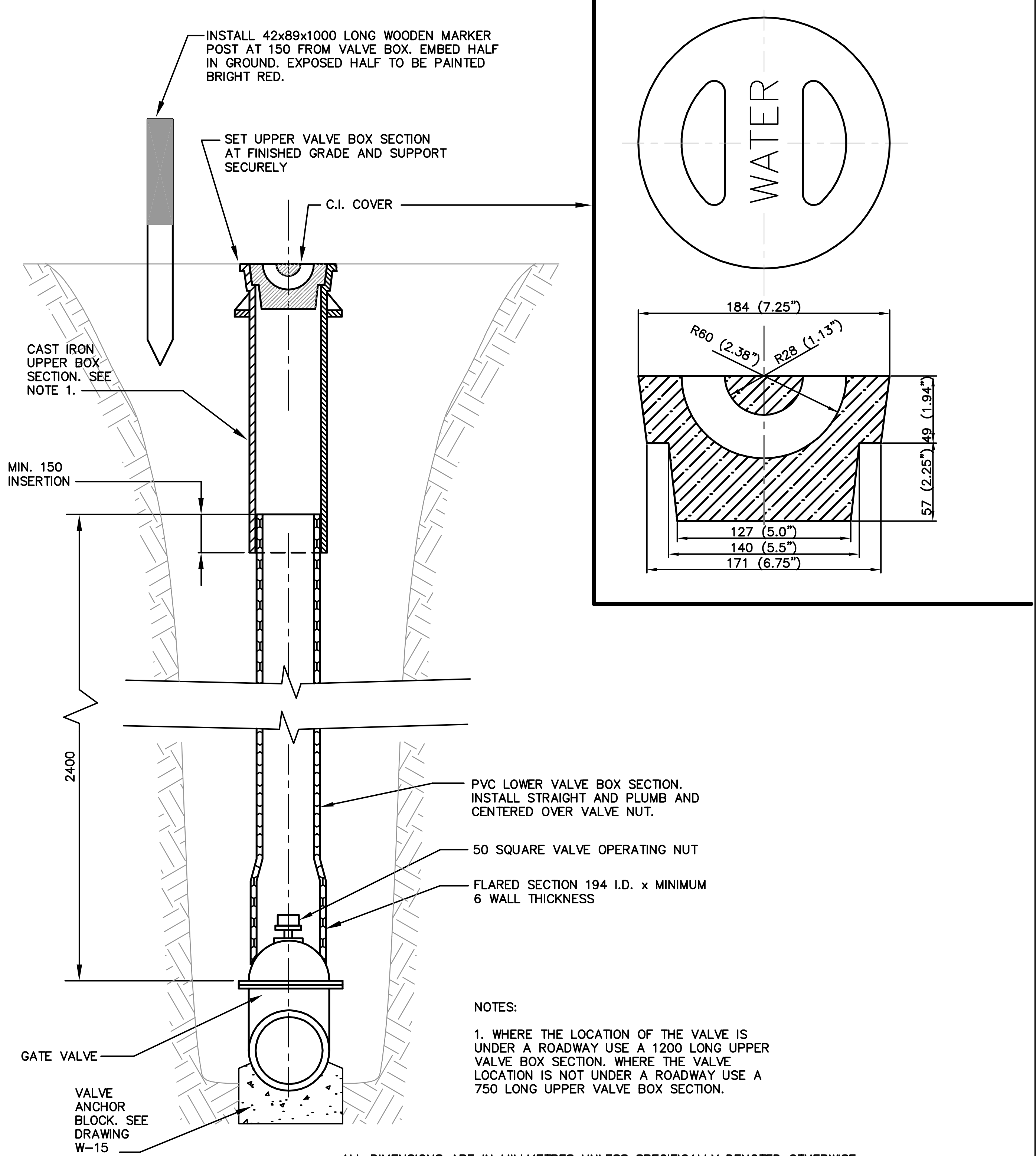
3.1 Workmanship

3.1.1 Complete all plumbing work in conformance with the current edition of the Saskatchewan Plumbing and Drainage Regulations.

3.2 Access

3.2.1 Ensure that building space provided for installation and maintenance access to metering and backflow prevention equipment is in accordance with the requirements shown and stated in the Standard Construction Specifications and Standard Drawings.

W-01	Valve Box Installation	99-07-09
W-02	Hydrant Installation	05-03
W-02A	Hydrant Installation in Narrow Streets	05-02-03
W-03	Support of Mains Over Uncompacted Areas	98-11-03
W-04	Watermain Trench Excavation and Backfill Details	02-12-05
W-05	Gate Valve Manhole	98-11-18
W-06	Detail for Watermain Crossing Beneath Sewermain	05-02-03
W-07	75mm Irrigation Meter - Kiosk and Equipment Installation Details	04-10-26
W-08	Winter Service Hydrant Type Irrigation Outlet	01-12-21
W-09	Above Grade Irrigation Kiosks Site Plan and Base Details	04-08-30
W-10	50mm Irrigation Service - Kiosk and Equipment Installation Details	04-10-26
W-11	100mm Irrigation Service - Kiosk and Equipment Installation Details	04-10-26
W-12	Flushout for Deadend Watermain	02-09-21
W-13	Thrust Blocks	02-12-18
W-14	Mechanical Thrust Restraints	98-11-18
W-15	Valve Anchoring	01-11-07
W-16	Details of 100mm and 50mm Water Service Extensions to Irrigation Kiosks	01-11-19
W-17	Typical Water Service Connection – 50mm and Smaller	03-10-14
W-18	No Drawing	
W-19	Multiple Metered Service or Deadend Main – Connection Details	02-10-11
W-20	No Drawing	
W-21	No Drawing	
W-22	No Drawing	
W-23	Blowoff from Steel Pipeline	98-11-19
W-24	Drain/Blowoff Connection from Non-Steel Pipelines	98-11-19



NOTES:

1. WHERE THE LOCATION OF THE VALVE IS UNDER A ROADWAY USE A 1200 LONG UPPER VALVE BOX SECTION. WHERE THE VALVE LOCATION IS NOT UNDER A ROADWAY USE A 750 LONG UPPER VALVE BOX SECTION.

ALL DIMENSIONS ARE IN MILLMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
JULY09/99	REVISED & CAP DET. ADDED	SB
NOV18/98	REVISED/RENUMBERED	SB
SEP05/97	GENERAL REVISIONS	
JAN27/97	REISSUED	

Regina

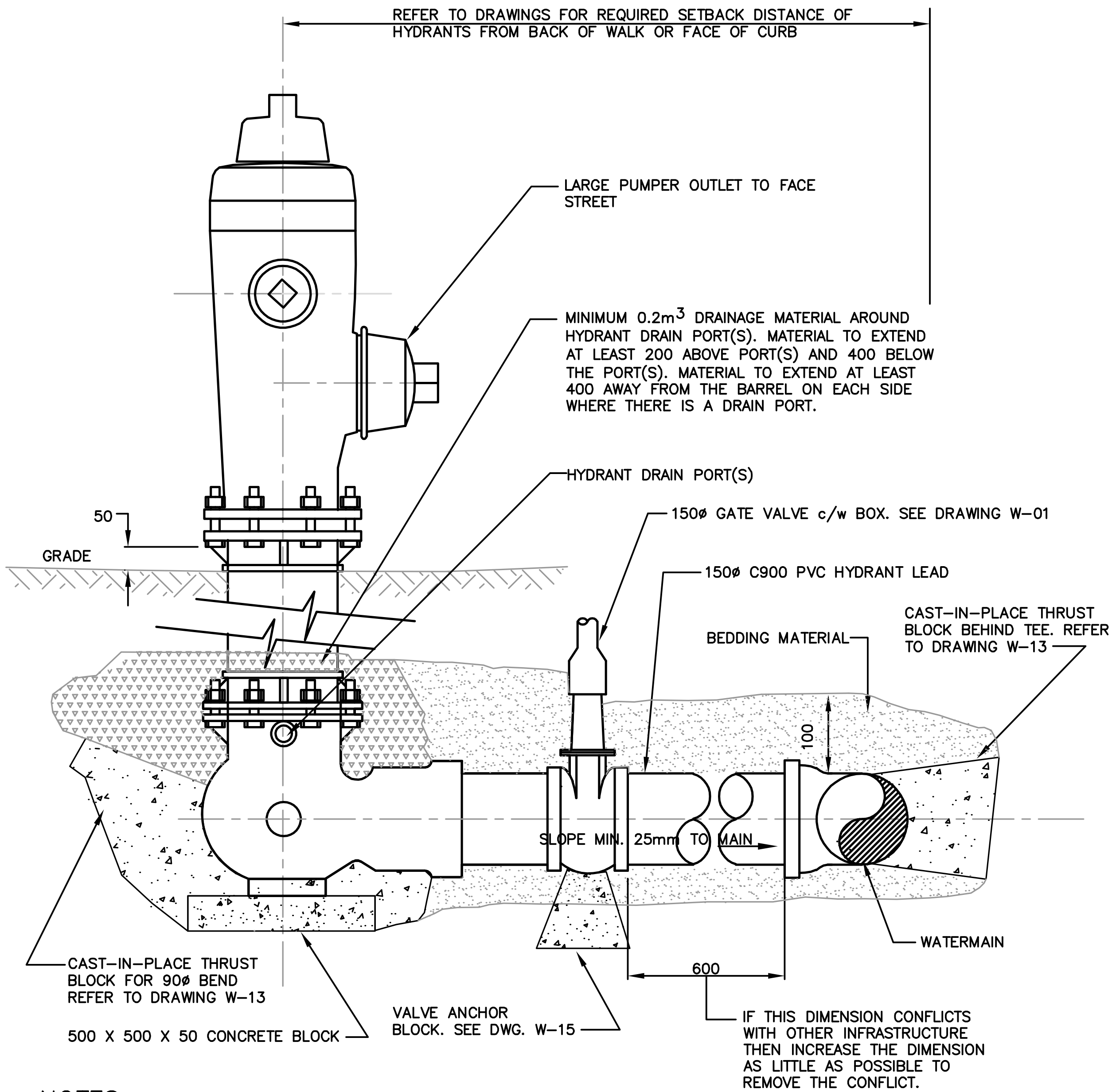
CITY OF REGINA

Engineering and Works

Description:

VALVE BOX INSTALLATION

Manager	Date	Digital File:
KEN WIENS	MAR18/77	o:me/wat/dwgs.....wat. st'd dwgs...
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-01



NOTES:

1) WHERE USE OF THIS DETAIL WOULD RESULT IN THE HYDRANT ISOLATING VALVE BOX BEING LOCATED UNDER EITHER GUTTER OR SIDEWALK – REFER TO AND USE THE DETAIL PRESENTED ON STANDARD DRAWING W-02A.

2) FOR THRUST BLOCK CONCRETE REQUIREMENTS REFER TO SPECIFICATIONS SECTION 02511-WATERMAINS

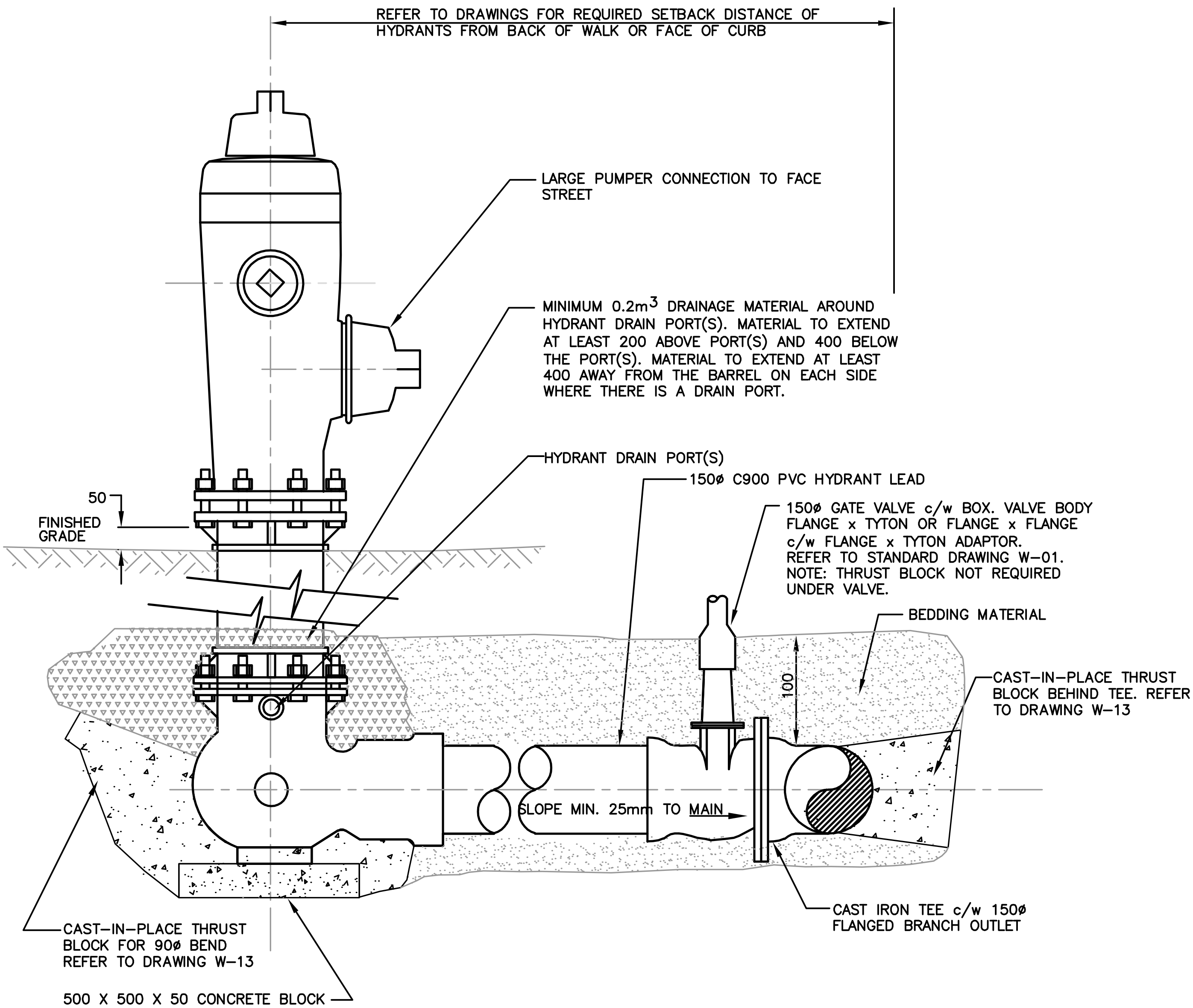
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
MAR/05	NOTES REVISED	SB
APR26/01	GATE VALVE REQUIREMENT	SB
SEP16/99	MINOR REVISIONS	SB
NOV18/98	RENUMBERED FROM W-7	SB

Regina
CITY OF REGINA
Engineering and Works

Description:
HYDRANT INSTALLATION

Manager	Date	Digital File:
KEN WIENS	JUN18/83	o:\me\wat\dwgs....wat div st'd dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-02



NOTES:

USE THIS DETAIL IN THOSE LOCATIONS WHERE USE OF THE DETAIL ON STANDARD DRAWING W-02 WOULD RESULT IN THE VALVE BOX BEING INSTALLED UNDER EITHER GUTTER OR SIDEWALK.

FOR MATERIALS AND INSTALLATION REQUIREMENTS REFER TO STANDARD CONSTRUCTION SPECIFICATIONS SECTIONS 02315 AND 02511.

IN LOCATIONS WHERE THE EXISTING WATERMAIN IS UNDER THE SIDEWALK OR GUTTER CONSULT ENGINEERING AND WORKS PRIOR TO PROCEEDING.

CORROSION PROTECTION FOR HYDRANT BODY TO BE SACRIFICIAL ANODE NOT PETROLATUM ENCAPSULATION.

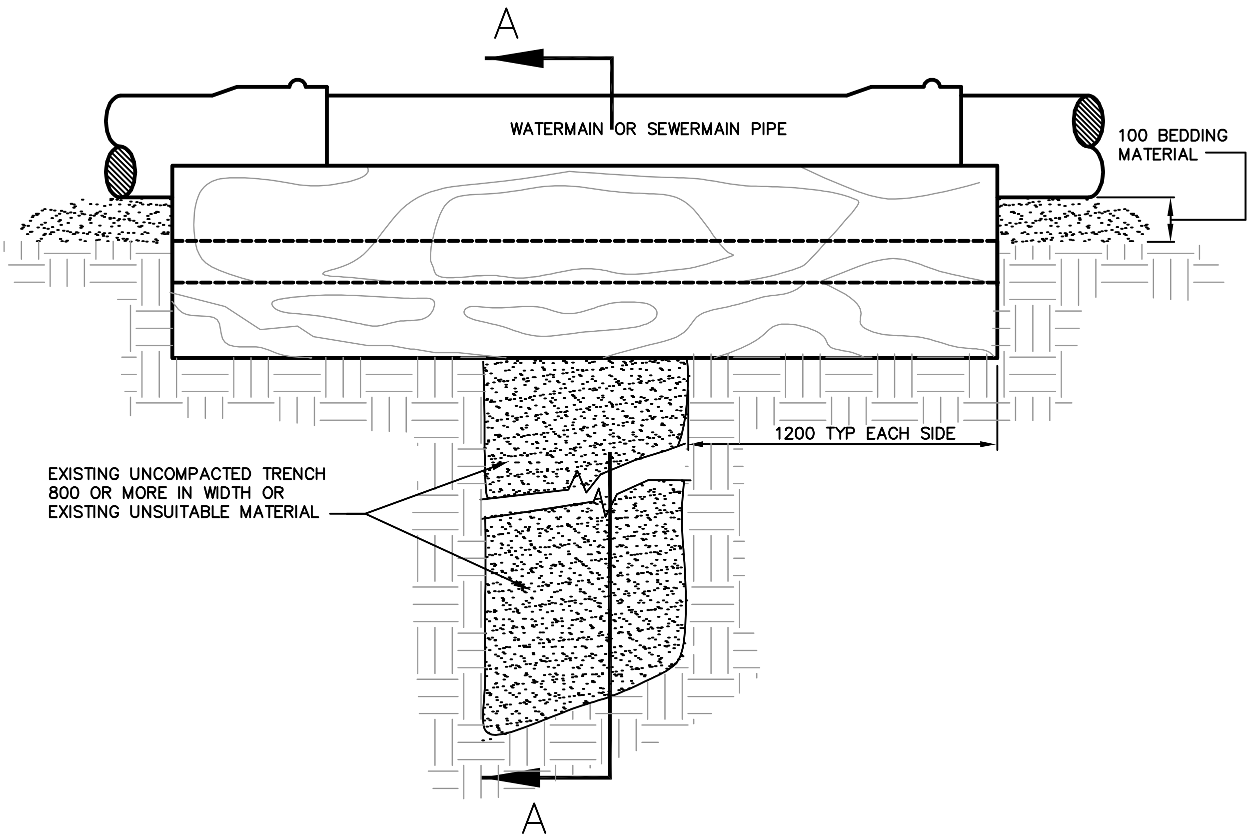
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
FEB03/05	NEW NARROW ST. OPTION	SB
JUL06/04	GATE VALVE MOVED TO TEE	SB
APR26/01	GATE VALVE REQUIREMENT	SB
SEP16/99	MINOR REVISIONS	SB
NOV18/98	RENUMBERED FROM W-7	SB

Regina
CITY OF REGINA
Engineering and Works

Description:
HYDRANT INSTALLATION IN NARROW STREETS

Manager	Date	Digital File:
KEN WIENS	FEB03/05	o:\me\wat\dwgs....wat div st'd dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-02A



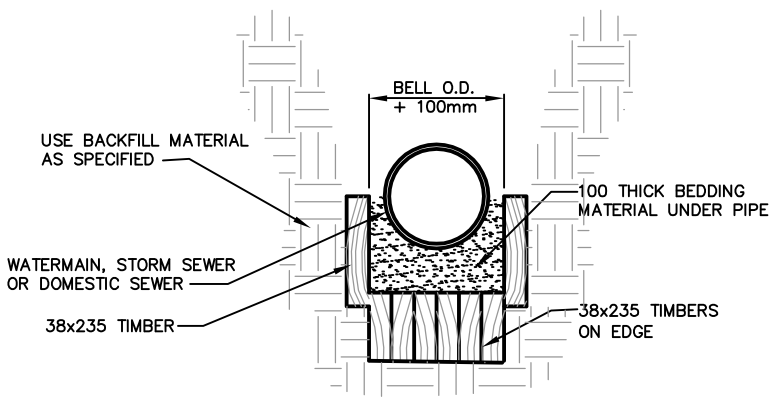
NOTES

1) NUMBER OF 38x235 TIMBERS USED DEPENDS ON SIZE OF PIPE AND SPAN OF TRENCH.

2) SUPPORT OVER TRENCH WIDTHS GREATER THAN 1500 MUST BE APPROVED BY THE ENGINEER.

3) USE PRESSURE TREATED TIMBER FOR SUPPORTS.

4) REINFORCED CONCRETE BRIDGING MAY BE USED IN LIEU OF TIMBER. DETAILS MUST BE PRE-APPROVED BY THE ENGINEER.



SECTION A–A

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
NOV03/98	RENUMBERED FROM W–4	S.B.
MAR04/98	MINOR MODS/TITLE CHANGE	S.B.
SEP05/97	GENERAL REVISIONS	S.B.

Regina

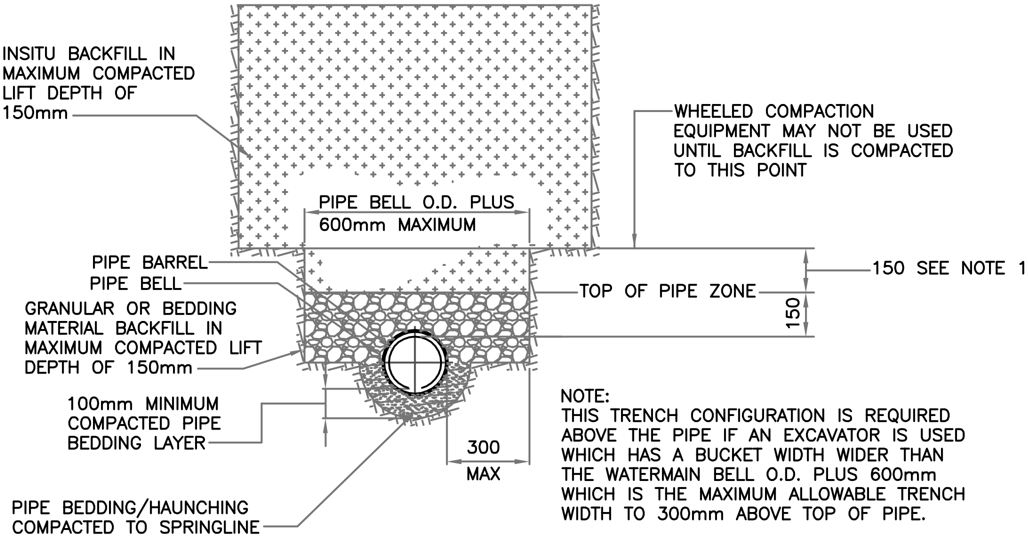
CITY OF REGINA

Engineering and Works

Description:

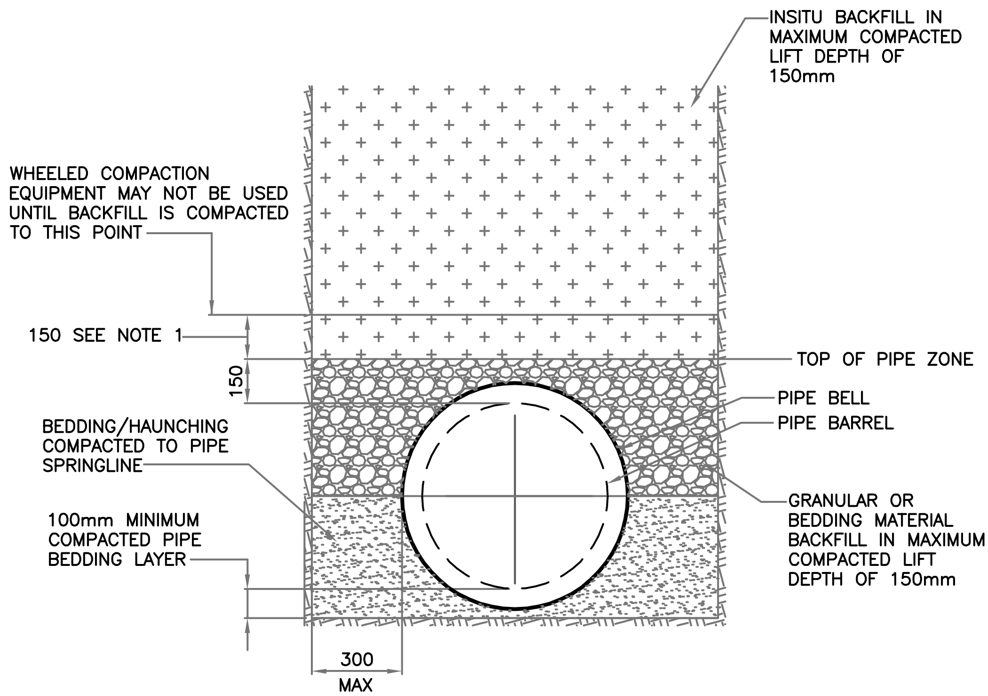
SUPPORT OF MAINS OVER UNCOMPACTED AREAS

Manager	Date	Digital File:
KEN WIENS	MAR18/77	o:\me\wat\dwgs....wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-03



BUCKET/SPOON METHOD

NOTE 1: THE USE OF GRANULAR MATERIAL IS RECOMMENDED FOR THE LIFT INDICATED. INSITU MATERIAL MAY BE USED PROVIDED THAT IT CONFORMS TO THE SPECIFICATIONS AND THAT IT CAN BE COMPACTED TO THE SPECIFIED DENSITY WITHOUT THE USE OF WHEELED COMPACTION EQUIPMENT.



BUCKET METHOD

Date	Revisions	By
DEC05/02	COMPACTION NOTES CLARIFIED	S.B.
NOV21/01	ISSUED AS STANDARD	S.B.

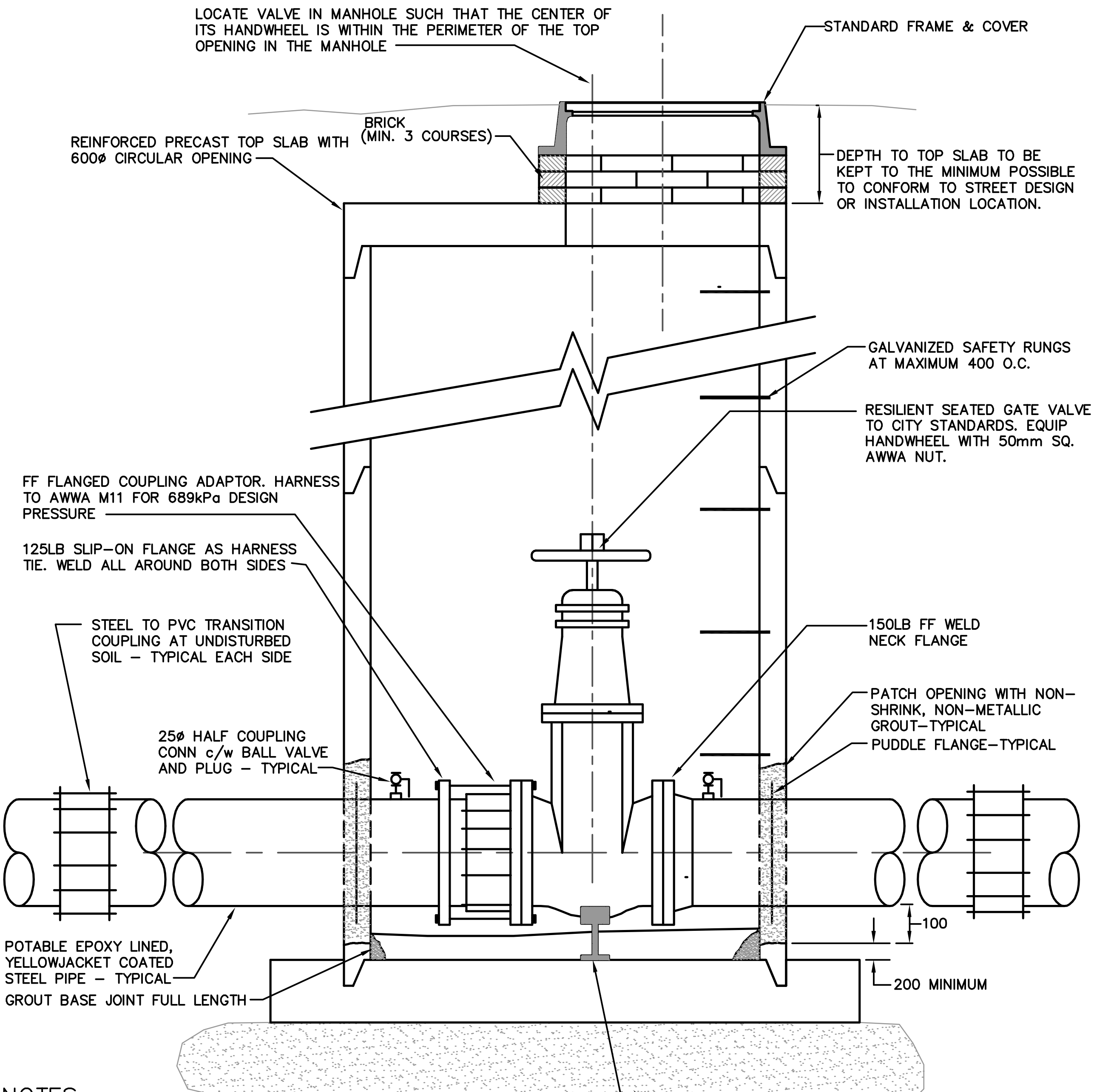
CITY OF REGINA

Engineering and Works

Description:

WATERMAIN TRENCH EXCAVATION AND BACKFILL DETAILS

Manager	Date	Digital File:
KEN WIENS	11/00	o:\me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-04



NOTES:

1) PIPING AND VALVING MATERIALS/INSTALLATION TO BE AS SPECIFIED IN CITY OF REGINA STANDARD CONSTRUCTION SPECIFICATIONS
2) PRECAST CONCRETE MANHOLE TO BE 1800ø MINIMUM. BOTTOM SECTION TO BE LONG AS POSSIBLE. ALL JOINTS TO BE MASTIC SEALED WITH 'RAM–NEK' OR EQUAL. GROUT ALL JOINTS OUTSIDE.
3) MANHOLE BASE TO BE REINFORCED, PRECAST OR CAST–IN–PLACE. AND TO BE DESIGNED BY A PROFESSIONAL ENGINEER.
4) PREPARE AND COAT EXPOSED METAL SURFACES PER SPECIFICATIONS SECTION 09910.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

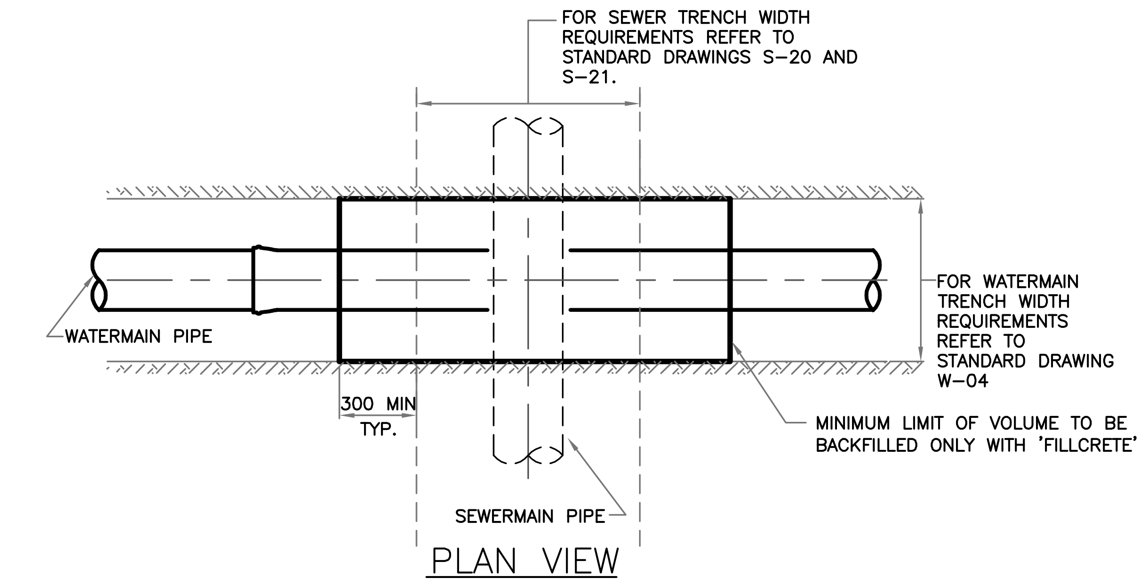
Date	Revisions	By
NOV18/98	RENUMBERED FROM W–13	S.B.
SEP17/97	REVISED	S.B.
JAN27/97	REISSUED	S.B.

Regina
CITY OF REGINA
Engineering and Works

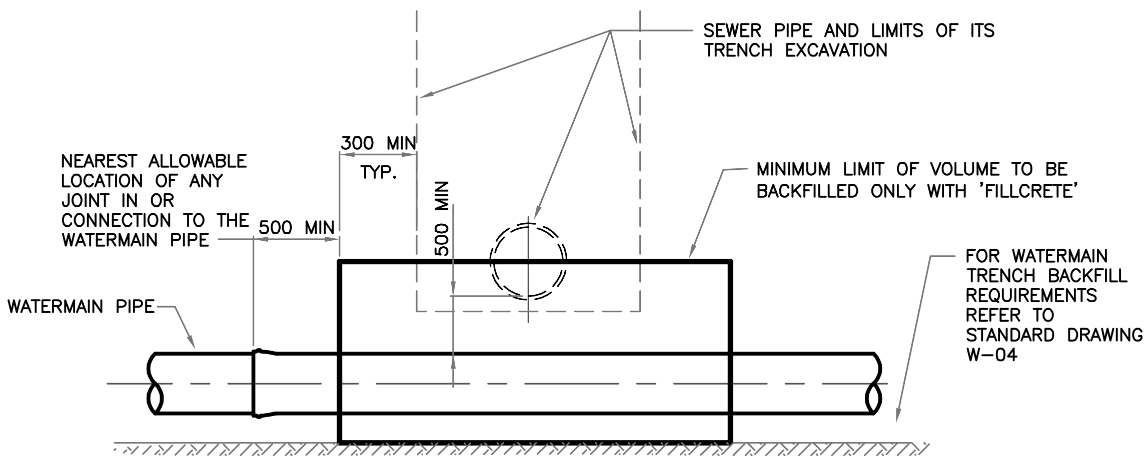
Description:

GATE VALVE MANHOLE

Manager	Date	Digital File:
KEN WIENS	APR07/82	o:\me\wat\dwgs....wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-05



PLAN VIEW



SECTION VIEW

NOTE 1:

THIS DETAIL IS TO BE APPLIED IN THE FOLLOWING INSTANCES WHERE THE OPEN CUT TRENCH METHOD IS USED:
- –ALL LOCATIONS WHERE NEW SANITARY SEWERMAIN IS INSTALLED OVER EITHER NEW OR EXISTING WATERMAIN.
- –ALL LOCATIONS WHERE NEW WATERMAIN IS INSTALLED UNDER EITHER EXISTING SANITARY SEWERMAIN OR EXISTING STORM SEWERMAIN.

NOTE 2:
WHERE, IN THE OPINION OF THE ENGINEER, SOIL CONDITIONS DICTATE THAT THE AREA FILLED WITH 'FILLCRETE' SHOULD BE EXPANDED FROM THAT SHOWN ON THIS DRAWING THEN THE FIELD DIRECTED EXTENT OF FILL WILL BE REQUIRED.

NOTE 3:
ENSURE MAINS ARE NOT DISPLACED DURING EITHER EXCAVATION OR 'FILLCRETE' INSTALLATION.

NOTE 4:
MAXIMUM DEPTH OF 'FILLCRETE' THAT MAY BE INSTALLED IN ANY SINGLE POUR IS 1.0 METRE. IF MORE THAN 1.0 METRE TOTAL DEPTH IS REQUIRED THEN THE INITIAL DEPTH MUST BE CURED TO THE SATISFACTION OF THE ENGINEER BEFORE FURTHER DEPTH IS ADDED ON TOP OF IT.

NOTE 5:
WHEREVER POSSIBLE, DESIGN WATER AND SEWER SERVICES SUCH THAT THE WATERMAIN CROSSES ABOVE SEWERMAIN(S).

NOTE 6:
AS MUCH AS POSSIBLE CENTRE THE LENGTH OF WATERMAIN PIPE AT THE POINT OF CROSSING THE SEWER(S).

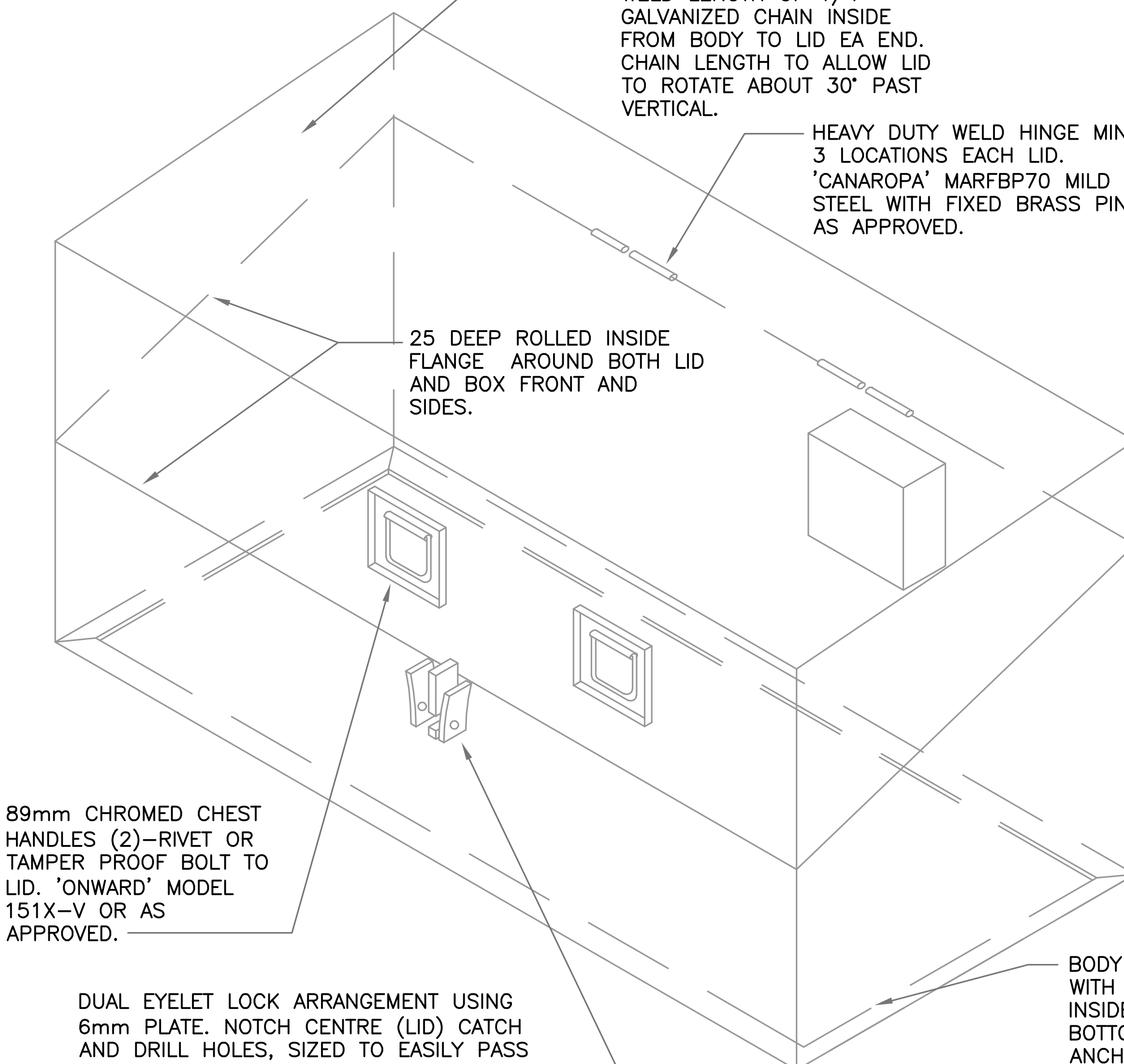
Date	Revisions	By
FEB03/05	REV. NEW ST'D ADOPTED	S.B.
SEP09/04	DRAFT NEW ST'D FOR REVIEW	S.B.

Regina
CITY OF REGINA
Engineering and Works

Description:
DETAIL FOR WATERMAIN CROSSING BENEATH SEWERMAIN

Manager	Date	Digital File:
KEN WIENS	02/05	o:\me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-06

1 – 100mm HDPE DR11 RISER FOR SUPPLY AND DISCHARGE FOR CONTINUATION REFER TO STANDARD DRAWINGS W-09/W-16 AND SITE PLAN.
2 – 100mm HDPE STUB END AND BACKING FLANGE ASSEMBLY. BACKING FLANGES TO BE EPOXY COATED DUCTILE IRON – 2 REQUIRED.
3 – 50mm x 2000LB HALF COUPLING
4 – 50mm x 75 LONG SHORT NIPPLE NPT BOTH ENDS
5 – 50mm x 300LB 90° M.I. THREAD ELL.
6 – 50mm x 400 LB WOG BRONZE BALL VALVE. NPT ENDS.
7 – 50mm MALE NPT x 'GRUVLOK' ADAPTOR.
8 – 100mm x 150LB FF WN FLANGE–2 REQUIRED
9 – 75mm x 125LB CAST IRON BODY, FLANGED END RESILIENT SEATED GATE VALVE TO AWWA C509 – ONE REQUIRED.
10 – 100mm x 75 WELD REDUCER – TWO REQUIRED.
11 – NOT USED
12 – 75mm FLOWMETER/MASTER VALVE ASSEMBLY AS SPECIFIED.
13 – 75mm x 150LB FF WN FLANGE – THREE REQUIRED
14 – 75ø PIPE SPOOL PIECE. OVERALL LENGTH APPROX. 315mm. FIELD CONFIRM.
15 – 75ø WATTS MODEL 757 DOUBLE CHECK STYLE BACKFLOW PREVENTOR ASSEMBLY c/w NON-RISING STEM GATE STYLE ISOLATING VALVES.
16 – 15ø x 2000LB HALF COUPLING CONNECTION c/w 15ø x 400 LB WOG BRONZE BALL VALVE.
17 – 150 x 150 x 100 EEMAC 1 ELECTRICAL JUNCTION BOX c/w HINGED FRONT AND MIN. 2 X 25ø CONDUIT KNOCKOUTS. BEL EUK0664 OR EQUAL. SPOT WELD TO BODY AND FINISH SAME AS KIOSK.
18 – 100ø SHORT RADIUS 90° WELD ELLS – 2 REQUIRED
19 – 75ø SHORT RADIUS 90° WELD ELLS – 2 REQUIRED
20 – 50mm x 65 LONG SHORT NIPPLE
21 – 50mm x 45° THREAD ELL



NOTES:

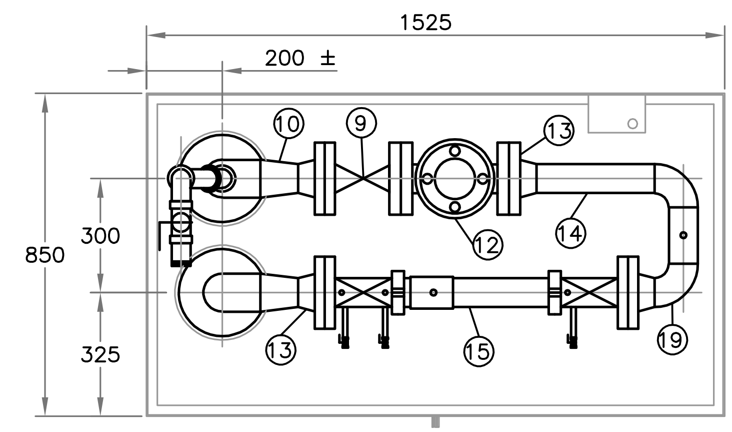
–CONSTRUCT KIOSK WITH 14 GA. STEEL PLATE. ALL WELDS TO BE FULL LENGTH AND GROUND SMOOTH. DEGREASE, BLAST TO SSPC–SP6 INSIDE AND OUT, PRIME AND FINISH WITH TWO COATS OF MARINE ENAMEL–COLOUR CGSB 503–127 (GP INDUSTRIAL 214 SIGNAL GREEN)

–MOUNT KIOSK ON PRECAST OR CAST–IN–PLACE SLAB. REFER TO STANDARD DRAWING W–09 FOR SLAB DETAILS.

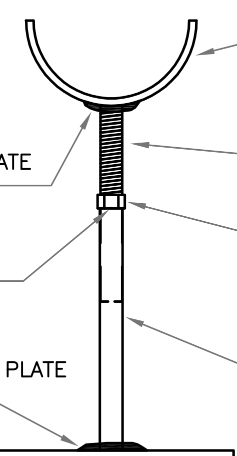
–PIPE AND FITTINGS 75mm AND LARGER TO BE STANDARD WT. STEEL. PIPING 50mm AND SMALLER TO BE SCH80. STEEL.

–PROVIDE A MINIMUM OF 1 REMOVABLE/ADJUSTABLE SUPPORT. LOCATE SUPPORT WHERE INDICATED. CLEAN, PRIME AND PAINT SUPPORT WITH TWO COATS OF MARINE ENAMEL.

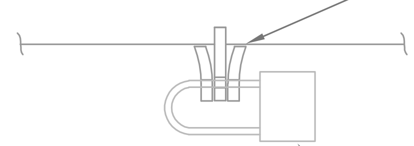
– DIMENSIONS OF KIOSK ARE BASED ON USE OF NON–RISING STEM GATE VALVES AND BACKFLOW PREVENTER INDICATED IN NOTES.

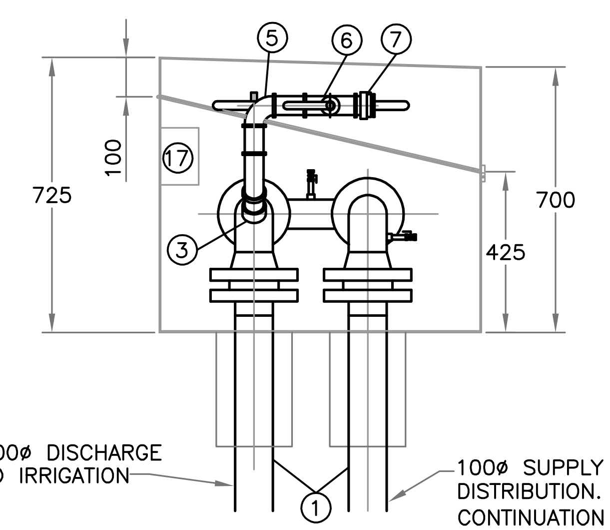


PLAN VIEW

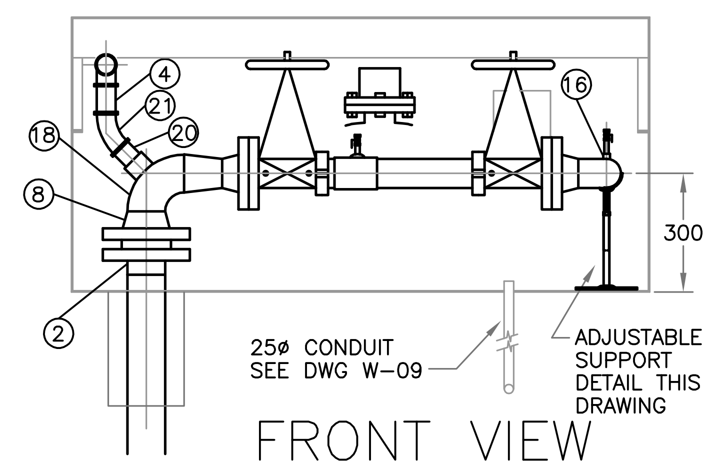


SUPPORT DET.





LEFT END VIEW

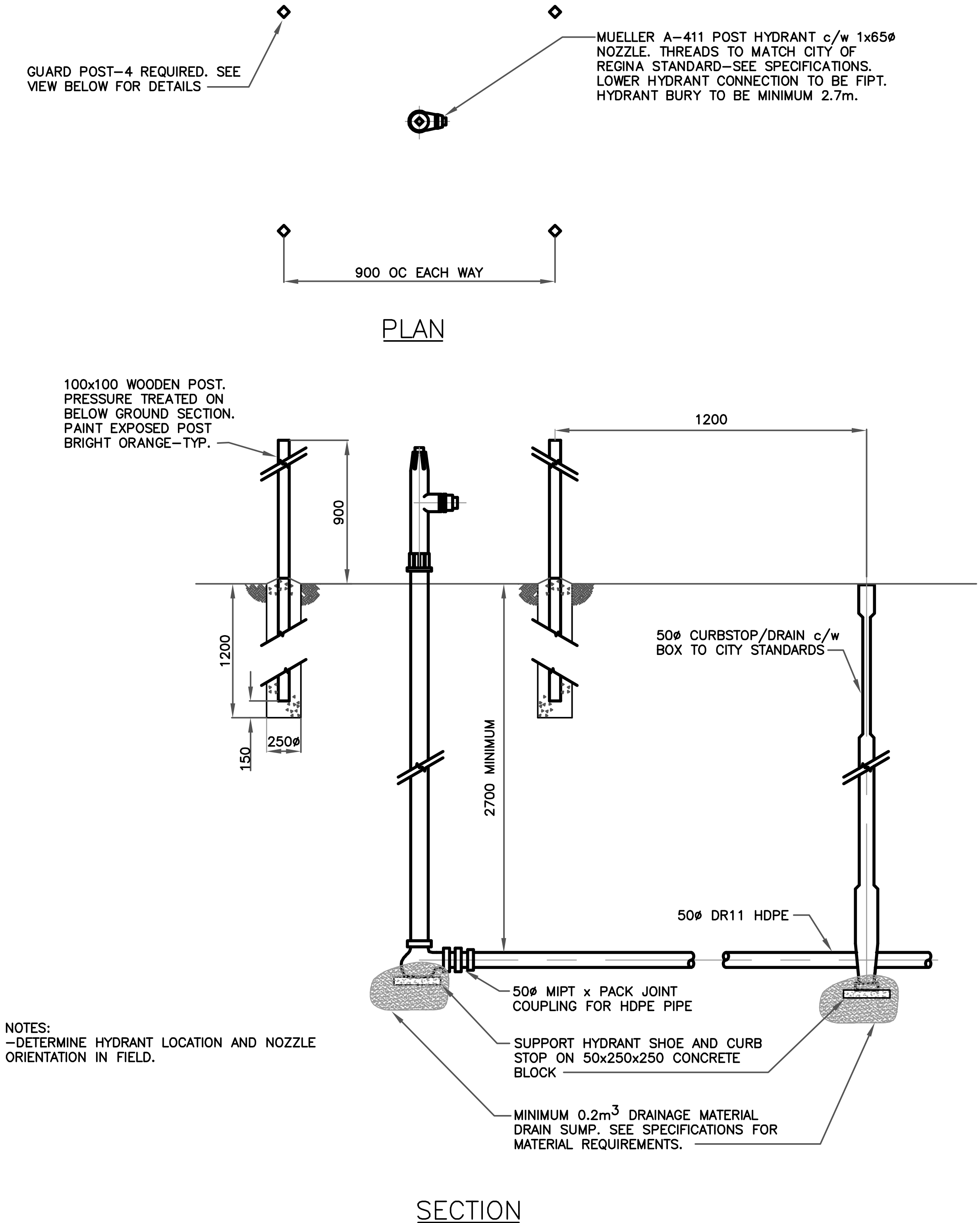


FRONT VIEW

M/D/Y	Ref.	Description	By
AUG26/04		PROP. NEW ST'D. - ISSUED FOR REVIEW	SB
OCT26/04		C.S.-IRRIG REVIEW COMMENTS INCOROPORATED	SB

Regina
CITY OF REGINA
Engineering and Works

Approved By: KEN WIENS, Division Manager	Drawn By: sb	Project: CITY OF REGINA	Date: 08/04
	Designed by: sb		Computer File: o:\me\wat\dwgs,..wat div std dwgs
DAVID CALAM, Director	Scale: NTS	Description: 75mm IRRIGATION METER - KIOSK AND EQUIPMENT INSTALLATION DETAILS	Sheet: 1 of 1
			Dwg: W-07



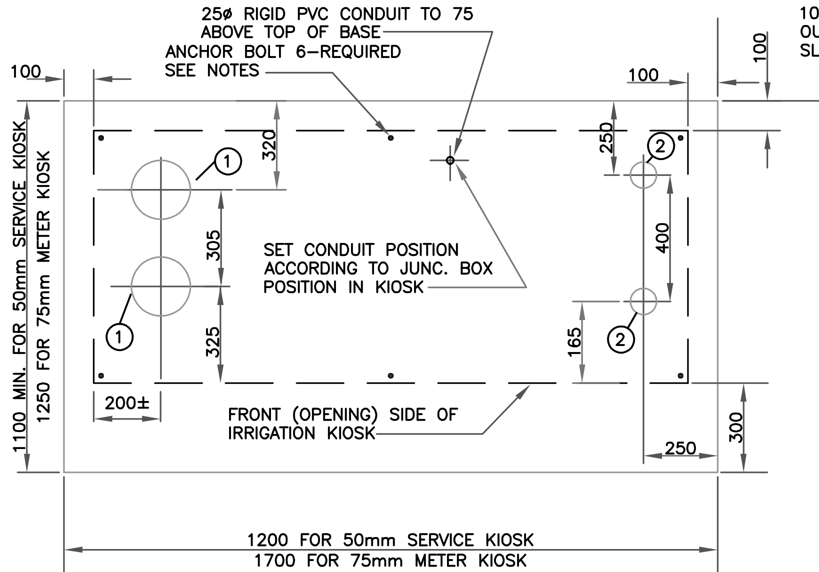
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY NOTED OTHERWISE

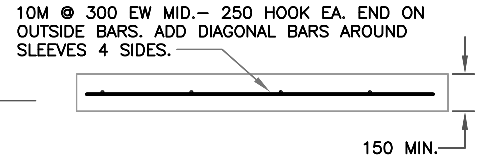
Date	Revisions	By
DEC21/01	NEW POST HYDRANT TYPE	S.B.

Regina
CITY OF REGINA
Engineering and Works

Description:
WINTER SERVICE - HYDRANT TYPE IRRIGATION OUTLET

Manager	Date	Digital File:
KEN WIENS	DEC09/01	o:\me\wat\dwgs....wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-08





NOTES:

1) COMPACT PIPE TRENCH BACKFILL TO MINIMUM 95% STANDARD PROCTOR DENSITY TO A MINIMUM DISTANCE OF 2.5m IN ALL DIRECTIONS FROM THE EDGE OF SLAB. MAXIMUM DEPTH OF UNCOMPACTED LIFT TO BE 300mm.
2) PROVIDE MINIMUM 150 THICK COMPACTED GRANULAR BASE UNDER SLAB.
3) TOP OF SLAB TO BE SLIGHTLY ABOVE FINISHED GRADE.
4) PROVIDE LAYER OF "RAMNEK" OR EQUIV. SEAL BETWEEN KIOSK AND SLAB. ALL ROUND.

FOR CAST–IN–PLACE BASE SLAB

4) CONCRETE TO BE 25MPa, TYPE 50, 5% ±1 AIR CONTENT. 80mm MAX SLUMP. MOIST CURE FOR 7 DAYS.
5) INSTALL 6x15ø SS ANCHOR BOLTS LOCATED AT CORNERS AND MID–PT. OF LONG SIDES. BOLTS TO PROTRUDE 25 MIN. BOLTS TO HAVE MIN. 50 HOOK EMBEDDED 75 IN SLAB.

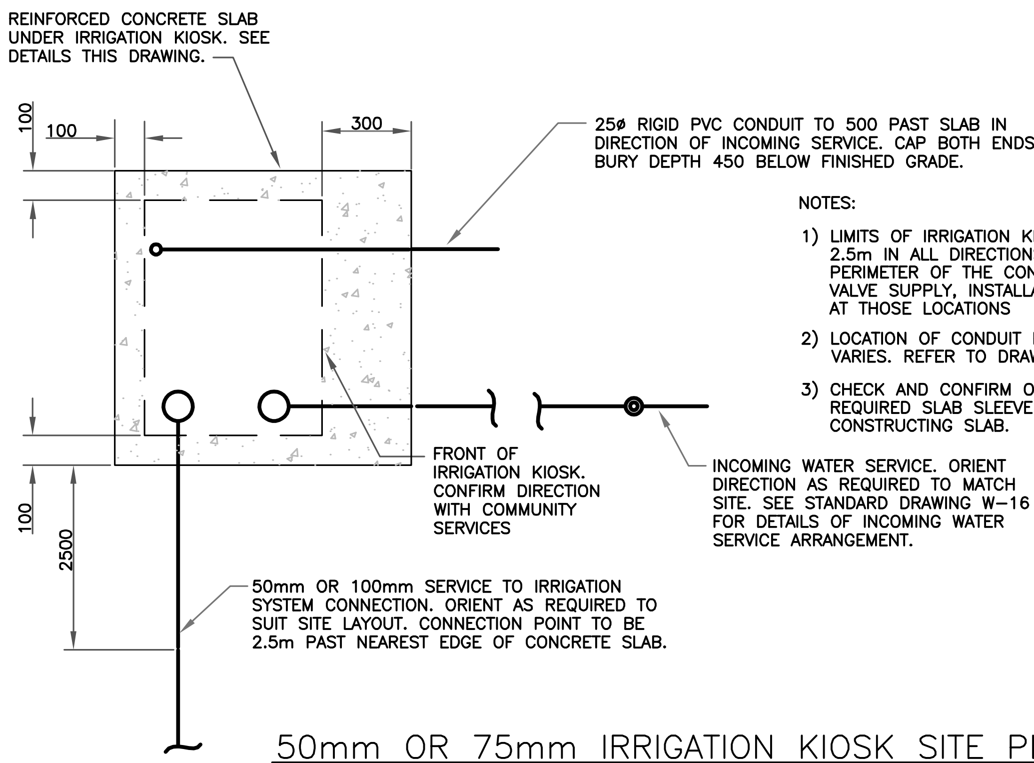
FOR PRECAST BASE SLAB

6) USE REINFORCED, PRECAST FLOOR SLAB AS PRODUCED BY 'CONFORCE' OR APPROVED. SLAB TO BE MIN. 1200 WIDE x 150 THICK.
7) INSTALL 15ø SELF–DRILLING SS ANCHOR BOLTS AS ABOVE. SLAB PENETRATIONS TO BE CORED. SIZES TO MATCH SLEEVE SIZES SHOWN.

(1) 200ø x MIN. 150 LG. SCH40 STEEL OR PVC SLEEVES–2 REQUIRED. EQUIP SLEEVES WITH NELSON STUD AT MID–LENGTH. SLEEVES TO BE FLUSH WITH OR JUST BELOW TOP OF SLAB. USE FOR 100mm SERVICE KIOSK.

(2) 75ø x MIN. 150 LG. SCH40 STEEL SLEEVES–2 REQUIRED. EQUIP SLEEVES WITH NELSON STUD AT MID–LENGTH. SLEEVES TO BE FLUSH WITH OR JUST BELOW TOP OF SLAB. USE FOR 50mm SERVICE KIOSK.

50mm OR 75mm IRRIGATION KIOSK BASE SLAB– PLAN/END VIEWS



NOTES:

1) LIMITS OF IRRIGATION KIOSK PAY ITEM EXTEND 2.5m IN ALL DIRECTIONS FROM THE OUTSIDE PERIMETER OF THE CONCRETE SLAB AND INCLUDE VALVE SUPPLY, INSTALLATION AND CONNECTION AT THOSE LOCATIONS
2) LOCATION OF CONDUIT PENETRATION IN BASE SLAB VARIES. REFER TO DRAWING W–07 OR W–10.
3) CHECK AND CONFIRM ORIENTATION OF KIOSK SLAB AND REQUIRED SLAB SLEEVE PENETRATIONS PRIOR TO CONSTRUCTING SLAB.

50mm OR 75mm IRRIGATION KIOSK SITE PLAN

Date	Revisions	By
AUG30/04	W–09 REV. FOR 75mm KIOSK	SB
NOV09/01	VARIOUS REVS SEE ALSO W–16	SB
JAN26/00	STANDARD DRAWING ISSUED	SB

Regina
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Engineering and Works

Description:
ABOVE GRADE IRRIGATION KIOSKS SITE PLAN AND BASE DETAILS

Manager	Date	Digital File:
KEN WIENS	08/04	o:\me\wat\dwgs....wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-09

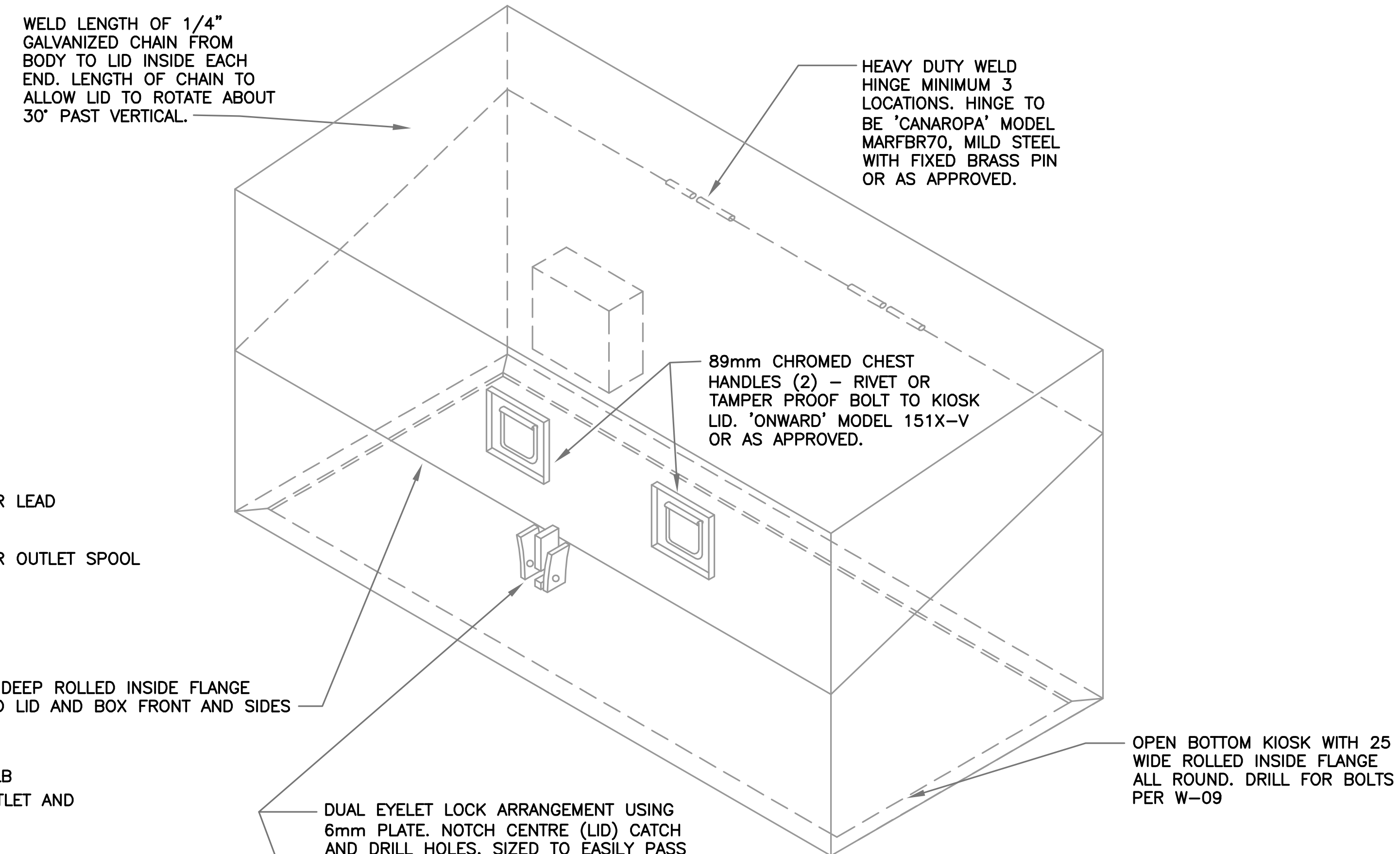
NOTES:

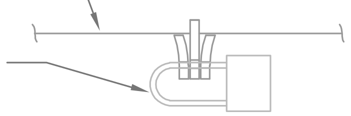
–CONSTRUCT KIOSK WITH 14 GA. STEEL. GRIND WELDS SMOOTH. DEGREASE AND BLAST TO SSPC–SP6 INSIDE AND OUT. PRIME AND FINISH WITH TWO COATS OF MARINE ENAMEL. CGSB 503–127 (GP INDUSTRIAL 214) – SIGNAL GREEN

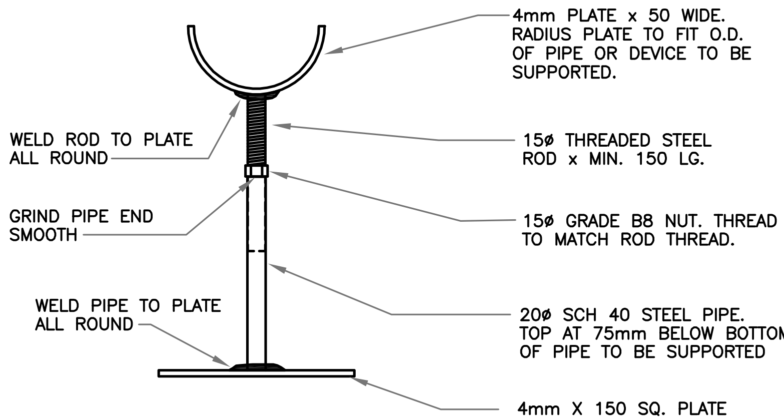
– MOUNT KIOSK ON CAST OR PRECAST SLAB. REFER TO STANDARD DRAWING W–09 FOR DETAILS.

– PIPE ABOVE GRADE TO BE SCH80 STEEL WITH NPT OR GROOVED ENDS. FITTINGS TO BE 300 LB BANDED MALLEABLE IRON THREADED OR DUCTILE IRON GROOVED.

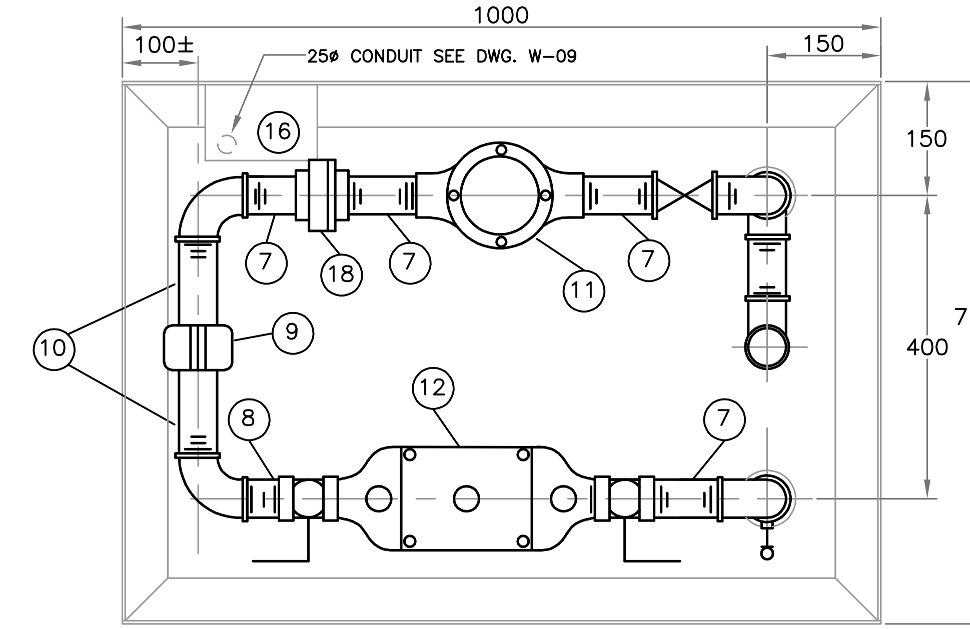
1. 50ø HDPE DR11 OR TYPE K SOFT DRAWN COPPER LEAD FROM INCOMING WATER SERVICE LINE
2. 50ø HDPE DR11 OR TYPE K SOFT DRAWN COPPER OUTLET SPOOL TO CONNECTION TO HDPE IRRIGATION LINES
3. FORD ADAPTOR COUPLING TO SUIT PIPE MATERIAL USED – 2 REQUIRED. TWO (2) – REQUIRED
4. 50ø BRONZE BODY GATE VALVE WITH FIPT ENDS. TWO (2) REQUIRED. SEE SPECIFICATIONS.
5. 50ø x 75 LONG MIPT NIPPLE c/w 15ø x 2000LB HALF COUPLING OR 'GRUVLOK' 7044 BRANCH OUTLET AND BALL VALVE.
6. 50ø x 90° M.I. ELLS SIX (6) – REQUIRED.
7. 50ø x 75 LONG MIPT NIPPLE SIX (6)– REQUIRED.
8. 50ø x 50 LONG MIPT NIPPLE – 2 REQUIRED
9. 50ø 'GRUVLOK' ROUGHNECK COUPLING.
10. 50ø MIPT x PLAIN END SPOOL. LENGTHS AS REQUIRED.
11. 50ø FLOWMETER/MASTER VALVE ASSEMBLY, FIPT ENDS. SEE SPECIFICATIONS FOR DETAILS
12. 50ø APPROVED DOUBLE CHECK BACKFLOW PREVENTER c/w BALL TYPE ISOLATION VALVES. REFER TO SPECIFICATIONS.
13. 50ø x 100 LONG MIPT x GROOVE END NIPPLE
14. 50ø M.I. TEE.
15. 50ø x 400 LB BRONZE BALL VALVE.
16. 150 x 150 x 100 EEMAC 1 JUNCTION BOX c/w HINGED COVER AND MIN. 2x 25ø CONDUIT KNOCKOUTS. BEL EUK0664 OR EQUAL. SPOT WELD TO BOX AND FINISH TO MATCH BOX – 1 REQUIRED.
17. ADJUSTABLE SUPPORTS SEE DETAIL THIS DRAWING. INSTALL TWO ASSEMBLIES AT LOCATIONS TO BE DIRECTED IN FIELD. PAINT SUPPORT ASSEMBLIES WITH MARINE ENAMEL.
18. 50ø FIPT M.I. UNION–GROUND JOINT BRONZE TO IRON



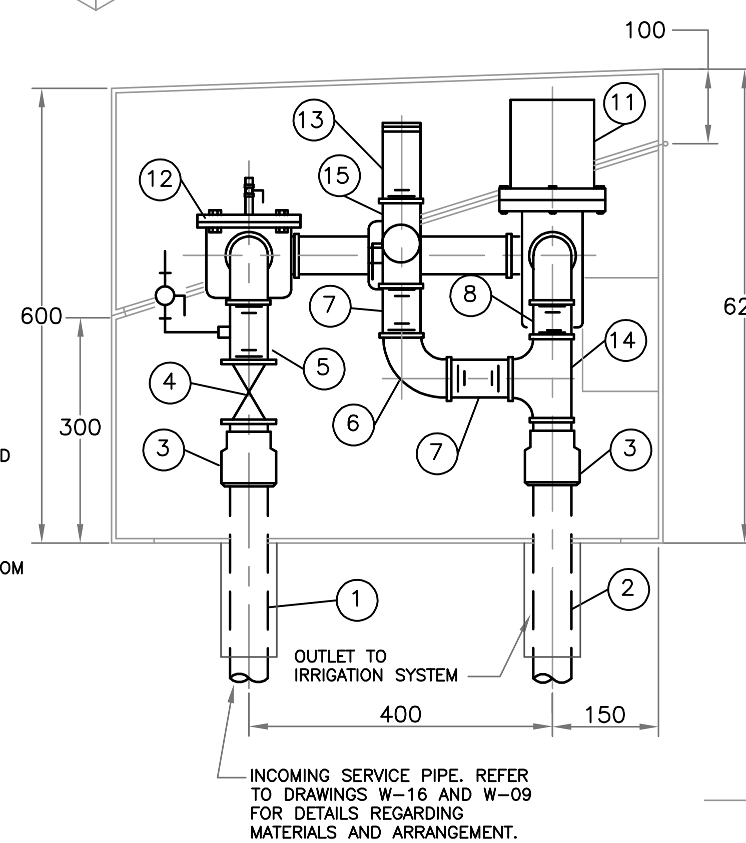




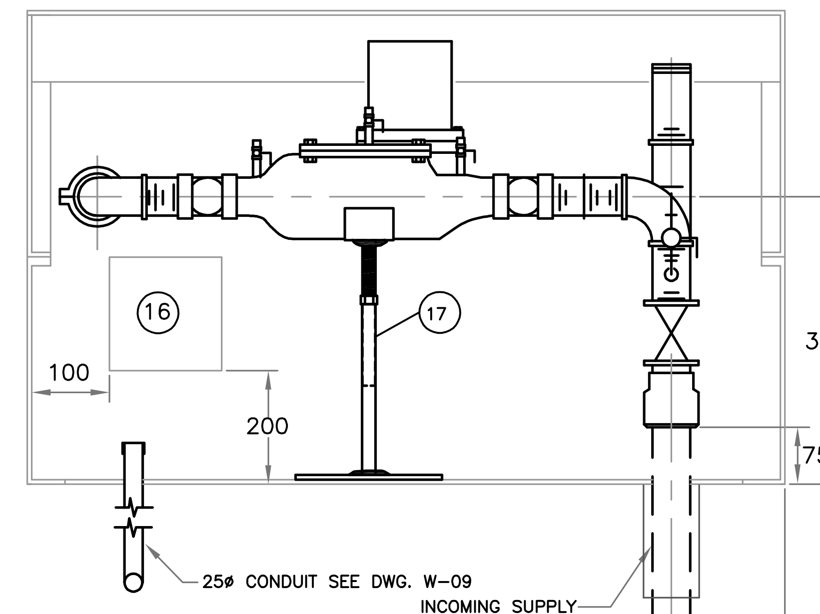
SUPPORT DET.



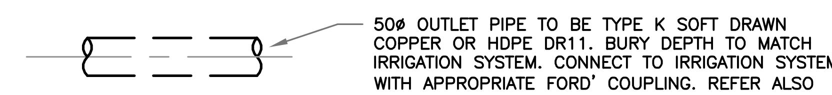
PLAN VIEW



RIGHT END VIEW



FRONT VIEW

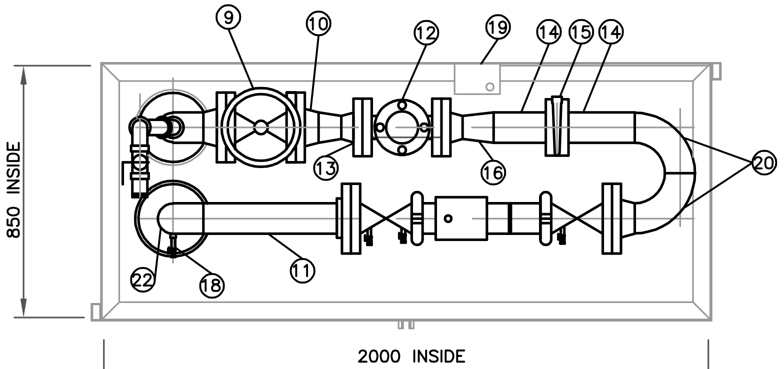


M/D/Y	Ref.	Description	By
OCT26/04		ENCLOSURE ARRANGEMENT, MATERIAL AND LATCH REVISED	SB
NOV26/01		ENCLOSURE AND PIPING DETAILS REVISED	SB
DEC21/00		ENCLOSURE AND MISC DETAILS REVISED	SB
JAN28/00		ISSUED AS STANDARD	SB

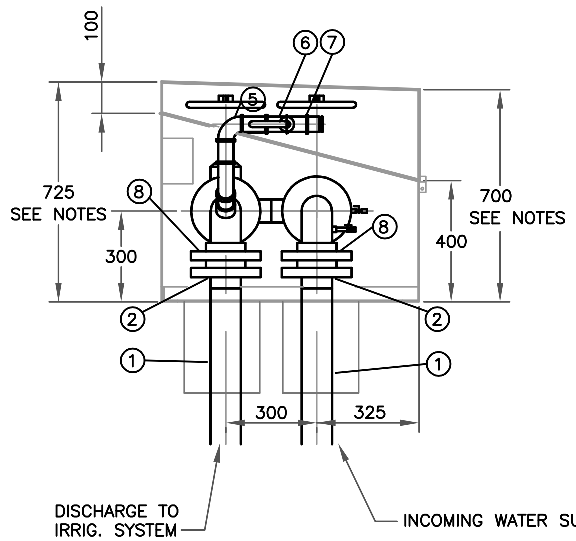
Regina
CITY OF REGINA
Engineering and Works

Approved By: KEN WIENS, Division Manager	Drawn By: sb	Project: CITY OF REGINA	Date: 01/00
	Designed by: sb		Computer File: o:\me\wat\dwgs,..wat div std dwgs
DAVID CALAM, Director	Scale: NTS	Description: 50mm IRRIGATION SERVICE - KIOSK AND EQUIPMENT INSTALLATION DETAILS	Sheet: 1 of 1
			Dwg: W-10

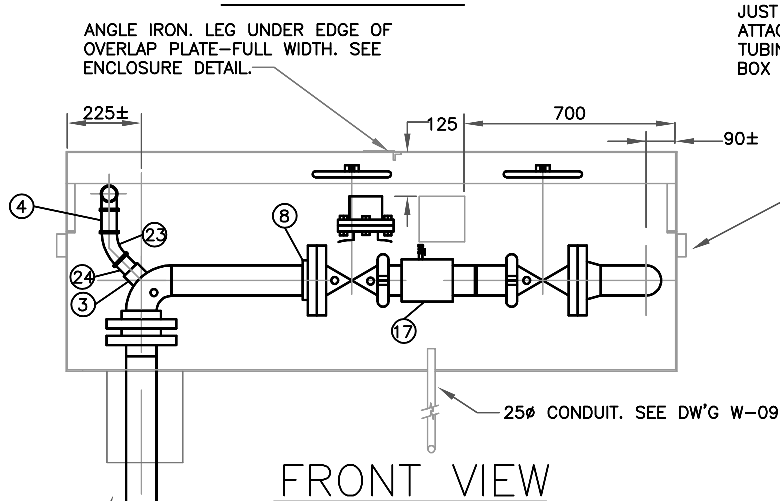
THIS DRAWING SUPERSEDED BY DRAWING W-07 APPROX 09/04 FOR 100mm IRRIGATION SERVICES. USE THIS DRAWING ONLY IF SPECIFICALLY INSTRUCTED TO DO SO.



PLAN VIEW



LEFT END VIEW



FRONT VIEW

1 – 100mm HDPE DR11 RISER FOR SUPPLY AND DISCHARGE FOR CONTINUATION REFER TO STANDARD DRAWINGS W-16, W-09 AND SITE PLAN.

2 – 100mm HDPE STUB END AND BACKING FLANGE ASSEMBLY. BACKING FLANGES TO BE EPOXY COATED DUCTILE IRON – 2 REQUIRED.

3 – 50mm x 2000LB HALF COUPLING

4 – 50mm x 75 LONG NIPPLE NPT BOTH ENDS

5 – 50mm x 300LB 90° M.I. THREAD ELL.

6 – 50mm x 400 LB WOG BRONZE BALL VALVE. NPT ENDS.

7 – 50mm MALE NPT x 'GRUVLOK' ADAPTOR.

8 – 100mm x 150LB FF SO FLANGE – 5 REQUIRED

9 – 100mm x 125LB CAST IRON BODY, FLANGED END RESILIENT SEATED GATE VALVE TO AWWA C509 – ONE REQUIRED.

10 – 100mm x 150LB FF WN FLANGE – THREE REQUIRED.

11 – 100ø STEEL PIPE. FIELD DETERMINE LENGTH REQUIRED.

12 – 75mm FLOWMETER/MASTER VALVE ASSEMBLY AS SPECIFIED.

13 – 75mm x 150LB FF WN FLANGE – TWO REQUIRED

14 – 2 x 100ø PIPE SPOOL PIECES 'GRUVLOK' GROOVE ONE END OF EACH. FIELD DETERMINE LENGTHS.

15 – 100ø 'GRUVLOK' STYLE 7003 SNAP-JOINT COUPLING – ONE REQUIRED

16 – 100 x 75 WELD REDUCER. – TWO REQUIRED.

17 – 100ø DOUBLE CHECK STYLE BACKFLOW PREVENTOR ASSEMBLY c/w NON-RISING STEM GATE STYLE ISOLATING VALVES. 'WATTS' 757 OR AS APPROVED.

18 – 15ø x 2000LB HALF COUPLING CONNECTION c/w 15ø x 400 LB WOG BRONZE BALL VALVE.

19 – 150 x 150 x 100 EEMAC 1 ELECTRICAL JUNCTION BOX c/w HINGED FRONT AND MIN. 2 X 25ø CONDUIT KNOCKOUTS. BEL EUK0664 OR EQUAL. SPOT WELD TO BOX AND FINISH SAME AS BOX.

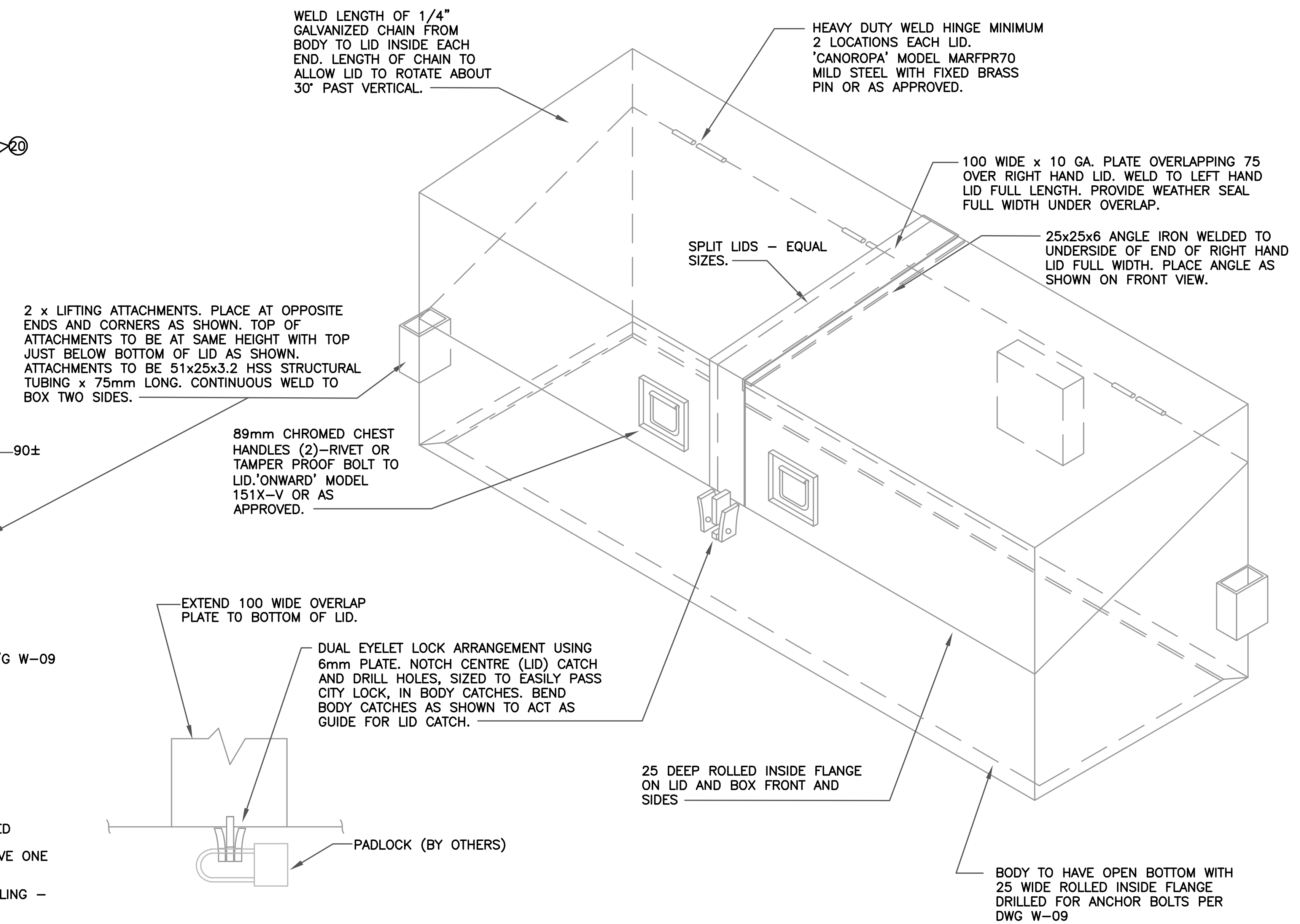
20 – 100ø LONG RADIUS 90° WELD ELLS – 2 REQUIRED

21 – NOT USED

22 – 100ø SHORT RADIUS 90° WELD ELLS – 2 REQUIRED

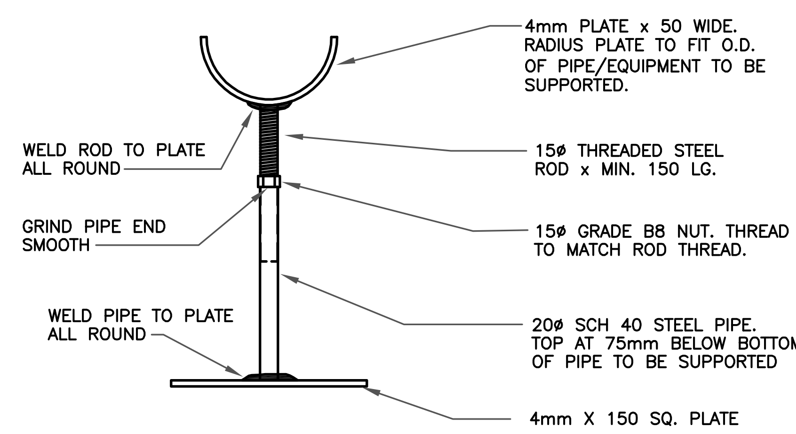
23 – 50ø x 45° 300LB THREAD ELL

24 – 50ø x 65 LONG SHORT NIPPLE



KIOSK DETAIL

NOT TO SCALE



SUPPORT DET.

NOTES:

–CONSTRUCT KIOSK WITH 14 GA. STEEL PLATE. ALL WELDS TO BE FULL LENGTH AND GROUND SMOOTH. DEGREASE, BLAST TO SSPC-SP6 INSIDE AND OUT. PRIME AND FINISH WITH TWO COATS OF MARINE ENAMEL-COLOUR CGSB 503-127 (GP INDUSTRIAL 214 SIGNAL GREEN)

–MOUNT KIOSK ON PRECAST OR CAST-IN-PLACE SLAB. REFER TO STANDARD DRAWING W-09 FOR SLAB DETAILS AND SUPPLY/DISCHARGE PIPING ARRANGEMENTS.

–PIPE AND FITTINGS 75mm AND LARGER TO BE STANDARD WT. STEEL. PIPING 50mm AND SMALLER TO BE SCH80. STEEL.

–PROVIDE A MINIMUM OF 2 REMOVABLE/ADJUSTABLE SUPPORTS. ONE UNDER BACKFLOW PREVENTER AND ONE UNDER THE METER. CLEAN, PRIME AND PAINT SUPPORTS WITH TWO COATS OF MARINE ENAMEL. SEE DETAIL THIS DRAWING.

– HEIGHT OF KIOSK SHOWN IS BASED UPON USE OF NON-RISING STEM GATE VALVES.

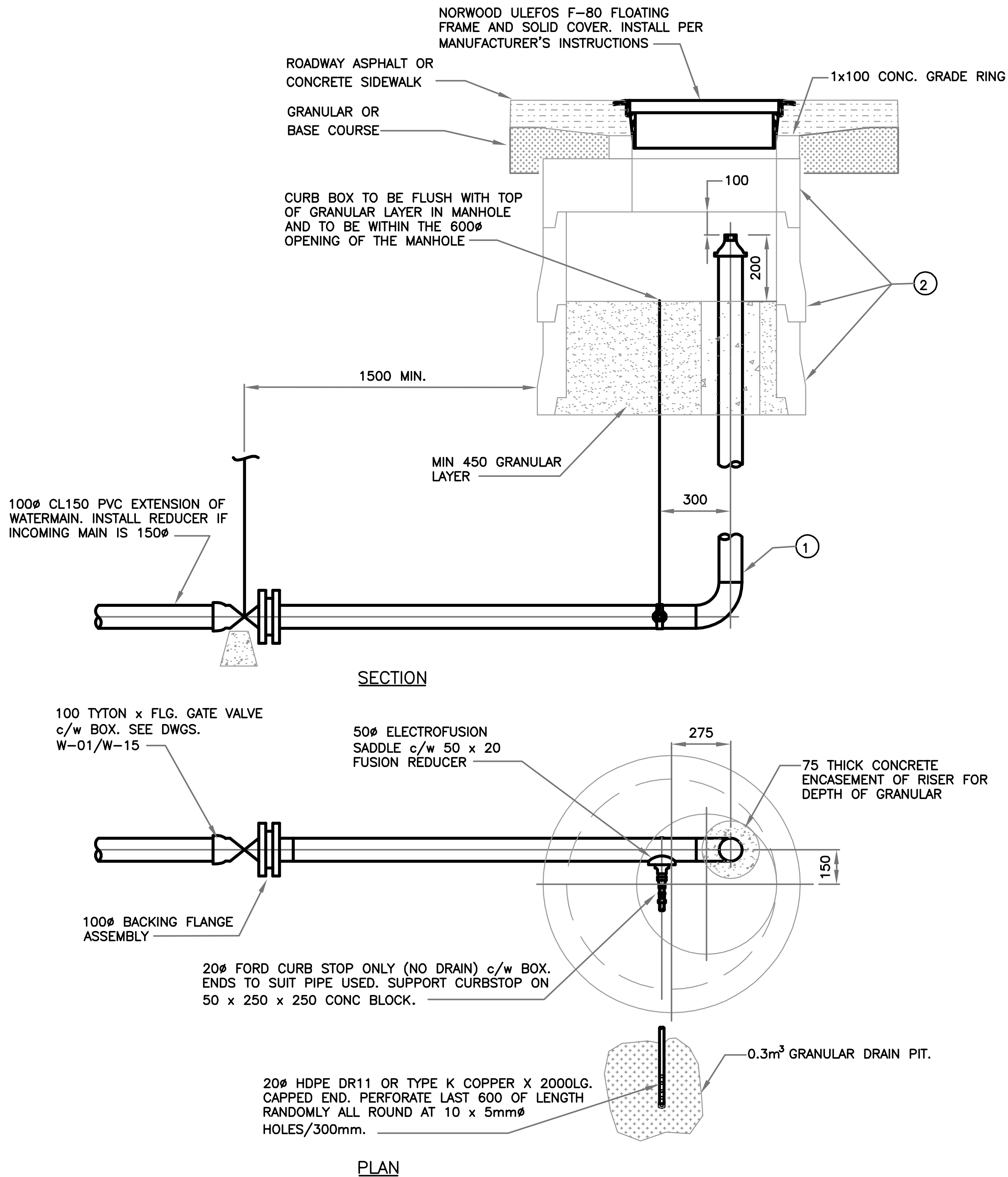
M/D/Y	Ref.	Description	By
JAN28/00		ISSUED AS STANDARD	SB
DEC21/00		REVISED ENCLOSURE AND MISC. DETAILS	SB
NOV22/01		REVISED PIPING DETAILS PER C.S. FIELD INSTALLATION	SB
JUN28/02		REVISED LOCKBOX TO MATCH 50mm KIOSK	SB
OCT26/04		REVISED KIOSK MATERIALS, PIPING, DETAILS AND LATCH	SB

Regina
CITY OF REGINA
Engineering and Works

Approved By: KEN WIENS, Division Manager	Drawn By: sb	Project: CITY OF REGINA	Date: 01/00
	Designed by: sb		Computer File: o:\me\wat\dwgs,..wat div std dwgs
DAVID CALAM, Director	Scale: NTS	Description: 100mm IRRIGATION SERVICE - KIOSK AND EQUIPMENT INSTALLATION DETAILS	Sheet: 1 of 1
			Dwg: W-11

(1) 100ø DR11 HDPE RISER ASSEMBLY c/w 100ø 'CENTRAL' TRANSITION FITTING WITH REGINA FIRE DEP'T PUMPER THREAD. CAP WITH STANDARD HYDRANT CAP AS SHOWN. LENGTH OF RISER AS REQ'D.

(2) TWO SECTIONS OF 900ø CATCHBASIN MANHOLE X 0.41m LONG AND ONE 900X600X300 CATCHBASIN FLAT TOP. CUT OFF ANY RUNGS IN MANHOLE SECTIONS. MORTAR ALL JOINTS.



Date	Revisions	By
09/02	REVISED PER TRIAL INSTALLATION	SB
11/00	PROPOSED DETAIL-FOR REVIEW	SB

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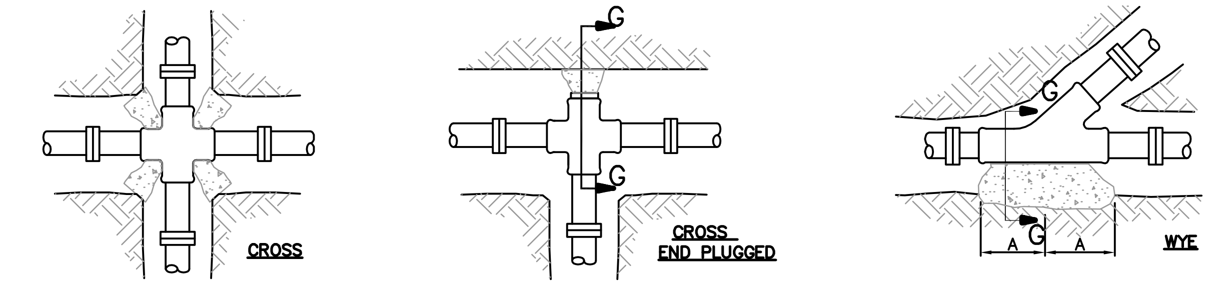
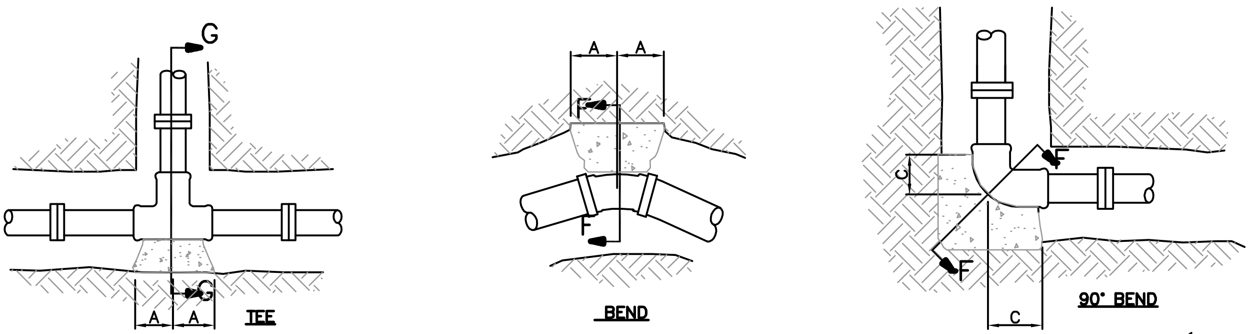
CITY OF REGINA
Engineering and Works

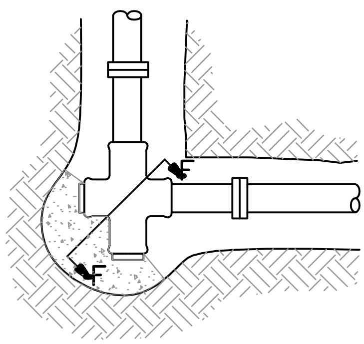
Description:

DETAIL FOR DEADEND WATERMAIN FLUSHOUT

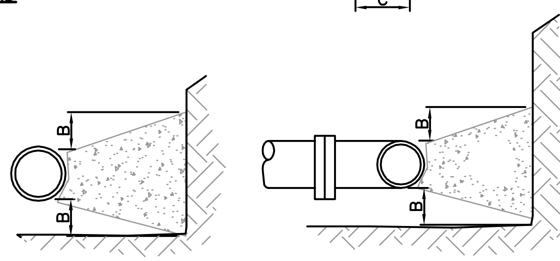
Manager	Date	Digital File:
KEN WIENS	JUL11/00	o:\me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-12







CORNER CROSS OR TEE
END(S) PLUGGED



SECTION 'F–F'   SECTION 'G–G'

NOTES:

–DIMENSIONS OF THRUST BLOCKS AND REQUIRED BEARING AREAS SHOWN ARE BASED ON A MAXIMUM TEST/OPERATING PRESSURE OF 689 kPa (100 psi) AGAINST SOIL WHICH HAS A SAFE LOAD BEARING CAPACITY OF 70 kPa (10 psi) MINIMUM. FOR ANY CONDITIONS WHICH VARY FROM THESE, THE DIMENSIONS/AREAS MUST BE ADJUSTED ACCORDINGLY

–REFER TO SPECIFICATIONS SECTION 02511 – WATERMAINS FOR CONCRETE REQUIREMENTS

ALL DIMENSIONS ARE IN MILLMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

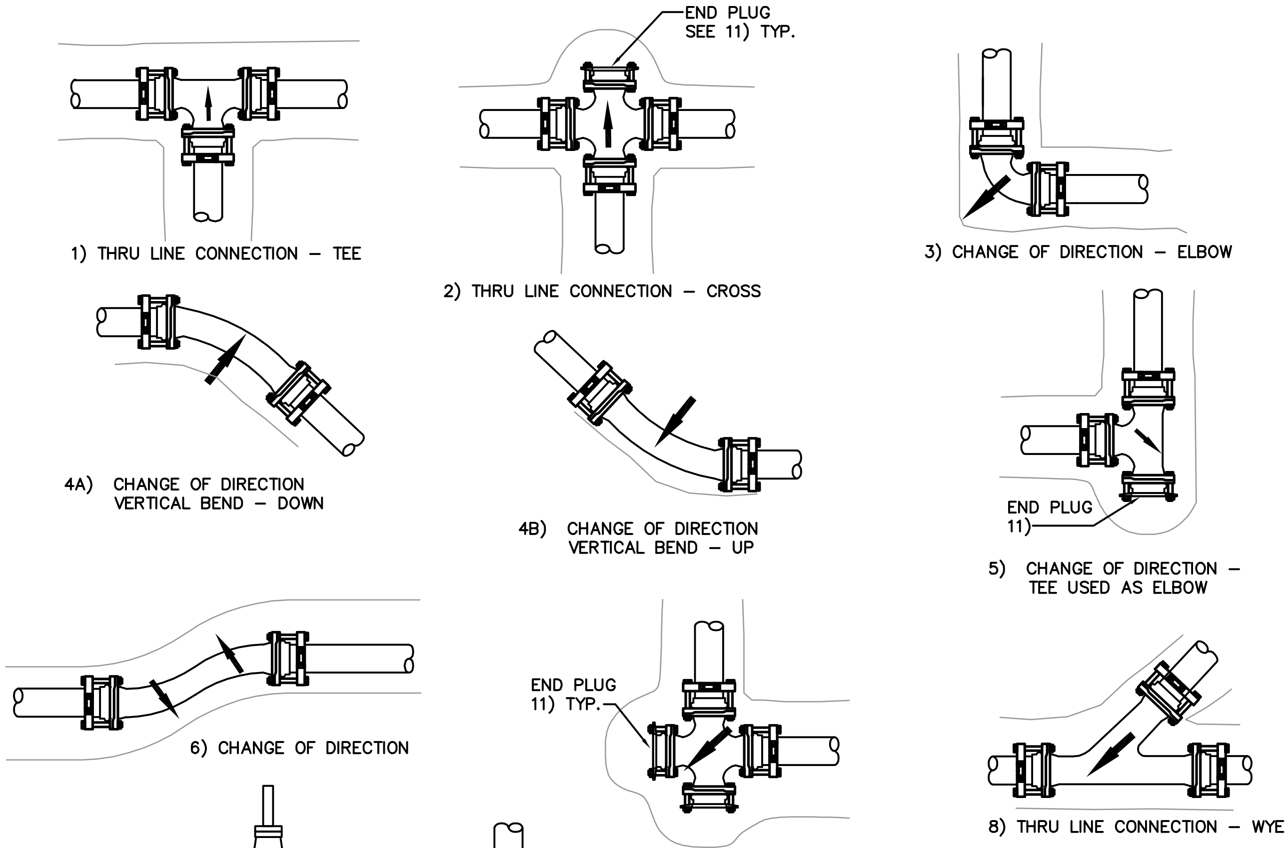
PIPE DIAMETER (mm)	90°BEND A (mm)	B (mm)	C (mm)	AREA (sq.m)	45°BEND A (mm)	B (mm)	C (mm)	AREA (sq.m)	TEE, PLUGS, WYES A (mm)	B (mm)	C (mm)	AREA (sq.m)	22.5 & 11.25 BENDS A (mm)	B (mm)	C (mm)	AREA (sq.m)
100		170	200	0.16	160	110		0.09	190	140		0.11	110	60		0.04
150		250	300	0.33	240	160		0.18	270	190		0.23	160	90		0.08
200		320	350	0.56	310	210		0.30	350	250		0.40	210	110		0.14
250		390	400	0.85	380	250		0.46	430	310		0.60	260	140		0.22
300		460	450	1.20	450	300		0.65	520	370		0.85	310	160		0.31
350		530	500	1.61	520	350		0.87	600	420		1.14	340	170		0.38
400		610	550	2.08	600	400		1.13	680	480		1.47	390	190		0.49
450		680	600	2.62	670	440		1.42	760	540		1.85	440	220		0.62
500		750	650	3.21	740	490		1.75	840	590		2.27	490	240		0.77
600		900	750	4.95	880	580		2.49	1010	710		3.24	590	290		1.22
750		1110	900	7.04	1090	720		3.81	1250	870		4.98	780	410		1.95
900		1330	1050	10.09	1310	860		5.46	1490	1040		7.14	930	480		2.79

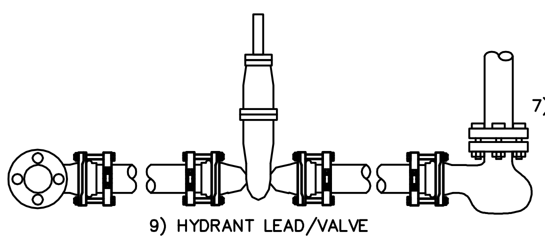
Date	Revisions	By
DEC18/02	SPEC. NO. REF. CORRECTED	SB
NOV18/98	RENUMBERED FROM W–5	SB
MAY19/98	BLOCK AREAS REVISED	SB
SEP09/97	REVISED NOTES/TITLE BLOCK	SB

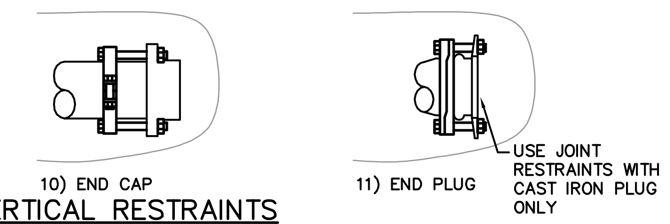
Regina
CITY OF REGINA
Engineering and Works

Description:
THRUST BLOCKS

Manager	Date	Digital File:
KEN WIENS	MAR18/77	o:\me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-13







HORIZONTAL RESTRAINTS

TYPE	NOMINAL PIPE SIZE 100	150	200	250	300
90° BEND	1.5m	2.1m	2.7m	3.4m	4.0m
45° BEND	0.6m	0.9m	1.2m	1.5m	1.8m
22.5° BEND	0.3m	0.6m	0.6m	0.6m	0.9m
11.25° BEND	0.3m	0.3m	0.3m	0.3m	0.6m
SIZE ON SIZE TEE	Br. only	Br. only	Br. only	Br. only	Br. only
PLUGS & VALVES	3.0m	4.3m	5.5m	6.7m	7.9m

NOTES

1) RESTRAINED LENGTHS IN TABLE ARE FOR MAXIMUM TEST PRESSURE OF 690kPa WITH PIPE FULLY BEDDED IN GRANULAR MATERIAL. IF SITE CONDITIONS VARY FROM THESE – CONTACT THE ENGINEER.

VERTICAL RESTRAINTS

1) THE FIRST NUMBER IN THIS TABLE IS THE RECOMMENDED RESTRAINED LENGTH OF PIPE ON EACH SIDE OF A VERTICAL BEND WHERE THE THRUST IS ACTING GENERALLY UPWARDS TOWARDS THE GROUND SURFACE. SEE FIGURE 4A.
2) THE SECOND NUMBER IN THIS TABLE IS THE RECOMMENDED RESTRAINED LENGTH OF PIPE ON EACH SIDE OF A VERTICAL BEND WHERE THE THRUST IS ACTING GENERALLY DOWNWARDS AWAY FROM THE GROUND SURFACE. SEE FIGURE 4B.
3) WHERE RECOMMENDED RESTRAINTS LENGTHS OVERLAP BETWEEN FITTINGS RESTRAIN ALL JOINTS BETWEEN THEM.

TYPE	NOMINAL PIPE SIZE 100	150	200	250	300
45° VERTICAL OFFSET	1.2m/0.6m	1.8m/0.9m	2.4m/1.2m	2.7m/1.5m	3.4m/1.8m
22.5° VERTICAL OFFSET	0.6m/0.3m	0.9m/0.6m	1.2m/0.6m	1.5m/0.9m	1.5m/0.9m

Date	Revisions	By
NOV18/98	RENUMBERED FROM W–5A	S.B.
SEP29/98	END PLUGS ADDED. MINOR MODS.	S.B.
SEP16/97	NOTES/TITLE BLOCK REVISED	S.B.

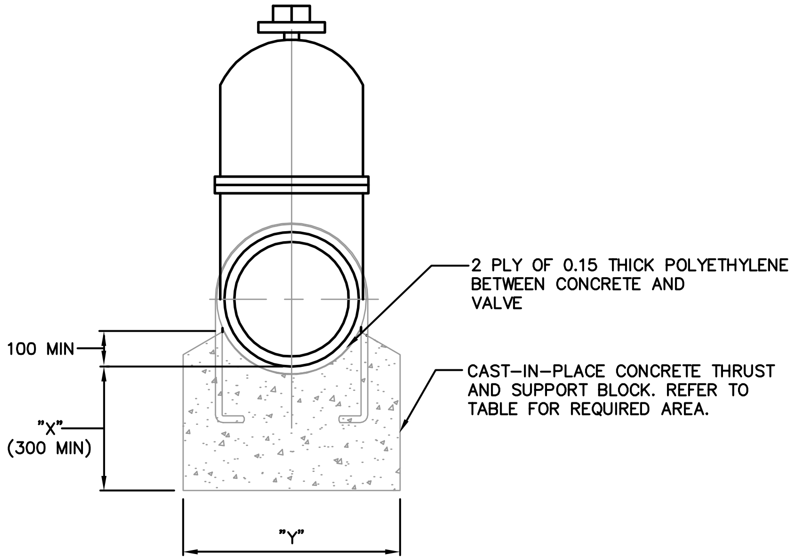
CITY OF REGINA

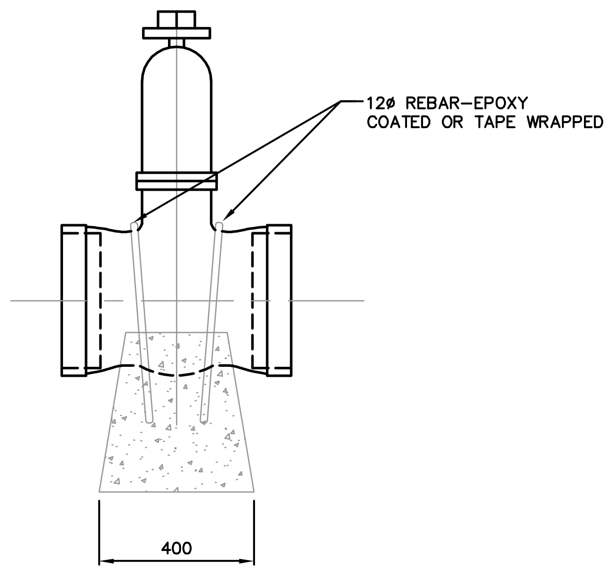
Engineering and Works

Description:

MECHANICAL THRUST RESTRAINTS

Manager	Date	Digital File:
KEN WIENS	SEP16/97	o:\me\wat\dwgs..wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-14





VALVE SIZE (mm)	REQUIRED AREA - SQ. M $\frac{"X"}{1000} \times \frac{"Y"}{1000} = AREA$
100	0.09
150	0.18
200	0.31
250	0.47
300	0.67
350	0.97
400	1.25
450	1.56
500	1.93
600	2.73
750	4.20
900	6.03

NOTES:

1) DIMENSIONS OF BLOCK AND REQUIRED BEARING AREA ARE BASED UPON A MAXIMUM TEST/OPERATING PRESSURE OF 689 kPa (100 psi) AGAINST SOIL WHICH HAS A SAFE LOAD BEARING CAPACITY OF 70 kPa (10 psi) MINIMUM. FOR ANY CONDITION WHICH VARIES FROM THESE CONFIRM REQUIRED AREA WITH THE ENGINEER.

2) FOR CONCRETE REQUIREMENTS REFER TO SPECIFICATIONS SECTION 02511-WATERMAINS

3) ANY VALVE WHICH HAS EITHER 'TYTON' OR MJ STYLE END CONNECTIONS MUST BE ANCHORED AS SHOWN. THIS INCLUDES GATE VALVES AND BUTTERFLY VALVES.

ALL DIMENSIONS ARE IN MILLMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
NOV07/01	NOTE 3 ADDED TO CLARIFY	S.B.
NOV18/98	RENUMBERED FROM W-5B	S.B.
MAY19/98	REVISED AND TABLE ADDED	S.B.
SEP09/97	REVISED TITLE BLOCK	S.B.

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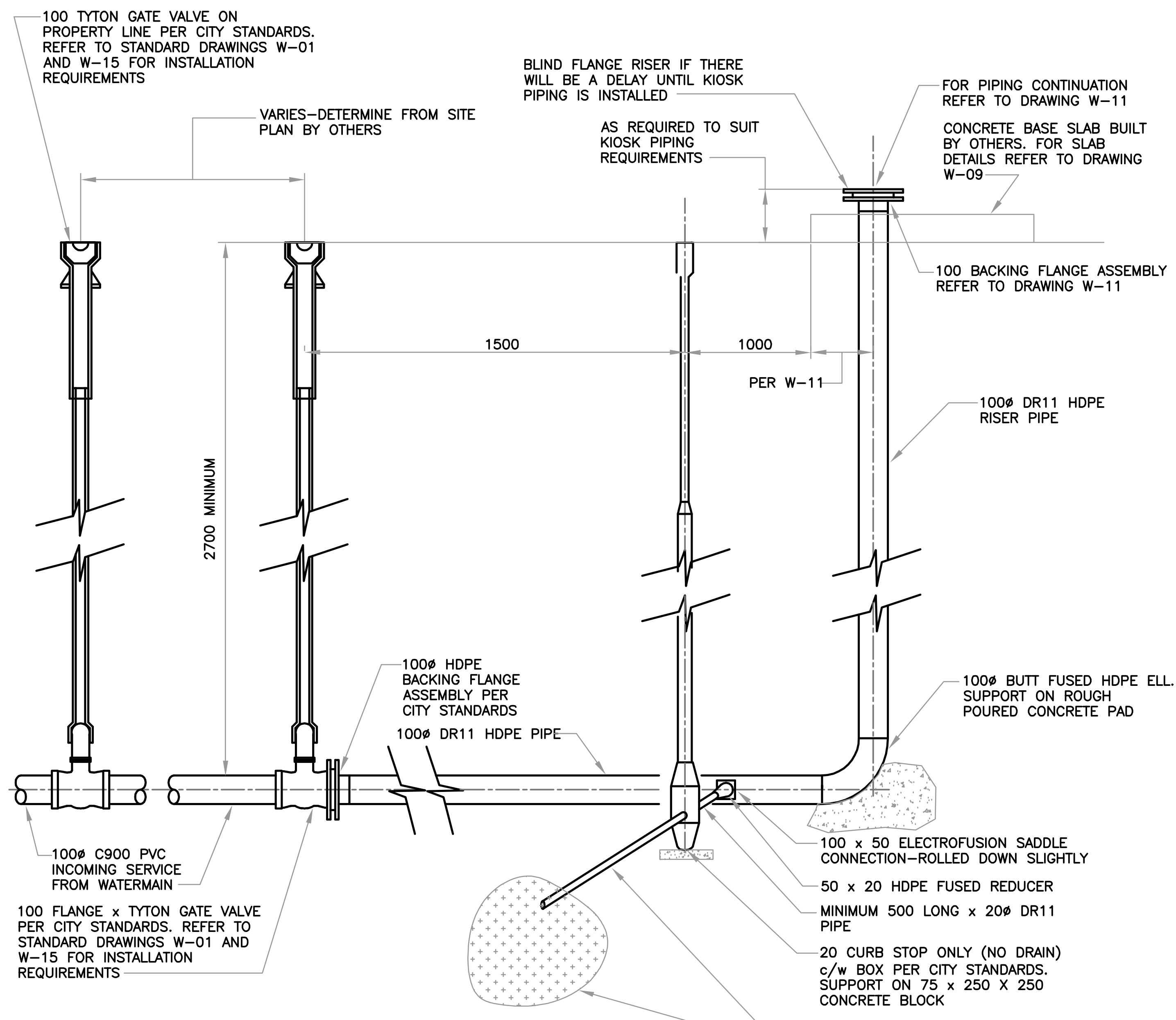
Engineering and Works

Description:

VALVE ANCHORING

Manager	Date	Digital File:
KEN WIENS	NOV06/96	o:\me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-15



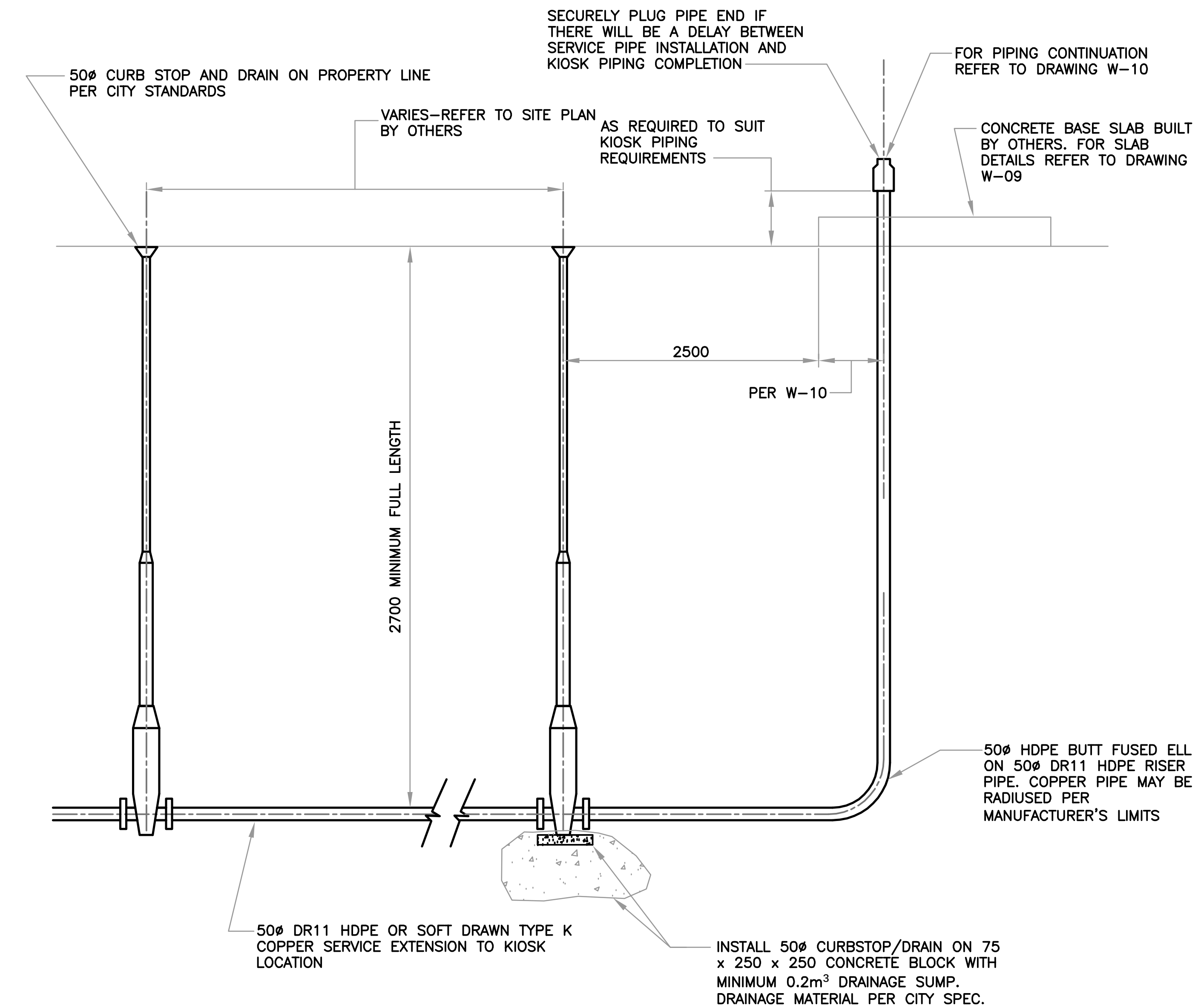
NOTES:

THOROUGHLY COMPACT INCOMING SERVICE EXCAVATION TO AT LEAST 95% STANDARD PROCTOR DENSITY. MAXIMUM UNCOMPACTED LIFT THICKNESS TO BE 300mm.

DETERMINE PIPE AND DRAIN ORIENTATION FROM DRAWINGS AND CONFIRM WITH COMMUNITY SERVICES, IRRIGATION DIVISION, BEFORE PROCEEDING WITH INSTALLATION.

TO OBTAIN PRE–MANUFACTURED HDPE EXTENSION/RISER AND DRAIN PIPING CONTACT PERMA ENGINEERING IN SASKATOON.

DETAIL–100mm SERVICE TO IRRIGATION KIOSK



NOTES:

THOROUGHLY COMPACT INCOMING SERVICE EXCAVATION TO AT LEAST 95% STANDARD PROCTOR DENSITY. MAXIMUM UNCOMPACTED LIFT THICKNESS TO BE 300mm.

DETERMINE PIPE AND DRAIN ORIENTATION FROM DRAWINGS AND CONFIRM WITH COMMUNITY SERVICES, IRRIGATION DIVISION, BEFORE PROCEEDING WITH INSTALLATION.

TO OBTAIN PRE–MANUFACTURED HDPE EXTENSION/RISER AND DRAIN PIPING CONTACT PERMA ENGINEERING IN SASKATOON.

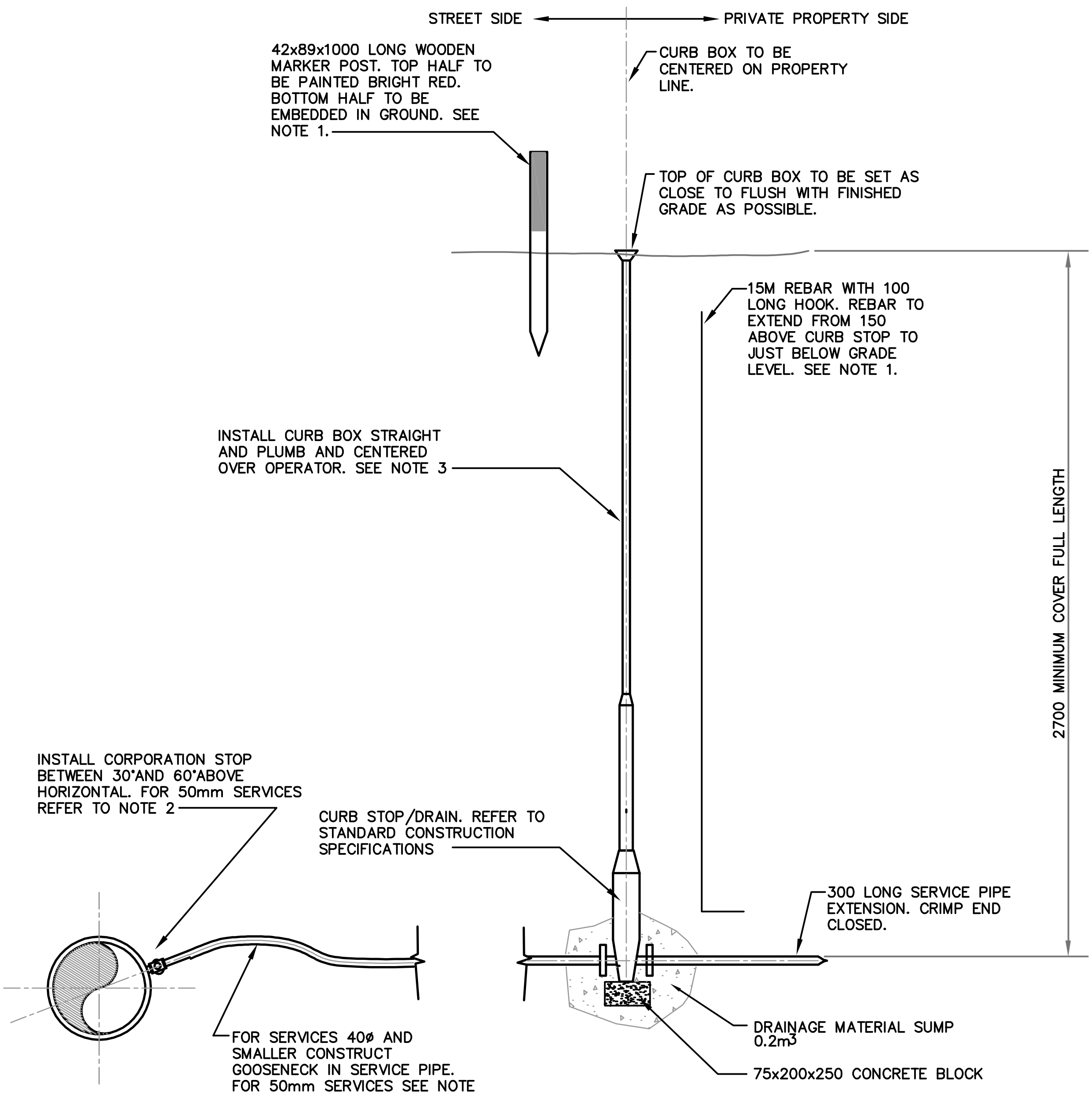
DETAIL–50mm SERVICE TO IRRIGATION KIOSK

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

M/D/Y	Ref.	Description	By
NOV19/01		NEW DRAWING – ISSUED FOR REVIEW AND APPROVAL	SB

Regina
CITY OF REGINA
Engineering and Works

Approved By	Drawn By	Project	Date:
KEN WIENS, Division Manager	sb	CITY OF REGINA	11/01
	Designed by: sb		Computer File: o:\me\wat\dwgs..wat div std dwgs
DAVID CALAM, Director	Scale: NTS	Description: DETAILS OF 50mm and 100mm WATER SERVICE EXTENSIONS TO IRRIGATION KIOSKS	Sheet: 1 of 1
			Dwg: W-16



NOTES:

1. WOODEN MARKER POST AND REBAR ARE ONLY REQUIRED IF CURB BOX IS TO BE INSTALLED AT A LATER DATE.

2. 50mm SERVICES DO NOT REQUIRE A GOOSENECK ON THE SERVICE PIPE. CONNECT TO MAIN AT HORIZONTAL.

3. INSTALL THE CURB BOX WHEN THE SERVICE LINE IS BEING EXTENDED TO THE BUILDING.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

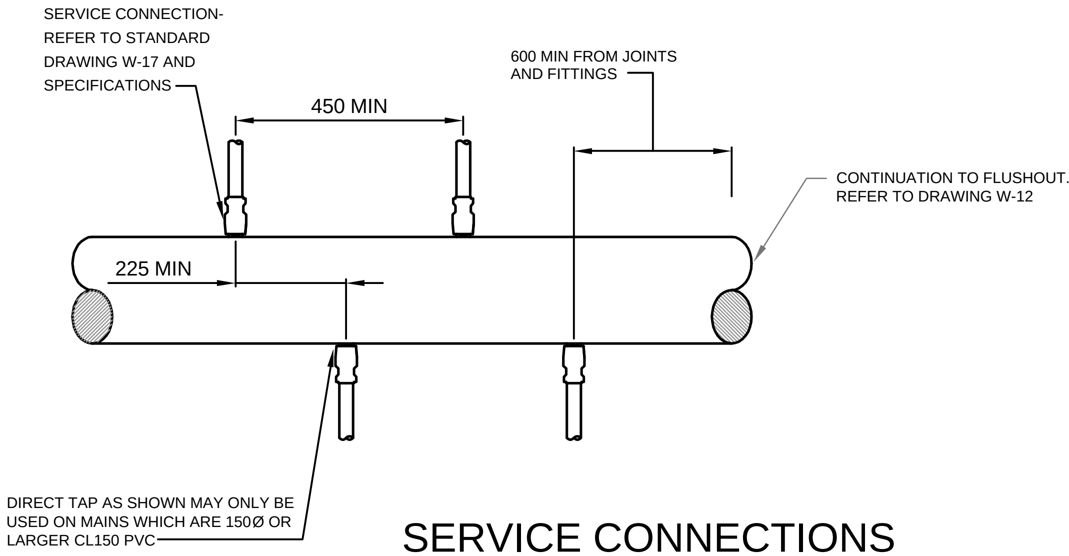
Date	Revisions	By
OCT14/03	NOTE 3 ADDED/MINOR MODS.	S.B.
NOV10/00	NOTE 2 ADDED/NOTES MOD.	S.B.
SEP17/99	W17 AND W18 COMBINED	S.B.
NOV19/98	RENUMBERED FROM W-20	S.B.
SEP24/98	FIRST ISSUE	S.B.

Regina
CITY OF REGINA
Engineering and Works

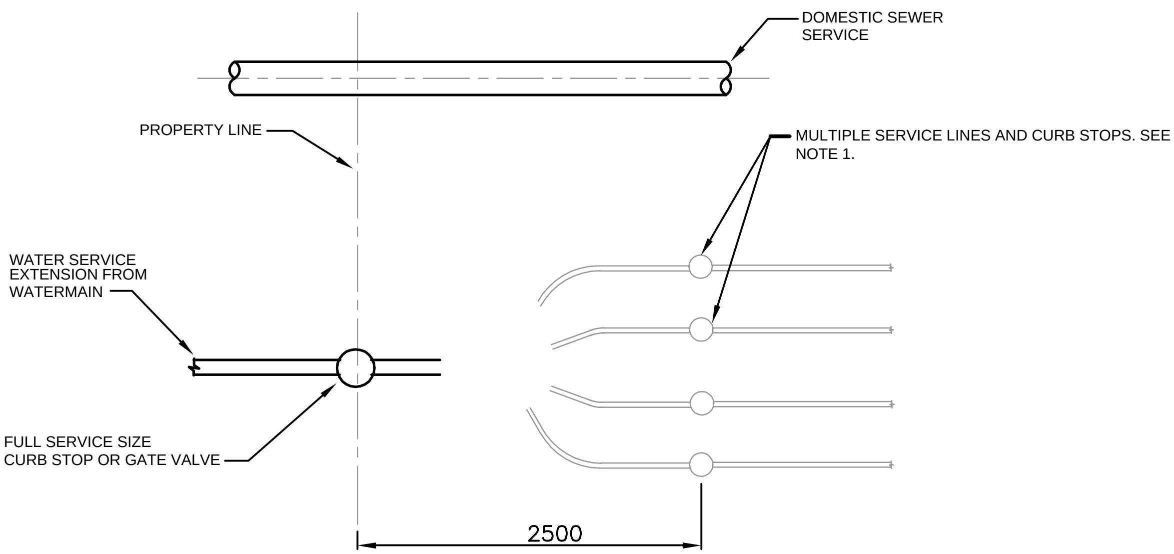
Description:

WATER SERVICE CONNECTION 50mm AND SMALLER SERVICES

Manager	Date	Digital File:
KEN WIENS	SEP24/98	o:\me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-17



SERVICE CONNECTIONS FROM DEADEND WATERMAINS



ARRANGEMENT OF SERVICE CONNECTIONS TO MULTIPLE METERED BUILDINGS

NOTES:

1) MULTIPLE SERVICE LINES AND CURB STOPS AS SHOWN MAY BE DELETED IF WATER METERS AND SHUTOFF VALVES ARE LOCATED IN A COMMON ROOM WHICH IS INACCESSIBLE TO THE PUBLIC IN ACCORDANCE WITH THE WATER BYLAW.

2) REFER TO SPECIFICATIONS SECTION 02516 FOR PIPING, VALVING AND INSTALLATION REQUIREMENTS

Date	Revisions	By
OCT11/02	DEADEND TO NEW FLUSHOUT	SB
SEP17/99	GENERAL REVISION	SB
NOV19/98	COMPLETE REVISION/RENUMBER	SB
MAR04/98	COMBINED W-15/W-17	SB

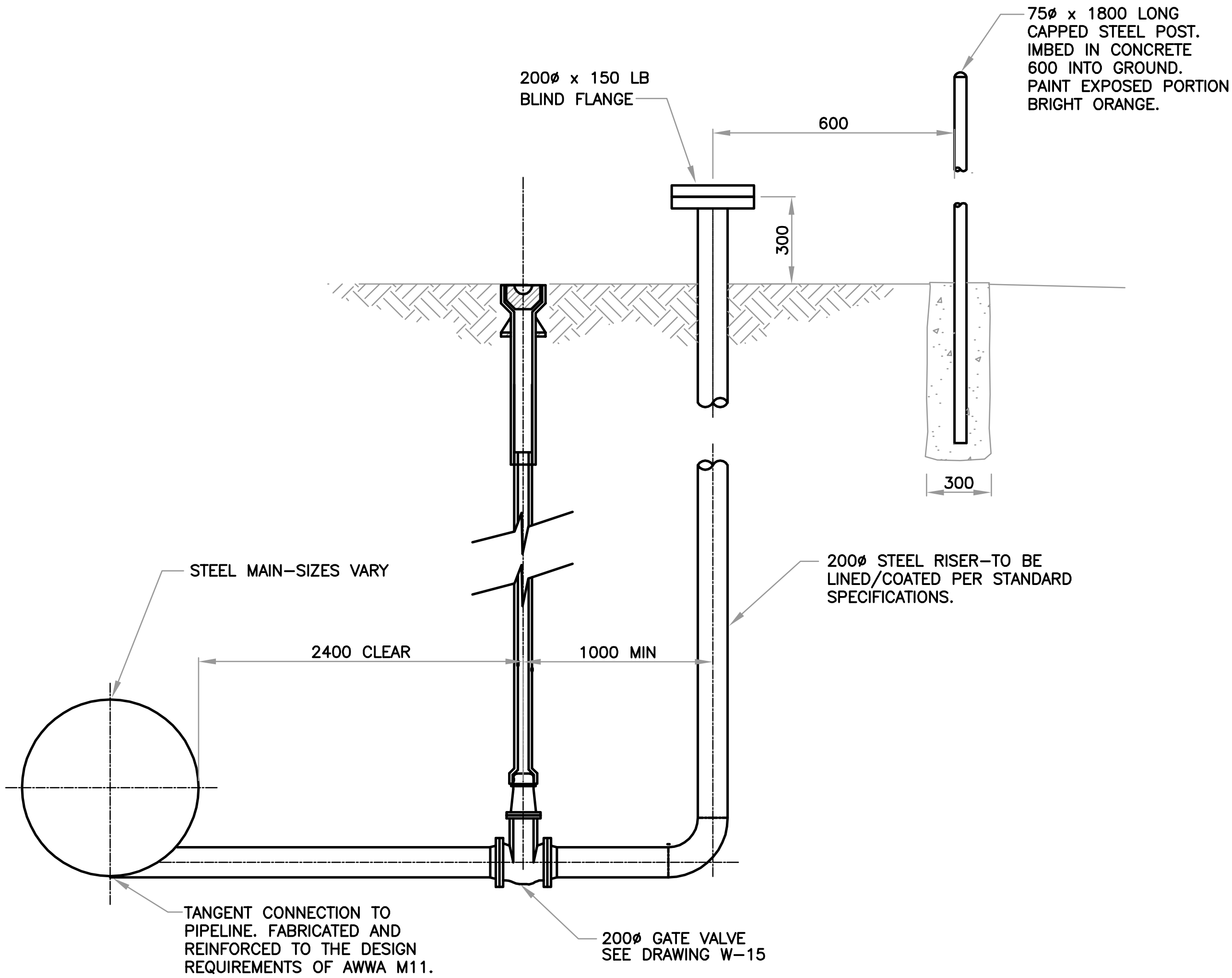
CITY OF REGINA

Engineering and Works

Description:

MULTIPLE SERVICE AND DEADEND MAIN CONNECTIONS

Manager	Date	Digital File:
KEN WIENS	July 31/ 02	me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-19



NOTES:

1) ALL MATERIALS/INSTALLATION TO BE IN ACCORDANCE WITH CITY OF REGINA STANDARD CONSTRUCTION SPECIFICATIONS FOR WATERMAIN.

2) REPAIR ALL LININGS/COATINGS DAMAGED BY CUTTING/WELDING OPERATIONS

Date	Revisions	By
NOV19/98	RENUMBERED FROM W–19	S.B.
SEP24/97	MINOR REVISIONS	S.B.
JAN27/97	REISSUED	

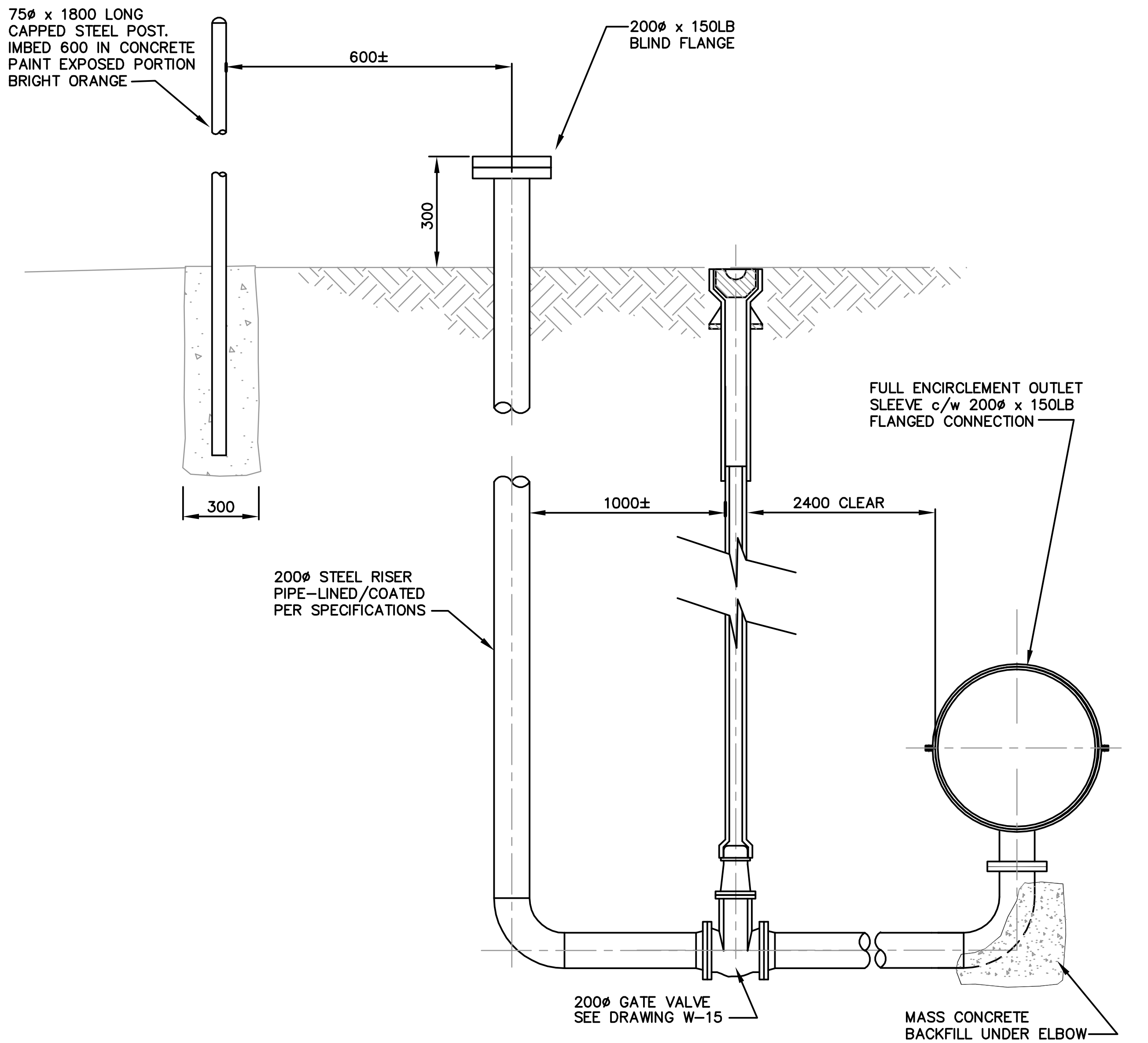
CITY OF REGINA

Engineering and Works

Description:

BLOWOFF FROM STEEL PIPELINE

Manager	Date	Digital File:
KEN WIENS	MAY01/94	o:\me\wat\dwgs...wat div std dwgs
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-23



NOTE

1) ALL MATERIALS AND INSTALLATION TO BE IN ACCORDANCE WITH CITY OF REGINA STANDARD CONSTRUCTION SPECIFICATIONS.

2) REPAIR ALL LININGS/COATINGS DAMAGED AS A RESULT OF CUTTING/WELDING OPERATIONS.

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
NOV18/98	RENUMBERED FROM W–19A	SB
SEP24/97	MINOR REVISIONS	SB
JAN27/97	REISSUED	SB

Regina

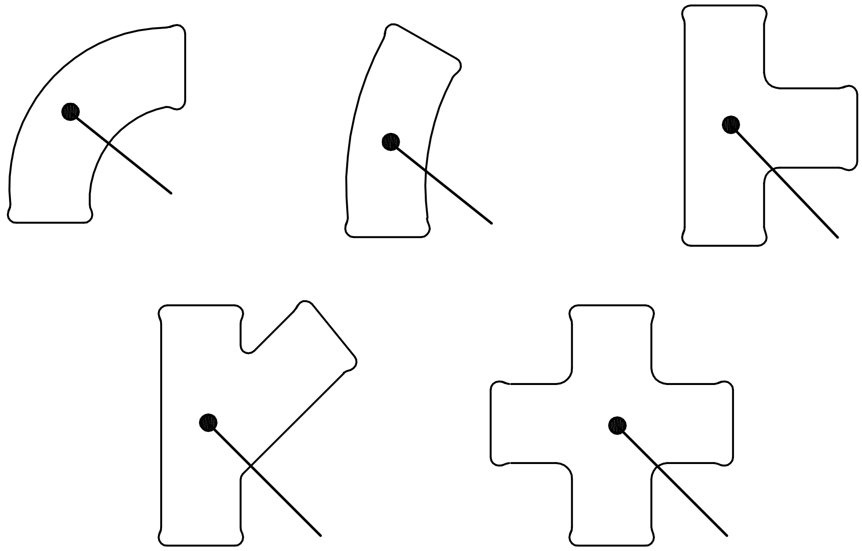
CITY OF REGINA

Engineering and Works

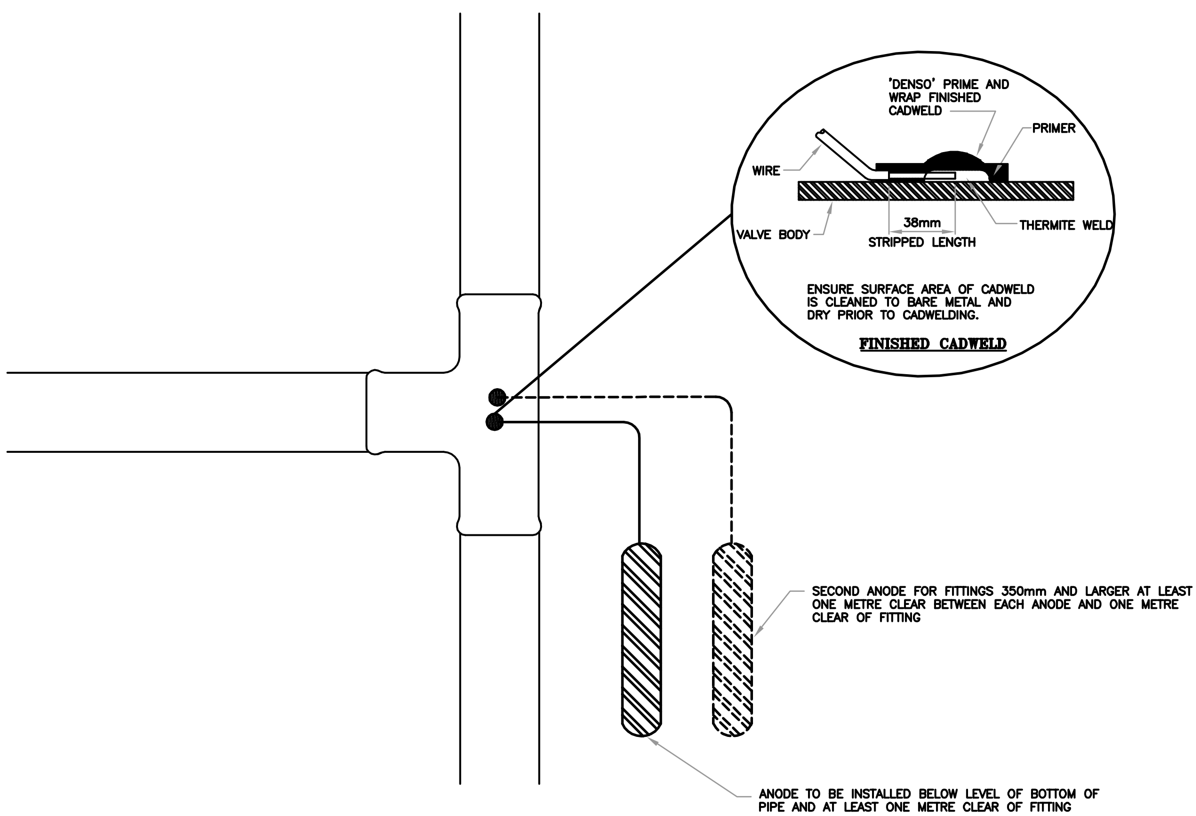
Description:

DRAIN/BLOWOFF CONNECTION FROM NON-STEEL PIPELINES

Manager	Date	Digital File:
KEN WIENS	MAY01/94	O:\ME\WAT\DWGS.........WAT DIV STD DWGS
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-24



CAST IRON FITTING—CADWELD LOCATION



NOTE:

–FITTINGS 300mm AND SMALLER REQUIRE A SINGLE ANODE. FITTINGS 350mm AND LARGER REQUIRE TWO (2) ANODES WHICH MUST BE LOCATED AS DESCRIBED AND ALSO SPACED AT LEAST ONE METRE APART.

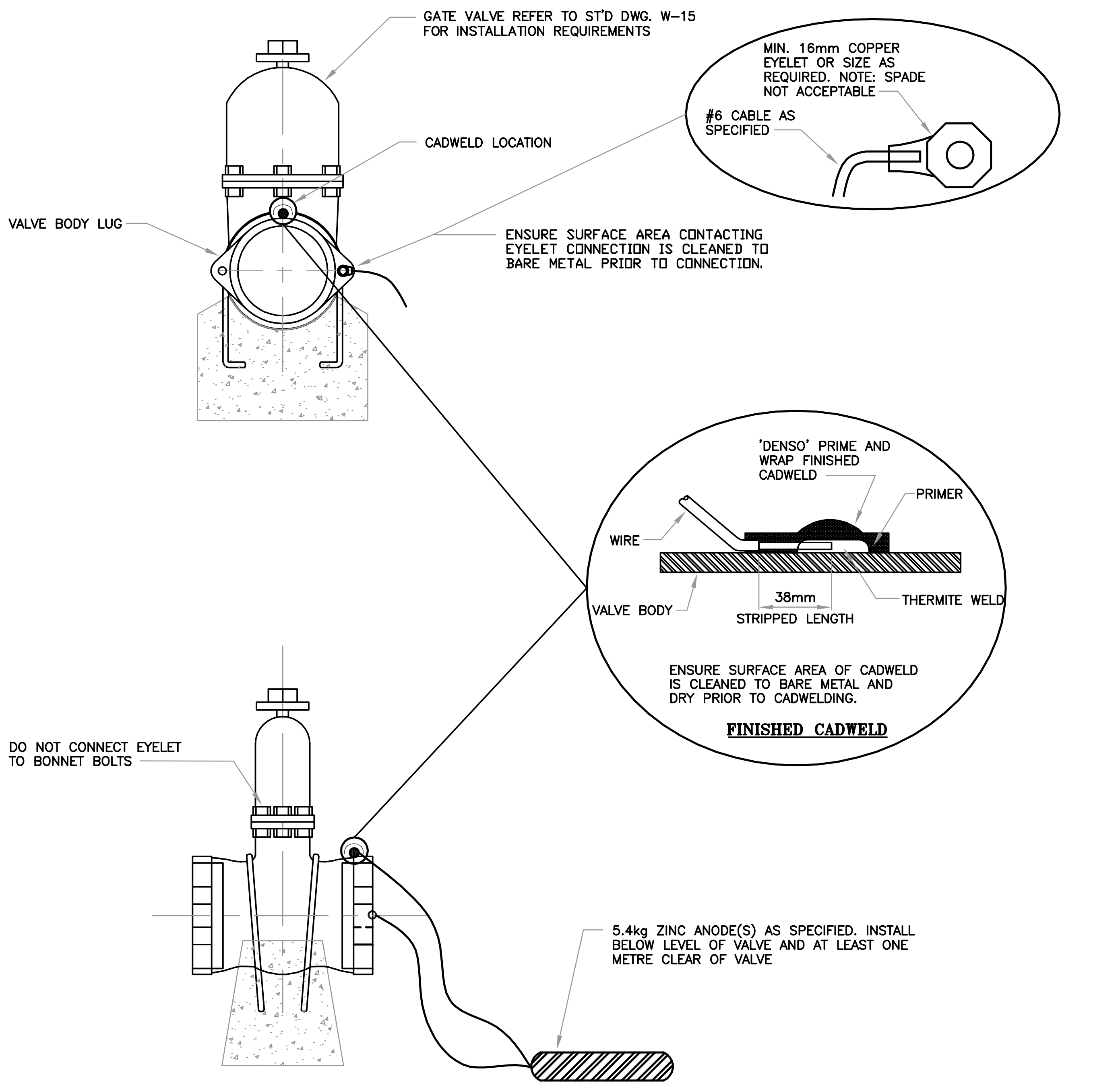
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
MAY/03	ISSUED AS STANDARD	SB

Regina
CITY OF REGINA
Engineering and Works

Description:
Cathodic Protection of Cast Iron Fittings

Manager	Date	Digital File:
KEN WIENS	Mar/03	O:me\wat\dwgs\2003 std dwgs\stdw25
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-25



NOTE:
–VALVES 300mm AND SMALLER REQUIRE A SINGLE ANODE. VALVES 350mm AND LARGER REQUIRE TWO (2) ANODES WHICH MUST BE LOCATED AS DESCRIBED AND ALSO SPACED AT LEAST ONE METRE APART.

–ANODE LEAD ATTACHMENT TO THE VALVE MAY BE MADE BY EITHER EYELET OR CADWELD. BOTH OPTIONS ARE DEPICTED ON THIS DRAWING.

–FOR VALVES 350mm AND LARGER THE ANODE LEADS MAY BE CONNECTED TO A SINGLE POINT IF EYELET CONNECTION IS USED. IF CADWELD IS USED THEN A CADWELD CONNECTION MUST BE PROVIDED FOR EACH LEAD

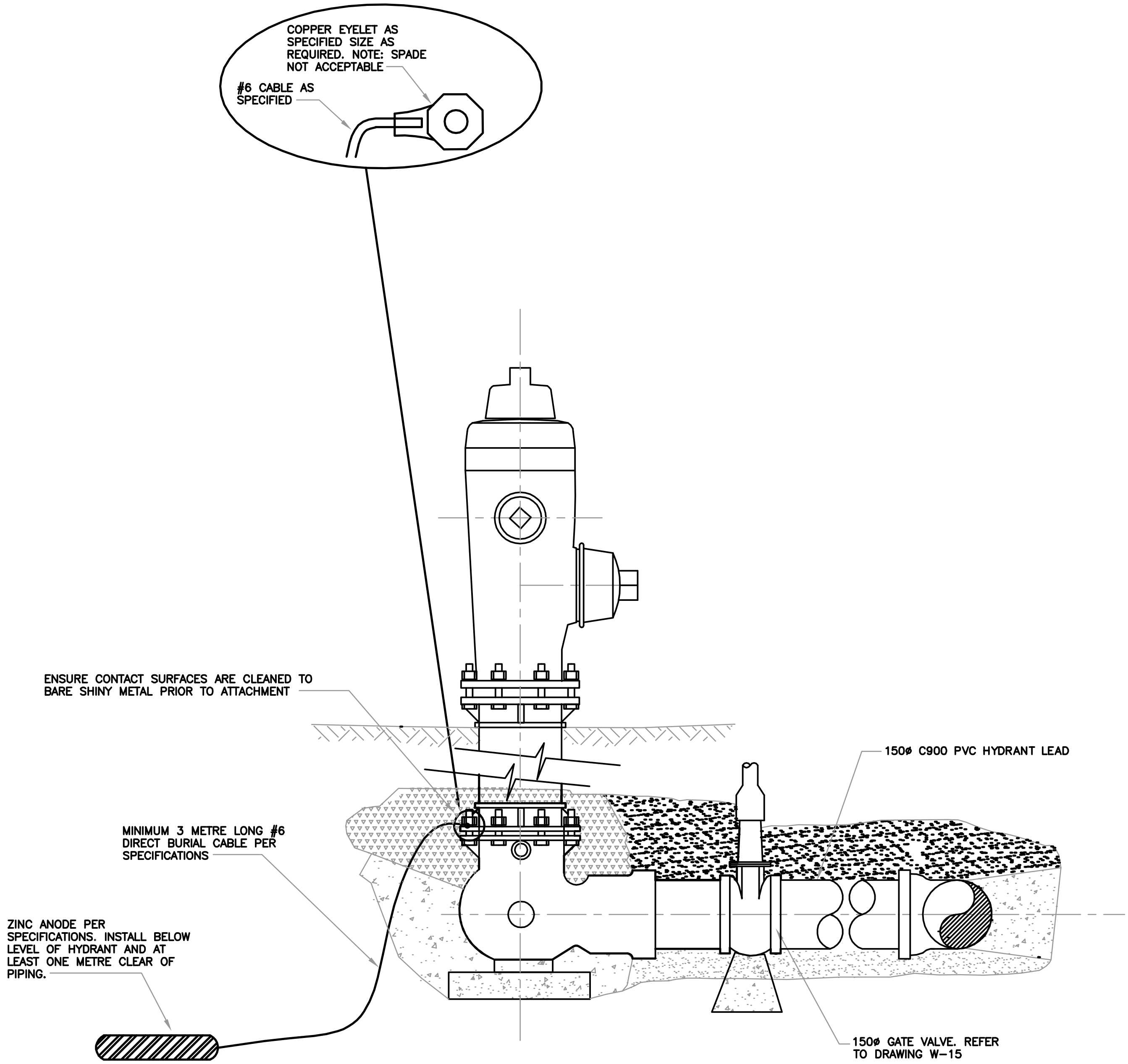
ALL DIMENSIONS ARE IN MILLMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
MAY/03	ISSUED AS STANDARD	SB

CITY OF REGINA
Engineering and Works

Description:
Cathodic Protection of Gate Valves

Manager	Date	Digital File:
KEN WIENS	Mar/03	O:\me\wat\dwgs\2003 std dwgs\stdw26
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-26



ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
MAY\03	ISSUED AS STANDARD	SB

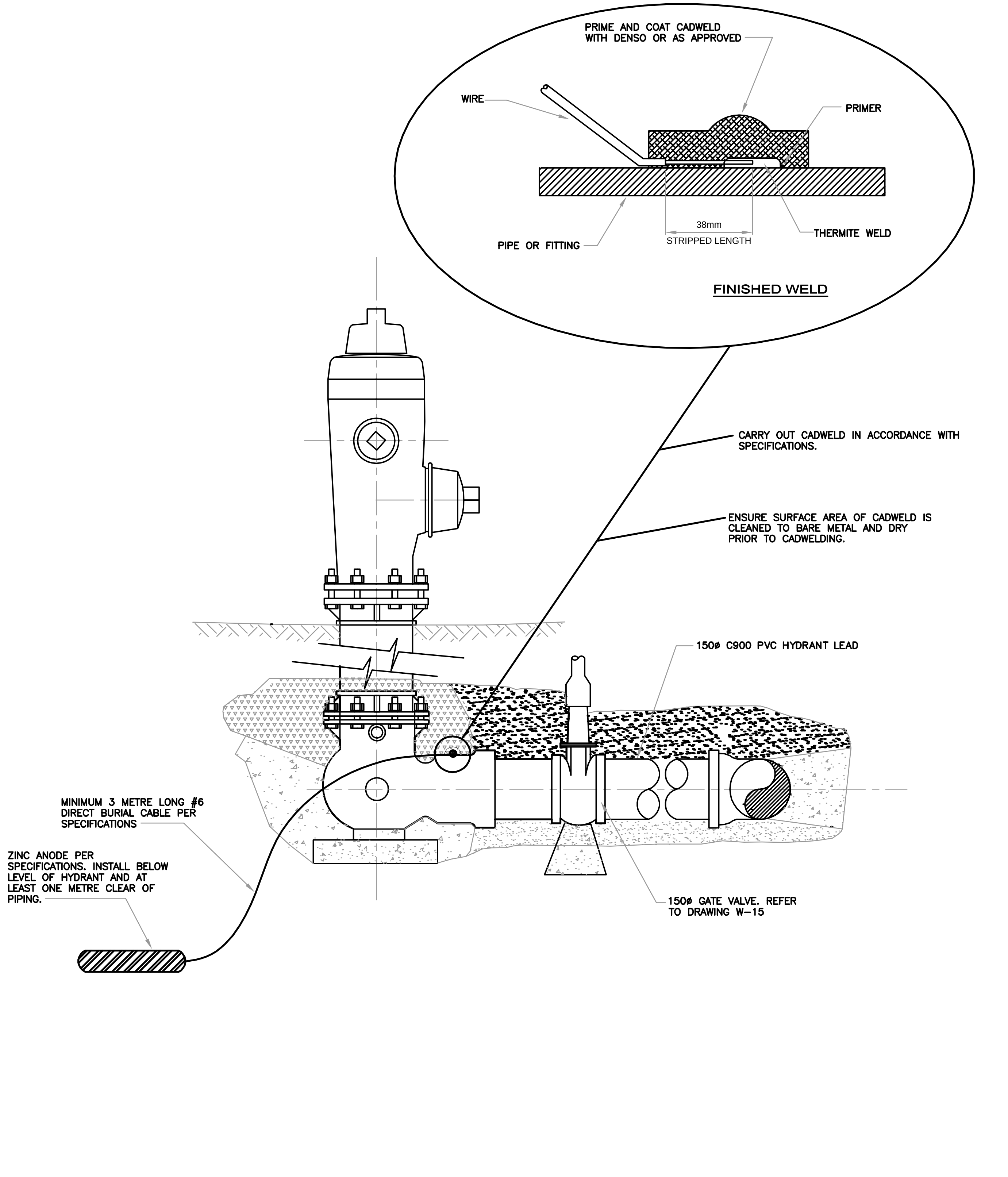
CITY OF REGINA

Engineering and Works

Description:

Cathodic Protection of Hydrant using Eyelet Connection

Manager	Date	Digital File:
KEN WIENS	Mar/03	O:\me\wat\dwgs\std dwgs 2003\stdw27
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-27



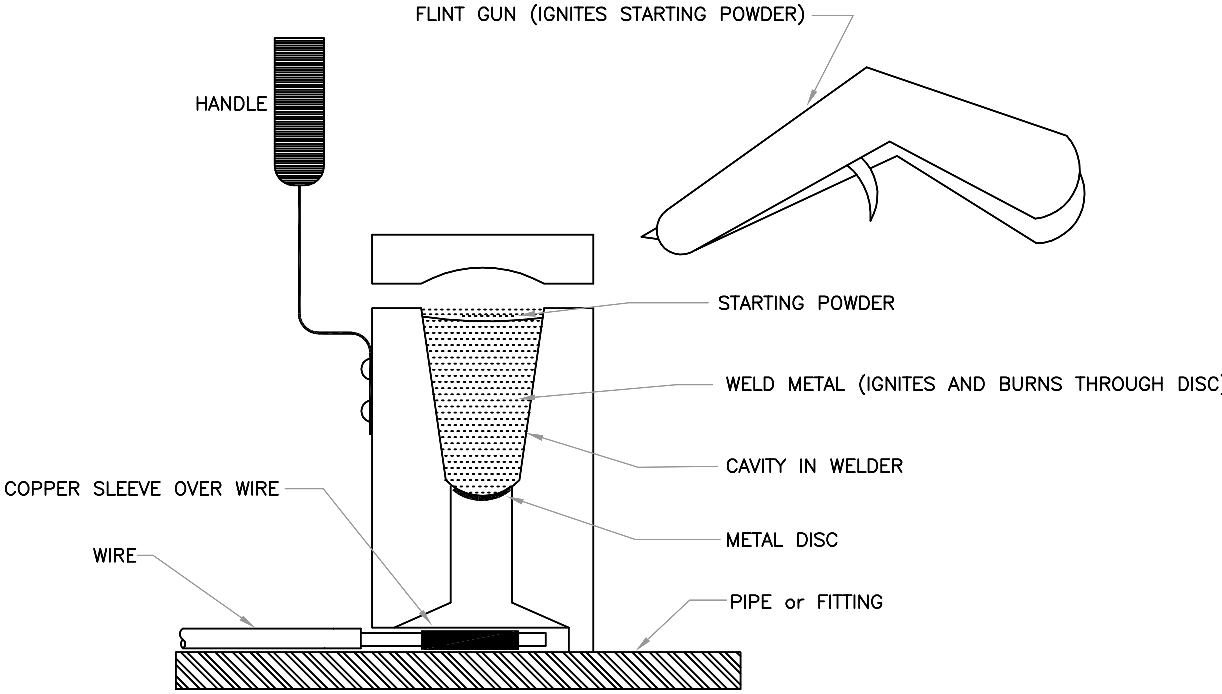
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SPECIFICALLY DENOTED OTHERWISE

Date	Revisions	By
MAY\03	ISSUED AS STANDARD	SB

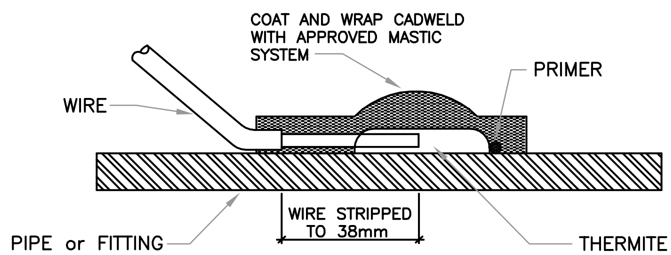
Regina
CITY OF REGINA
Engineering and Works

Description:
Cathodic Protection of Hydrant using Cadweld Connection

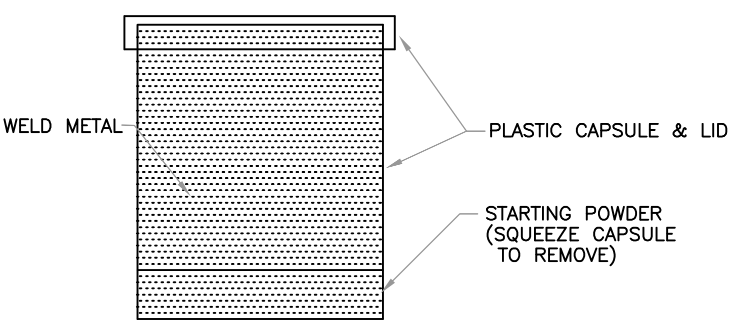
Manager	Date	Digital File:
KEN WIENS	Mar/03	O:\me\wat\dwgs\std dwgs 2003\stdw28
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-28



CADWELD



FINISHED WELD



WELD METAL CAPSULE

Date	Revisions	By
MAY\03	ISSUED AS STANDARD	SB

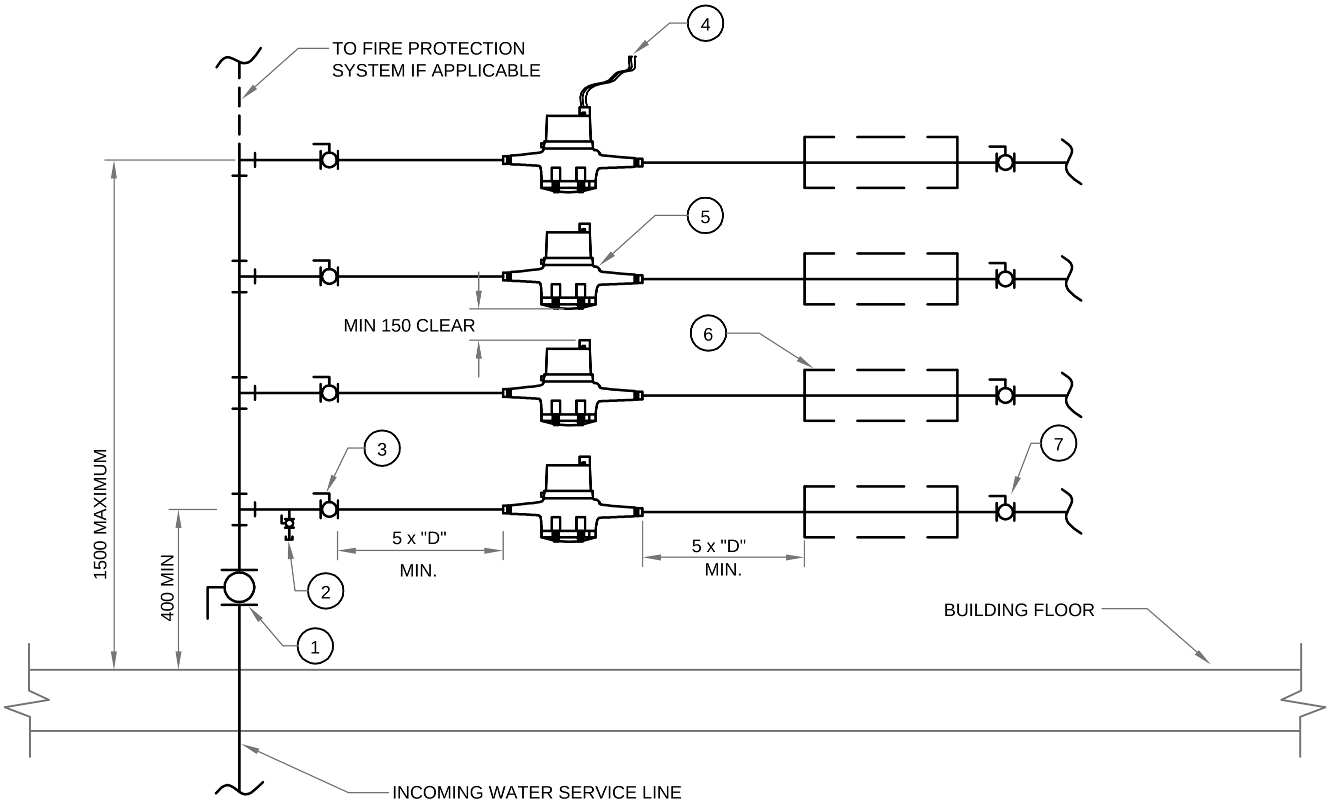
CITY OF REGINA

Engineering and Works

Description:

Typical Cadweld Description and Details

Manager	Date	Digital File:
KEN WIENS	Mar/03	O:\,me\wat\dwgs\std dwgs 2003\stdw29
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W - 29



1. ISOLATING VALVE - MUST BE THE SAME SIZE AS THE INCOMING WATER SERVICE OR THE DOMESTIC WATER SUPPLY PIPE - WHICHEVER IS SMALLER.

2. 6mm CONNECTION c/w BALL VALVE AND THREAD PLUG. ORIENT AS SHOWN.

3. FACTORY LOCKABLE BALL VALVE. SAME SIZE AS INDIVIDUAL SERVICE LINE. LOCK WILL BE SUPPLIED AND INSTALLED BY THE CITY OF REGINA. A LISTING OF APPROVED VALVES IS AVAILABLE FROM THE CITY OF REGINA.

4. THREE WIRE LEADS FROM EACH METER TO 'MULTI-READ' MXU MODULE SUPPLIED BY THE CITY OF REGINA.

5. WATER METER TYP. - SUPPLIED AND INSTALLED BY THE CITY OF REGINA - METERS WILL BE ROLLED OUTWARD APPROX. 30° SO THAT REGISTER CAN BE READ WITHOUT BEING DIRECTLY OVER TOP OF THE METER.

6. BACKFLOW PREVENTION ASSEMBLY IF SO DIRECTED BY THE CITY OF REGINA CROSS CONNECTION CONTROL COORDINATOR. UNIT TO BE FACTORY SUPPLIED c/w ISOLATING VALVES. ASSEMBLY MAY BE INSTALLED IN THE VERTICAL POSITION IF IT IS CSA APPROVED FOR THAT MOUNTING ORIENTATION. BACKFLOW PREVENTERS MAY ONLY BE INSTALLED DOWNSTREAM OF THE METER.

7. ISOLATING BALL VALVE TO BE THE SAME SIZE AS THE SERVICE LINE. THIS VALVE IS RECOMMENDED IF A BACKFLOW PREVENTER IS INSTALLED AND IS MANDATORY IF A BACKFLOW PREVENTER IS NOT REQUIRED.

NOTES:

- PIPING MATERIALS AND INSTALLATION MUST CONFORM TO CANADIAN PLUMBING CODE AND REQUIREMENTS OF THE CITY OF REGINA WATER BYLAW 8942. PROVIDE ADDITIONAL PIPING SUPPORT AS REQUIRED TO ELIMINATE STRAIN ON METER AND BACKFLOW PREVENTER.

-"D" IS THE NOMINAL DIAMETER OF THE SERVICE PIPE TO WHICH THE METER IS ATTACHED. METER SIZE(S) WILL BE DETERMINED BY THE CITY OF REGINA.

-METERS SHOWN MANIFOLDED VERTICALLY. HORIZONTAL MANIFOLDING OF METERS IS ACCEPTABLE. MINIMUM CLEAR SPACING BETWEEN METERS IS 150mm. IF METERS ARE MOUNTED IN THIS MANNER THE 'REACHOVER' DISTANCE TO THE FURTHEST METER MAY NOT EXCEED 1000mm.

-METERS MUST BE MOUNTED A MINIMUM OF 50mm CLEAR FROM WALLS.

-FOR LOCATIONS REQUIRING IN EXCESS OF 16 METERS CONSULT THE CITY OF REGINA FOR INSTALLATION REQUIREMENTS.

-ADDITIONAL PROTECTION DEVICES MAY BE REQUIRED ON INSTALLATIONS EMPLOYING A BOILER OR OTHER SPECIALIZED EQUIPMENT

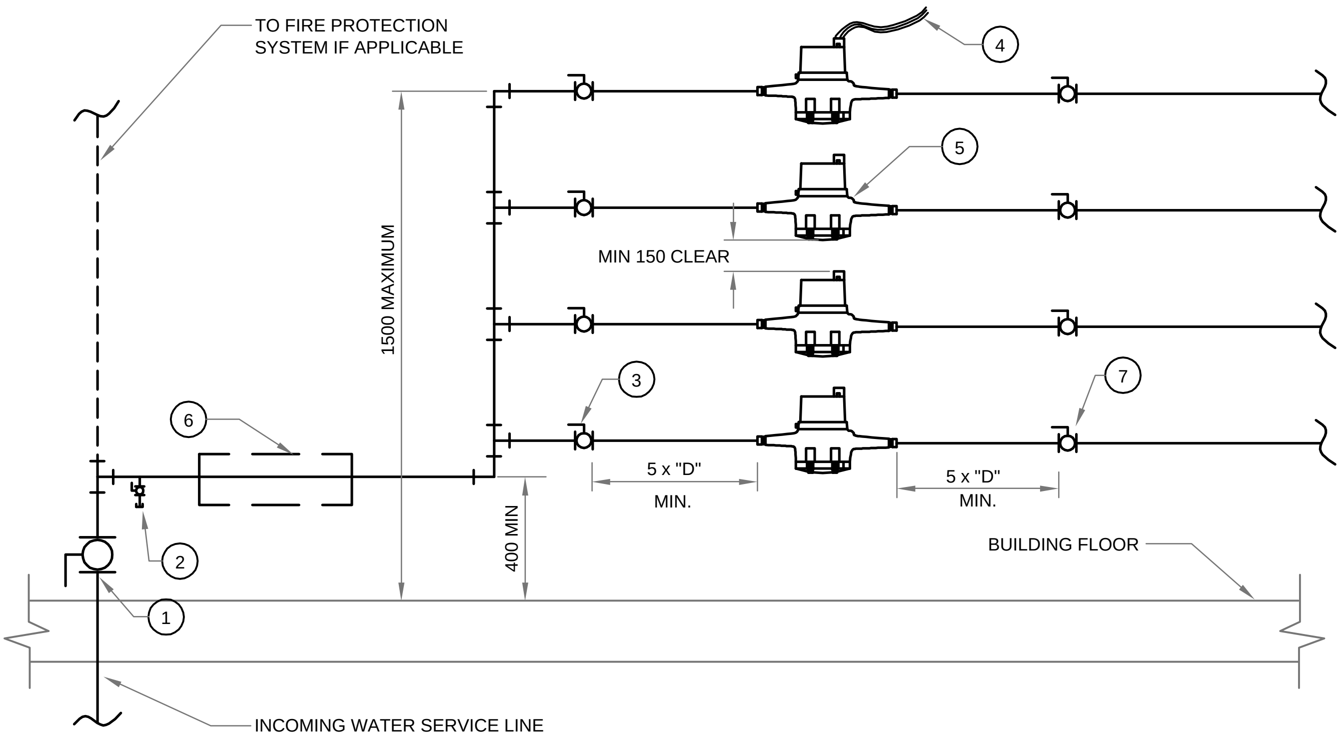
Date	Revisions	By
APR08/03	PROP. STD. FOR REVIEW	SB
JUN/03	NEW STANDARD	SB

Regina
CITY OF REGINA
Engineering and Works

Description:

WATER METER/BACKFLOW PREVENTER INSTALLATION REQUIREMENTS FOR MULTI - METERED LOCATIONS - ALT. 1

KEN WIENS **Director**	**Date** APR/03	**Digital File:** O:\ME\WAT\DWGS\WAT DIV..\ 2004\W-30
DAVID CALAM **Manager**	**Scale** NTS	**File:** W-30



1. ISOLATING VALVE - MUST BE THE SAME SIZE AS THE INCOMING WATER SERVICE OR THE DOMESTIC WATER SUPPLY PIPE - WHICHEVER IS SMALLER.

2. 6mm CONNECTION c/w BALL VALVE AND THREAD PLUG. ORIENT AS SHOWN.

3. FACTORY LOCKABLE BALL VALVE. SAME SIZE AS INDIVIDUAL SERVICE LINE. LOCK WILL BE SUPPLIED AND INSTALLED BY THE CITY OF REGINA. A LISTING OF APPROVED VALVES IS AVAILABLE FROM THE CITY OF REGINA.

4. THREE WIRE LEADS FROM EACH METER TO 'MULTI-READ' MXU MODULE SUPPLIED BY THE CITY OF REGINA.

5. WATER METER TYP. - SUPPLIED AND INSTALLED BY THE CITY OF REGINA - METERS WILL BE ROLLED OUTWARD APPROX. 30° SO THAT REGISTER CAN BE READ WITHOUT BEING DIRECTLY OVER TOP OF THE METER.

6. BACKFLOW PREVENTION ASSEMBLY IF SO DIRECTED BY THE CITY OF REGINA CROSS CONNECTION CONTROL COORDINATOR. UNIT TO BE FACTORY SUPPLIED c/w ISOLATING VALVES. ASSEMBLY MAY BE INSTALLED IN THE VERTICAL POSITION IF IT IS CSA APPROVED FOR THAT MOUNTING ORIENTATION.

7. ISOLATING BALL VALVE TO BE THE SAME SIZE AS THE SERVICE LINE.

NOTES:

-METER INSTALLATION/BACKFLOW PREVENTION REQUIREMENTS WILL BE ADVISED AS A PART OF THE PLAN REVIEW PROCESS

- PIPING MATERIALS AND INSTALLATION MUST CONFORM TO CANADIAN PLUMBING CODE AND REQUIREMENTS OF THE CITY OF REGINA WATER BYLAW 8942. PROVIDE ADDITIONAL PIPING SUPPORT AS REQUIRED TO ELIMINATE STRAIN ON METER AND BACKFLOW PREVENTER.

-"D" IS THE NOMINAL DIAMETER OF THE SERVICE PIPE TO WHICH THE METER IS ATTACHED. METER SIZE(S) WILL BE DETERMINED BY THE CITY OF REGINA.

-METERS SHOWN MANIFOLDED VERTICALLY. HORIZONTAL MANIFOLDING OF METERS IS ACCEPTABLE. MINIMUM CLEAR SPACING BETWEEN METERS IS 150mm. IF METERS ARE MOUNTED IN THIS MANNER THE 'REACHOVER' DISTANCE TO THE FURTHEST METER MAY NOT EXCEED 1000mm.

-METERS MUST BE MOUNTED A MINIMUM OF 50mm CLEAR FROM WALLS.

-FOR LOCATIONS REQUIRING IN EXCESS OF 16 METERS CONSULT THE CITY OF REGINA FOR INSTALLATION REQUIREMENTS.

-ADDITIONAL PROTECTION DEVICES MAY BE REQUIRED ON INSTALLATIONS EMPLOYING A BOILER OR OTHER SPECIALIZED EQUIPMENT.

Date	Revisions	By
APR08/03	PROP. STD. FOR REVIEW	SB
JUN/03	NEW STANDARD	SB

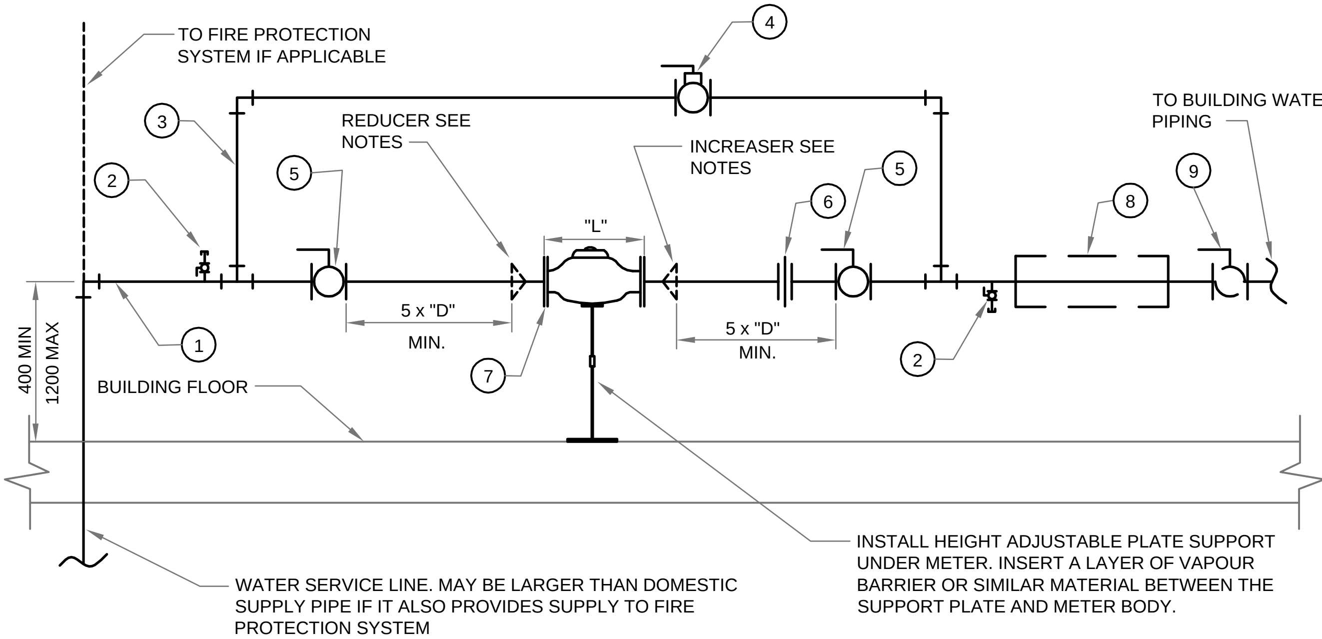
CITY OF REGINA

Engineering and Works

Description:

WATER METER/BACKFLOW PREVENTER INSTALLATION REQUIREMENTS FOR MULTI - METERED LOCATIONS - ALT 2

KEN WIENS **Director**	**Date** APR/03	**Digital File:** O:\ME\WAT\DWGS...STD DWGS 2004\W-31
DAVID CALAM **Manager**	**Scale** NTS	**File:** W-31



1. DOMESTIC WATER SUPPLY PIPE. ISOLATING AND BYPASS VALVING SHOWN MUST BE THE SAME SIZE AS THE INCOMING WATER SERVICE OR THE DOMESTIC WATER SUPPLY PIPE - WHICHEVER IS SMALLER.

2. 6mm CONNECTION c/w BALL VALVE AND THREAD PLUG. ORIENT CONNECTIONS AS SHOWN.

3. METER BYPASS LINE. THIS PIPING MAY BE ABOVE OR BELOW OR TO EITHER SIDE OF THE METER BUT WHEN ABOVE MUST BE SPACED A MINIMUM OF 500mm ABOVE THE METER REGISTER HEAD.

4. METER BYPASS VALVE. THIS VALVE IS TO BE A BALL STYLE VALVE AND MUST BE EQUIPPED WITH A FACTORY SUPPLIED QUARTER TURN, LOCKABLE LEVER ACTUATOR. LOCK WILL BE PROVIDED AND INSTALLED BY THE CITY OF REGINA. A LISTING OF APPROVED VALVES IS AVAILABLE FROM THE CITY OF REGINA.

5. METER ISOLATING VALVES - 2 REQUIRED AT LOCATIONS SHOWN. VALVES TO BE BALL STYLE WITH QUARTER TURN LEVER ACTUATOR. A LISTING OF APPROVED VALVES IS AVAILABLE FROM THE CITY OF REGINA.

6. QUICK DISCONNECT SUCH AS PIPE UNION OR GROOVED COUPLING.

7. WATER METER. METER SIZE WILL BE DIRECTED BY THE CITY OF REGINA. METER WILL BE SUPPLIED AND INSTALLED ONLY BY THE CITY OF REGINA. WATER METER MUST BE INSTALLED ONLY IN THE HORIZONTAL POSITION. PROVIDE PIPING CONNECTIONS AS REQUIRED FOR METER INSTALLATION. METER SPACER WILL BE PROVIDED BY THE CITY OF REGINA FOR USE BY THE PIPING CONTRACTOR.

8. BACKFLOW PREVENTION ASSEMBLY c/w ISOLATING VALVES AS DIRECTED BY THE CITY OF REGINA CROSS CONNECTION CONTROL COORDINATOR. ASSEMBLY MAY BE INSTALLED IN THE VERTICAL POSITION IF IT IS CSA APPROVED FOR THAT MOUNTING ORIENTATION. BACKFLOW PREVENTERS MAY ONLY BE INSTALLED DOWNSTREAM OF THE METER BYPASS CONNECTION AS SHOWN.

9. BALL TYPE ISOLATING VALVE FOR BACKFLOW PREVENTER. NOTE - PROVISION OF THIS VALVE IS RECOMMENDED BUT IS NOT MANDATORY.

NOTES:

- PIPING MATERIALS AND INSTALLATION MUST CONFORM TO CANADIAN PLUMBING CODE AND REQUIREMENTS OF THE CITY OF REGINA WATER BYLAW 8942. PROVIDE ADDITIONAL PIPING SUPPORT AS REQUIRED TO ELIMINATE STRAIN ON METER AND BACKFLOW PREVENTER.

-IF METER SIZE DOES NOT MATCH DOMESTIC WATER SUPPLY PIPE SIZE, PROVIDE AND INSTALL ALL REQUIRED REDUCERS AND INCREASERS. NOTE THAT USE OF THREADED REDUCING BUSHINGS IS NOT ALLOWED. REDUCERS AND INCREASERS TO BE INSTALLED AS CLOSE AS POSSIBLE TO THE WATER METER.

-"D" IS THE NOMINAL DIAMETER OF THE DOMESTIC WATER SUPPLY PIPE.
-"L" IS THE LENGTH OF A FULL DOMESTIC PIPE SIZE WATER METER. OVERALL PIPE RUN PROVIDED MUST INCLUDE THIS LENGTH.

Date	Revisions	By
SEP26/02	PROP. STD. FOR REVIEW	SB
DEC20/02	REV. PROP. STD. FOR REVIEW	SB
JUN/03	NEW STANDARD	SB

CITY OF REGINA

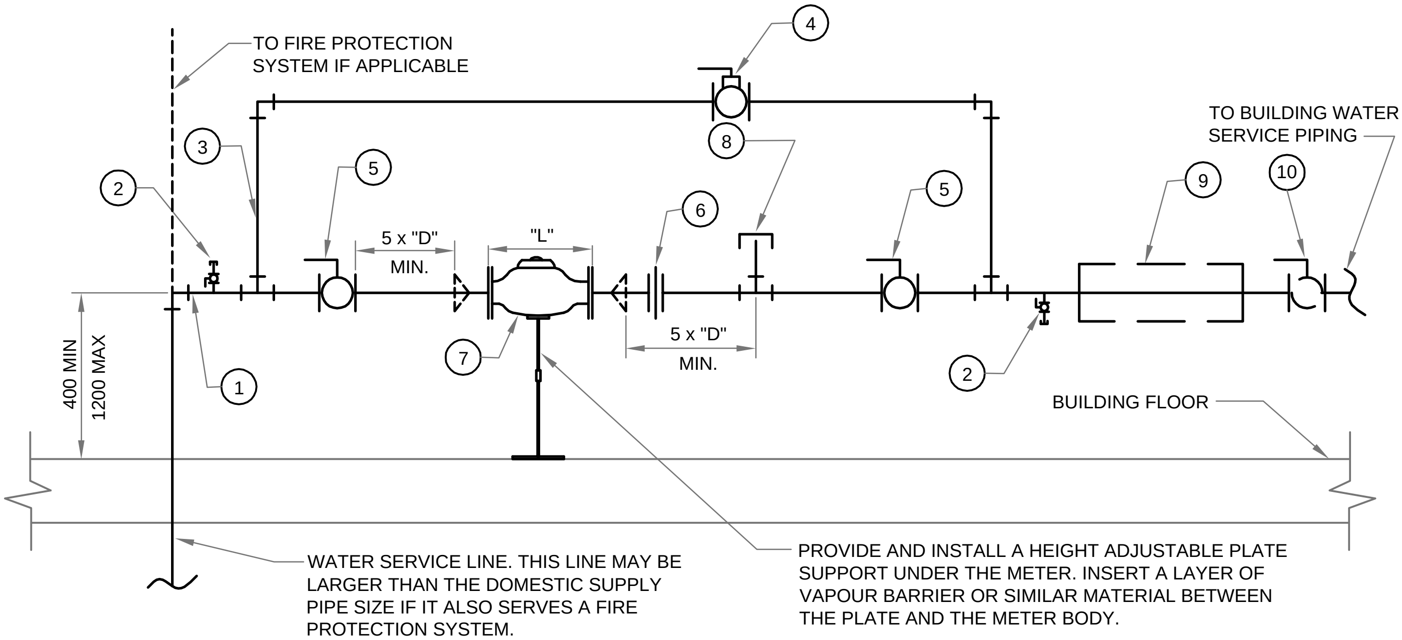
Engineering and Works

Description:

WATER METER INSTALLATION FOR

40mm OR 50mm DOMESTIC SUPPLY PIPE SIZES

KEN WIENS **Director**	**Date** SEP/02	**Digital File:** O:\ME\WAT\DWGS.....WAT DIV...STD 2004\W-32
DAVID CALAM **Manager**	**Scale** NTS	**File:** W-32



1. DOMESTIC WATER SUPPLY PIPE. ISOLATING VALVES AND BYPASS VALVE MUST BE THE SAME SIZE AS THIS LINE OR THE INCOMING WATER SERVICE LINE - WHICHEVER IS SMALLER.

2. 6mm CONNECTION c/w BALL VALVE AND THREAD PLUG. ORIENT EACH CONNECTION AS SHOWN.

3. METER BYPASS LINE. THIS PIPING MAY BE ABOVE OR BELOW OR TO EITHER SIDE OF THE METER BUT IF IT IS ABOVE IT MUST BE A MINIMUM OF 500mm CLEAR ABOVE THE METER REGISTER HEAD.

4. METER BYPASS VALVE. THIS VALVE IS TO BE EITHER A BALL OR BUTTERFLY STYLE VALVE AND MUST BE EQUIPPED WITH A FACTORY SUPPLIED, QUARTER TURN ,LOCKABLE LEVER ACTUATOR. LOCK WILL BE PROVIDED AND INSTALLED BY THE CITY OF REGINA. A LISTING OF APPROVED VALVES IS AVAILABLE FROM THE CITY OF REGINA.

5. METER ISOLATING VALVES - 2 REQUIRED AT LOCATIONS SHOWN. VALVES TO BE EITHER BALL OR BUTTERFLY STYLE WITH QUARTER TURN LEVER ACTUATOR. A LISTING OF APPROVED VALVES IS AVAILABLE FROM THE CITY OF REGINA.

6. QUICK DISCONNECT SUCH AS PIPE UNION OR GROOVED COUPLING.

7. WATER METER. METER SIZE WILL BE DETERMINED BY THE CITY OF REGINA. METER WILL BE SUPPLIED AND INSTALLED ONLY BY THE CITY OF REGINA. WATER METER MUST BE MOUNTED IN THE HORIZONTAL POSITION. PROVIDE PIPING CONNECTIONS AS REQUIRED FOR METER INSTALLATION. METER SPACER WILL BE PROVIDED BY THE CITY OF REGINA FOR USE BY THE PIPING CONTRACTOR.

8. 65mm CONNECTION WITH NPT THREAD CAP. ORIENT CONNECTION TOWARD THE MOST ACCESSIBLE DIRECTION FOR CONNECTION AND EXTENSION OF A TEST HOSE.

9. BACKFLOW PREVENTION ASSEMBLY c/w ISOLATING VALVES AS DETERMINED BY THE CITY OF REGINA CROSS CONNECTION CONTROL COORDINATOR. ASSEMBLY MAY BE INSTALLED IN THE VERTICAL IF THE ASSEMBLY IS CSA APPROVED FOR MOUNTING IN THAT ORIENTATION. BACKFLOW PREVENTERS MAY ONLY BE INSTALLED DOWNSTREAM OF THE WATER METER AS SHOWN.

10. BALL OR BUTTERFLY TYPE ISOLATING VALVE FOR BACKFLOW PREVENTER. NOTE - PROVISION OF THIS VALVE IS RECOMMENDED BUT IS NOT MANDATORY.

NOTES:

- PIPING MATERIALS AND INSTALLATION MUST CONFORM TO CANADIAN PLUMBING CODE AND REQUIREMENTS OF THE CITY OF REGINA WATER BYLAW 8942. PROVIDE ADDITIONAL SUPPORT IF REQUIRED TO ENSURE NO STRAIN IS TRANSMITTED TO EITHER THE METER OR BACKFLOW PREVENTER.

-IF METER SIZE DOES NOT MATCH WATER SERVICE SIZE, PROVIDE AND INSTALL ALL REQUIRED REDUCERS AND INCREASERS. NOTE THAT USE OF THREADED REDUCING BUSHINGS IS NOT ALLOWED. REDUCERS AND INCREASERS TO BE INSTALLED AS CLOSE TO THE METER AS POSSIBLE.

-DIMENSION "D" IS THE NOMINAL DIAMETER OF THE DOMESTIC WATER SUPPLY PIPE.
-DIMENSION "L" IS THE LENGTH OF A FULL DOMESTIC PIPE SIZE WATER METER. OVERALL PIPE RUN PROVIDED MUST ALLOW FOR INSTALLATION OF A METER OF THIS LENGTH.

Date	Revisions	By
SEP26/02	PROP STD FOR REVIEW	SB
DEC20/02	REV. PROP STD FOR REVIEW	SB
JUN/03	NEW STANDARD	SB

Regina
CITY OF REGINA
Engineering and Works

Description:

WATER METER INSTALLATION FOR

75mm OR 100mm DOMESTIC SUPPLY PIPE SIZES

KEN WIENS **Director**	**Date** SEP25/02	**Digital File:** O:\ME\WAT\DWGS\STD DWGS.... 2004\W-33
DAVID CALAM **Manager**	**Scale** NTS	**File:** W-33

NOTES:

Customers must obtain, complete and return a Water Meter Sizing Form so that the proper meter size for the installation can be determined. Forms are available from the Water Engineering Division of the Engineering and Works Department.

The customer is responsible for having the operation of the backflow preventer certified by an approved technician on an annual basis and for all costs for each certification.

The customer is responsible for supply and installation of all piping and accessories except the water meter which is supplied and installed by the City of Regina. For details refer to other WM series drawings.

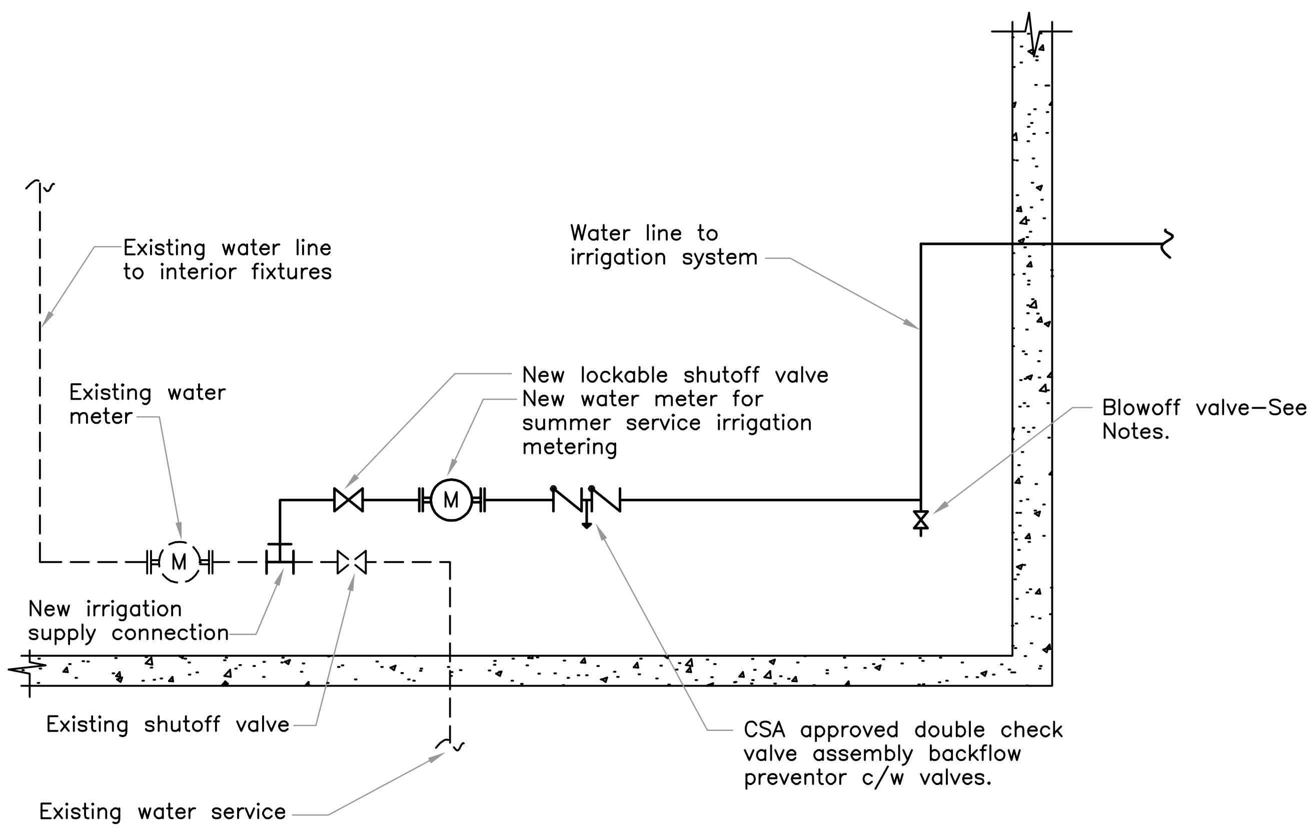
Application for summer water service may be made in person on the main floor of City Hall or by calling 777-7208. The water meter is installed after process of the application.

Installation of new piping and components must conform to the plumbing code. Backflow preventor MUST be installed in the horizontal position.

New irrigation supply connection may be made on the upstream side of the existing shutoff valve if there is not sufficient room to allow the preferred connection location shown.

Blowoff valve must be installed on the downstream (customer) side of the water meter.

Installed height of summer service meter may not exceed 1.5 metres above floor level. Meter must be in an accessible location



Date	Revisions	By
JUNE/03	NOTES REV. /EXPANDED	SB

CITY OF REGINA

Engineering and Works

Description:

INSTALLATION REQUIREMENTS FOR SUMMER SERVICE IRRIGATION METERS

Manager	Date	Digital File:
KEN WIENS	MAY 97	O:\ME\WAT\DWGS\WAT DIV STD....\STD2004\W-34
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-34

BALL STYLE VALVES AVAILABLE WITH LOCKING CAPABILITY
(IN NO ORDER OF PREFERENCE)

RED & WHITE/TOYO MODEL 5044A
APOLLO FIG. 70-100-27
WATTS B-6400
WATTS B-6800

BUTTERFLY STYLE VALVES AVAILABLE WITH LOCKING CAPABILITY
(IN NO ORDER OF PREFERENCE)

BRAY c/w PADLOCK KIT
KEYSTONE/TYCO c/w POSILOCK OR PADLOCKING HANDLE

Date	Revisions	By
JUN/03	NEW STANDARD	SB

CITY OF REGINA

Engineering and Works

Description:

LISTING OF VALVES WITH

FACTORY SUPPLIED LOCKING

Manager	Date	Digital File:
KEN WIENS	DEC20/02	o:\me\wat\dwgs\wat div std...\2004 STD...\W-35
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	W-35

CITY OF REGINA

Engineering and Works Department

SEWER

SPECIFICATIONS

SECTION

1.0 GENERAL

1.1 Scope

1.1.1 The work covered by this section involves the cleaning and CCTV inspection of sanitary and storm sewer mains.

1.2 CCTV Operator Certification

1.2.1 The CCTV operator shall be certified by NAAPI. Submit copy of current NAAPI certification prior to start of CCTV inspection operations.

2.0 PRODUCTS

2.1 High velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of nozzles capable of scouring the interior of the size range of sewers indicated in the Form of Tender.

2.2 Debris removal equipment shall consist of a vacuum tanker unit capable of removing typical sewage debris accumulated by the sewer cleaner at the manholes.

2.3 Solid debris cutting equipment shall be hydraulically driven by the sewer cleaner. The equipment must have circular saw-tooth blades in sizes consistent with the sewer being cleaned.

2.4 CCTV inspection equipment shall consist of solid state cameras with pan and tilt capability and components capable of providing clear, well illuminated videotape or digital recording of the interior of the sewers.

2.5 Video inspection reports shall be submitted in hard copy and in digital format (CD ROM) that is compatible with the City's Easycan sewer inspection software. Reports will include photos of each major defect and each service connection. Record video inspection on SVHS tape with video recorder set on SP mode. Also provide video inspections as MPEG files on CD ROM.

2.6 Coding for reports will use codes as provided by the City of Regina specifically for this project. Submit sample of inspection log, videotape and corresponding digital data file for review prior to starting project.

2.7 Traffic control equipment shall conform with the City of Regina Manual for Temporary Traffic Control.

3.0 EXECUTION

3.1 Sewer Cleaning

3.1.1 Acceptance of sewer and manhole cleaning shall be made upon review of the corresponding video inspection.

3.1.2 Block debris at downstream manhole to prevent contamination of the downstream mains.

3.1.3 The liquid portion of material removed at the manholes shall be decanted back into the sewer. The solid and semi-solid material removed at the manholes shall be disposed of at a designated site, at a lagoon adjacent to the City's Wastewater Treatment Plant. There is no charge to the Contractor for the disposal site. Disposal hours are restricted to 7:00am to 6:00pm. Entrance to the Plant is through a security gate. The Contractor will be provided with a code to open the security gate.

3.2 CCTV Inspection

3.2.1 Travelling speed of the camera in the pipeline to be as follows:
- 0.1m/s for pipelines less than 200mm diameter
- 0.15m/s for 200mm to 310mm diameter
- 0.2m/s for over 310mm diameter

3.2.2 Position camera lens centrally in the pipeline with a positioning tolerance of plus or minus 10% off the vertical centerline axis of the pipeline.

3.2.3 Observe and record structural features and defects.

3.2.4 Submit sample of video inspection weekly for quality assurance review by the City.

3.2.5 Acceptance of CCTV inspection is based on the City's review of all submitted material

3.2.6 The City will excavate, if required, to free lodged camera equipment at no cost to the Contractor.

1.0 GENERAL

1.1 This Specification shall cover the repair of defective sewers at select locations by trenchless methods utilizing CIPP products.

1.2 The work to be done by the Contractor under this Specification shall include the furnishing of all superintendence, overhead, labour, material, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all works shown on the Drawings and hereinafter specified.

2.0 PRODUCTS

2.1 CIPP Point Repair Products

Minimum material requirements for Internal CIPP point repairs shall conform to ASTM D5813 "Standard Specification for Cured-In-Place Thermosetting Resin Sewer Pipe" and the supplemental requirements noted herein.

2.2 Verification of Existing Sewer Dimensions

Prior to manufacture of the point repair fabric tube for any location the contractor shall site verify dimensional requirements (diameter, length, etc.) for each section of sewer where point repairs are proposed.

3.0 DESIGN REQUIREMENTS

3.1 Point Repair Liner Design

Point repair liners shall be designed in accordance with Appendix XI of ASTM Standard F1216 as a gravity pipe in a partially or fully deteriorated pipe condition and the supplemental requirements noted herein. The required design condition (partially or fully deteriorated) for each repair location is noted in Table A1 of Appendix A of these Specifications.

The liner shall be sized in accordance with the design objectives to provide a close-fit with the host pipe with no annulus with the exception of the maximum allowable diametric shrinkage due to curing permitted in ASTM D5813-95.

For both ***partially and fully deteriorated designs*** a design check shall be performed to confirm that the rehabilitated section of pipe will have a hydraulic capacity equal to or greater than the existing pipeline. This design check shall be based on full flow capacity and the use of Manning's formula. The assumed long-term Manning's 'n' for the CIPP section shall be 0.012. The roughness of the existing section shall be estimated based on the observed condition of the pipeline from the CCTV inspection.

The design features of the point repair system shall also include:

1. Tapered end section to promote a smooth transition from point repair to host pipe

2. A means to facilitate flow through by-pass of existing wastewater during the course of the repair

3.2 Point Repair Design Partially Deteriorated

Partially deteriorated design, where specified, shall be designed in accordance with Appendix XI of ASTM Standard F1216-98 and the following minimum drainage checks:

1. Wall thickness determination by restrained buckling analysis

2. A design check to determine whether wall thickness will be governed by long term flexural stress

3. Design checks to determine whether any localized thickening is required for missing segments or holes

For partially deteriorated design unless stipulated otherwise, the following minimum design assumptions shall be employed:

.1 The groundwater load shall be calculated based on the assumption that the groundwater table is 2.0 m below the existing ground surface.

.2 An enhancement factor (K) of 7.

.3 The value assumed for ovality of the existing conduit shall be a minimum of 3% unless a greater value is specified or warranted based on the Contractor's observation of the CCTV inspection prior to effecting the point repair.

.4 The long-term value for the flexural strength shall be deemed to be:

- the projected value at 50 years of continuous application of the design load based on the specific resin and felt composite proposed for use as established by ASTM D2990 – "Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics."
- In the case of having no ASTM D2990 values, 25% of the flexural strength value as established by ASTM D790 – "Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials."

.5 The minimum factor of safety (N) to be utilized in the restrained buckling analysis shall be 2.

3.3 Point Repair Design – Fully Deteriorated

Fully deteriorated design, where specified, shall be based on the modified AWWA formula as detailed in Appendix XI of ASTM F1216 and unless stipulated otherwise, the following minimum design assumptions shall be employed:

.1 The total external pressure on the pipe shall include an allowance for an AASHTO HS20 concentrated live load. If the liner crosses under a railway line the minimum live load surcharge shall be calculated based on a Cooper E80 distributed load (for the portion of liner affected by that loading).

.2 The minimum soil density utilized in computation of the dead load shall be 1920 kg/m^3.

.3 The height of water above the pipe shall be based on the assumption that the groundwater table is 2.0 m below the existing ground surface.

.4 The ovality reduction factor shall be based on a minimum value of 3% unless a greater value is specified or warranted based on the Contractor's observation of the CCTV inspection prior to effecting the point repair.

.5 The long-term value for the flexural strength be deemed to be:
- the projected value at 50 years of continuous application of the design load based on the specific resin and felt composite proposed for use as established by ASTM D2990 – "Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture Plastics."
- In the case of having no ASTM D2990 values, 25% of the flexural strength value as established by ASTM D790 – "Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials."

.6 The modulus of soil reaction (E's) shall be assumed to be 6900 kPa unless a higher or lower value is specified herein.

.7 The minimum factor of safety (N) to be utilized in the fully deteriorated design analysis shall be 2.

3.4 Shop Drawing

The following submissions are required:

A design submission detailing all liner thickness computations in accordance with these specifications sealed by a Professional Engineer licensed to practice in Canada.

Independent third party verification of the flexural strength of the composite fabric tube and resin system(s) proposed for use based on ASTM D790 or ASTM D2990. If independent third party testing results are not available for the proposed fabric tube and resin system(s), samples of said system shall be provided to the Contract Administrator for independent test verification.

4. CONSTRUCTION METHODS

4.1 Sewer Cleaning and Preparation

The Contractor shall remove all loose and solid debris and intruding connections, in accordance with the requirements of SP:2 Sewer Cleaning and Preparation, to adequately prepare the sewer for internal point repairs.

4.2 Existing Sewer Flow During Construction

If the prevailing flow condition in the sewer to be repaired is substantially in excess of the flow through capacity of the Contractor's proposed point repair system the Contractor shall be responsible for bypassing existing sewer flow from upstream sewers during construction around the point of repair. Under no circumstances shall sewer flow be diverted directly to the environment, Land Drainage Sewers, or Storm Relief sewers.

4.3 Reinstatement of Sewer Connections

After the point repair has adequately cured, the Contractor shall reinstate any existing active sewer connections and catchbasin drains effected by the repair. Reinstatement shall be performed from the interior of the pipeline by means of a television camera and remote controlled cutting device or by manual means in man accessible and man entry diameter ranges. Sewer connection reinstatement shall be a minimum of 95% of the original cross sectional area of the service.

Reinstatement of service connection shall be performed in such a manner so as to remove the coupon with as much material intact as practical. All connection coupons shall be provided to Contract Administrator immediately subsequent to reinstatement.

Any voids between the point repair liner and the existing sewer connection shall be grouted with approved non-shrink cement grout material.

5. QUALITY CONTROL

5.1 Workmanship

Completed workmanship shall conform to Clause 6.2 of ASTM D5813 and the supplementary requirements noted herein.

If the point repair liner does not fit tight against the host pipe at its termination points or at connecting pipe(s), the annular space shall be completely filled with a resin mixture compatible with the point repair system.

The termination points of the repair shall provide a smooth and uniform flow transition from the host pipe to the repair for the full circumference of the repair.

5.2 Physical Samples

The Contractor shall prepare field samples for every 10 spot repair installations during the course of the work at locations where repairs terminate at or in close proximity to a manhole. Field samples shall be prepared at locations designated by the Engineer. Samples shall consist of a section of repair material that has been inserted through a like diameter form and cured in the invert of the manhole under existing flow conditions.

All physical samples shall be tested to confirm the flexural strength and flexural modulus in accordance with the requirements of ASTM D5813 and D790.

The point repair liner thickness will be measured in accordance with the requirements of ASTM D5813 and ASTM D3567 for conformance with the design requirements.

The City will bear the cost of testing.

5.3 Sewer Inspections

Upon completion of the work, the Contractor shall provide the Engineer with an inspection report containing the pre and post-lining inspections prior to Total Performance.

Payment shall be at the contract unit prices in the Form of Tender and shall be full compensation for the supply of all equipment and materials and the performing of all operations to complete the work as specified including any items incidental to work.

1.0 GENERAL

1.1 Work Included

1.1.1 Supply and installation of impregnated bi-directional woven fiberglass tissue with a predetermined epoxy resin. The impregnating tissue is rolled on a pneumatic tube (thermomandrel) corresponding in length with the length to be repaired. The thermomandrel will then be slipped inside the conduit (concrete, clay, brick, PVC, etc.) to repair using a nearby manhole.

1.1.2 Existing CCTV tapes, video logs and location plans of all spot repairs are available for review at the office of the Engineer.

2.0 PRODUCTS

Materials include:

- Balanced bi-directionally woven fiberglass tissue
- Two Component epoxy resin as binding matrix

2.1 General Physical Properties of the Fiberglass

Tension load	3.4×10^3 MPa	(493 000 psi)
Tension modulus	72×10^3 MPa	(10 442 000 psi)
Thermal expansion coefficient	$2,8 \times 10^{-6}$ po/po/^{0}C	
Break elongation	4,8%	
Elastic recovery	100%	

2.2 General Physical Properties of the Resin

Tension load	ASTM D638	60 MPa	(8 700 psi)
Tension modulus	ASTM D638	$3,3 \times 10^3$ MPa	(478 600 psi)
Flexion load	ASTM D790	100 MPa	(14 500 psi)
Flexion modulus	ASTM D790	$2,1 \times 10^3$ MPa	(304 500 psi)
Elongation		4.5% to 12%	
Barcol<<hardness	ASTM 2583-81	50	
Thermal expansion	ASTM D696	52×10^{-6} po/po/^{0}C	

2.3 Composite Material

Tension constraint	ASTM D638	250 MPa	(36 250 psi)
Tension modulus	ASTM D638	8.0 MPa	(1 160 000 psi)
Flexion constraint	ASTM D790	250 MPa	(36 250 psi)
Flexion modulus	ASTM D790	9 GPa	(1 305 000psi)
Hardness (shore D)		>80	

2.4 Chemical Resistance

.1 Resist sewer gas including carbon monoxide, dioxide, hydrogen sulphide etc. The fiberglass tissue shall not be affected by chemicals, bacteria, fungus or insects.

2.5 Resin Mix

.1 Two component epoxydic resin mix controlled by volume. The homogenated mix shall be applied on the different layers of the bi-directional fiberglass tissue. The mixing and the wetting shall be made at the plant.

2.6 Fiberglass Stratification

.1 The bi-directional tissue layers shall overlap when wetted.

2.7 Wall Thickness Design

.1 The thickness shall be established by the Contractor, considering the size of the conduit to be lined.

2.8 Submittals

.1 Submit information on material, procedure, wall thickness for each line prior to installation.

.2 Submit as-build data to the Engineer indicating locations of lines repaired following installation.

.3 Submit a field sample for every 10 spot repairs completed. Longer spot repairs which are completed in multiple segments, will be considered as one spot repair. Typically sample locations will be adjacent to manholes so the repair material can be confined and subject to the same curing as the adjacent spot repair. The City will bear the costs of testing.

3.0 EXECUTION

3.1 Notification of Residents/Businesses

.1 The Contractor is responsible for notification of residents/businesses of disruption of sewer service. Contractor must liase with residents/businesses during spot repairs and advise when normal service is restored. Provide alternative service to residents/businesses as required.

.2 Traffic Accommodation: Follow all requirements as set out in the City of Regina’s Manual for Temporary Traffic Control.

3.2 Conduits Cleaning

.1 The manholes and the conduits shall be cleaned to remove roots, debris and other deposits that could cause problems during installation.

3.3 Inspection

.1 The section to be lined will be CCTV inspected before and after installation.

.2 The laterals will be detected and thoroughly noted to minimize possible errors when reopening them after lining.

.3 If the inspection reveals major defects, notify Engineer before remedial actions are undertaken.

3.4 Laterals Opening

.1 The laterals shall be reopened with a remote controlled robotic cutter for non-accessible sewers. A CCTV camera shall be used to ascertain position.

3.5 Installation

.1 Clean and CCTV inspect existing line and make a videocassette prior to installation.

.2 The flow of water shall be by-passed above ground till the closest possible other manhole if required.

.3 The composite (fiberglass and resins) shall be prepared in a shop under a total quality control. On-site preparation will be acceptable based on on-site preparation facilities which meet the approval of the Engineer.

.4 The wetted composite materials shall be transported to the jobsite and slipped into the conduit to be lined.

.5 Cure with steam for a predetermined time based on diameter and length (between 45 and 90 minutes).

.6 Cool and retrieve the thermomandrel to be reused for other insertions.

.7 Open the lateral connections to reinstate service.

.8 Provide CCTV inspection report and video after installation.

1300 - GENERAL

The work shall consist of constructing domestic and/or drainage mains to line and grade and cross-sections as shown on the plans or as designated by the Engineer in the field.

1300 - 2 MATERIAL

a) Pipe

1. Reinforced Circular Concrete Pipe

Shall meet ASTM Specification C76M-90. Non-reinforced circular concrete pipe shall meet ASTM Specification C14. ASTM C655-83 shall be used for concrete pipe where a D-load for pipe is specified.

At the manufacturer's discretion, pipe designated as Class pipe under ASTM C76-82a may be manufactured under ASTM C655-82, providing the D-load is equivalent or exceeds the D-load (based on test results) for the Class of pipe specified. In addition a pipe designated as a D-load pipe may be manufactured as class pipe under ASTM C76-82a provided that the class of pipe exceeds the D-load specified (based on test results).

Pursuant to Section 4 of ASTM C655-82 each bidder shall submit, along with the completed tender documents, the pipe designs to be utilized which shall include pipe outside diameters, wall thickness, joint dimensions, laying length, concrete mixtures and compressive strength; size, amount and spacing of all circumferential, longitudinal and special reinforcement, and the manufacturing and curing process.

Design and manufacturing of Class pipe shall be in compliance with ASTM C76-82a. All concrete pipe shall be manufactured with sulphate resistant, Type 50 Portland Cement to meet CSA CAN 3-A5.

2. Clay Tile Pipe

Shall be Extra Strength unglazed clay pipe meeting ASTM C700.

No cut or damaged clay tile pipe shall be used.

3. Polyvinyl Chloride (PVC) Pipe

PVC pipe installations of storm sewers in Industrial areas are restricted to pipe diameters of less than 450mm.

PVC gravity sewer pipe and fittings (150mm to 375mm diameter) shall conform to CSA certified B182.1-M92 and B182.2-M90, standard dimension ratio (SDR) 35 and minimum pipe stiffness of 320 kPa and ASTM D3034-89.

PVC gravity sewer pipe and fittings (large diameter 450mm to 675mm) shall conform to CSA certified B182.2-M90, minimum pipe stiffness of 320 kPa and ASTM F679-89. For sizes 750mm to 900mm, third party independent test verification shall accompany each shipment of pipe and shall not be installed until approved by the City. These sizes (750mm to 900mm) must also have minimum pipe stiffness of 320 kPa.

PVC ribbed gravity sewer pipe and fittings (150mm to 900mm diameter) shall conform to CSA certified B182.4-M90 and shall be Class V pipe of minimum pipe stiffness of 320 kPa and ASTM F794-93a.

The PVC pipe referred to in this specification may be used for domestic and storm sewer up to and including 900mm diameter except as noted.

PVC sewers shall meet an inside diameter deflection test limit of 6% after thirty days and a maximum of 7.5% after two years in accordance with ASTM D3034-89.

4. Corrugated Steel Pipe (CSP)

Shall be used only at the storm sewer outlets to a water course, galvanized with bituminous exterior and interior protective coating, thickness and size as shown on drawings. Corrugated Steel Pipe shall conform to CSA G401-01.

5. Polyethylene Pipe

Polyethylene pipe shall be used for sewer forcemain and shall conform to CSA B173.1, Type PE Series 45.

b) Joints

All joints shall be done in accordance with Manufacturer's recommendations.

1. Sanitary Sewer

Concrete pipe joints shall be rubber gasket to ASTM C443. Lift holes in concrete pipe shall be made water tight with mortar from the inside and outside.

Clay tile pipe joints shall be to CSA A60.3M Type 2 or Type 3.

Polyvinyl Chloride pipe joints shall be locked-in gasket and integral bell system which conforms to ASTM C443.

Polyethylene to polyethylene joints shall be thermal butt fusion welded according to manufacturer's instructions. Polyethylene to flanged fittings or pipe shall be made by a slip on flange assembly. The flanged assembly shall consist of a polyethylene stub end, and metal slip on flange. The polyethylene stub end shall be butt fused to the end of the pipe and will be made of the same resin and of the same series as the remainder of polyethylene pipe. The slip on metal flange shall be ductile iron, conforming with AWWA:C203. It shall be faced and drilled to ANSI:B16.1, 860 kPa and coated with coal tar enamel.

2. Storm Sewer

Concrete pipe joints shall be rubber gasket to ASTM C443-85a and installed as recommended by the Manufacturer.

Clay Tile pipe joints shall be to CSA A60.3M, Type 4, Rol-o-mate.

Polyvinyl Chloride (PVC) Pipe joints shall be locked-in gasket and integral bell system.

Lift holes in concrete pipe shall be made water tight with mortar from the inside and outside.

c) Cement

Cement shall be sulphate resisting Type 50 Portland to meet CSA CAN3-A5 for all pipe, underground structures and mortar.

d) Mortar

Shall be one part sulphate resisting Portland cement to two parts clean sharp sand mixed dry. Add only sufficient water after mixing to give optimum consistency for placement. The use of additives shall not be allowed.

e) Rip Rap

Shall consist of hard, dense, durable field stone, boulders, quarry rock or broken concrete well graded in size between 150mm and 250mm, with a minimum of 50% by weight exceeding 200mm in diameter.

1300 - 3 CONSTRUCTION

The interior of pipes and fittings shall be kept free of dirt and foreign matter. Cement shall be stored properly to prevent dampness.

No pipe shall be laid in water or on frozen trench bottom or when in the opinion of the Engineer the trench conditions or the weather conditions are unsuitable for such work.

a) Concrete, Polyvinyl Chloride or Clay Tile Pipe

Commence laying at lower end of line, lay pipes and specials true to line and grade, socket ends up grade, joints close and evenly butted all around pipe. Take special care to prevent sagging of spigot end in hub and provide true, even invert surface throughout entire length of sewer. Excavate at end of each pipe to provide rest for socket, sufficient to permit proper jointing.

Set each pipe with measuring rod and sight rails set at equal height from grade line. Adjust pipe until sight rails and top of rod are exactly in line while rod is held plumb and to invert of pipe. Set pipe true to line by plumbing down from a taut cord fastened to sight rails or reference line. Provide at least three sight rails during construction of any section of sewer. Do not lay pipe until all sight rails line through correctly. Fabricate sight rails of substantial material and pin to prevent any variation from preset grades. Other methods of establishing lines and grades may be used subject to the approval of the Engineer. Before leaving work at anytime, close end of sewer with plug to prevent entry of water and foreign matter. Backfilling shall not be carried out until the pipe installation has been approved by the Engineer.

b) Polyethylene Pipe

Install polyethylene pipe in accordance with manufacturer's instructions. Provide copies of manufacturer's directions on site for reference. Obtain technical assistance from manufacturer or representative during jointing of pipe by thermal butt-fusion process.

Inspect all pipe and specials prior to jointing and remove all foreign materials from the inside.

After jointing, lower or snake the pipe into the trench, laying in the uphill direction unless otherwise approved by the Engineer. Open sufficient trench ahead of the pipe to avoid excessive stresses in the pipe during lowering in.

Take measures in accordance with the manufacturer's instructions to avoid excessive temperature differentials which may result in expansion or contraction between pipe during jointing, laying in and final operating conditions. Install pipe so that it will absorb future expansion and contraction after backfilling.

c) Junctions and Risers

Junctions and risers where required shall be installed in the sewer mains using prefabricated T branches or Y branches, Strap-On-Saddles are not acceptable. Vertical wooden 50 mm by 50 mm markers shall be placed opposite the risers and shall extend from the bottom of the trench to approximately 300 mm above ground surface.

d) Connection to Existing System

Connections to existing pipes, manholes and structure shall be made as indicated on the drawings. Perform all excavation, backfilling, pipe cutting, jointing, demolition, repair and other work required. Supply all materials.

Connections shall be scheduled to reduce interruptions in service as much as possible. Adequate notice shall be given to the property owner prior to making any connections.

e) Storm Outlets to Creeks or Storm Channels

Where storm sewers outlet to creeks, storm channels, etc., the outlet shall be of corrugated metal pipe, 6 meters in length and the same diameter of the line being connected. Rip Rap shall be placed at the mouth of the outlet pipe to prevent erosion of the existing slope and shall conform to Drawing S-23. For submerged outlets the installation shall be as per Drawing S-22.

1320 **SPECIFICATION FOR SEWERMAIN TESTS**

1320 - 1 GENERAL

The following tests shall be carried out after completion of backfilling. All tests shall be carried out under direct supervision of the Engineer. The Contractor shall assist the Engineer in preparing a log documenting all tests completed. The log shall be property of the City and kept for record purposes. One copy shall be turned over to the Contractor for his records. All repairs and replacements necessary within the maintenance period shall be responsibility of the Contractor.

1320 - 2 MATERIALS

The Contractor shall be responsible to provide all labour and equipment as required to complete the tests.

1320 - 3 PROCEDURE

a) Maximum Acceptable Deviation From Line

Sewers shall be laid to the grade and alignment shown on the drawings and/or staked in the field by the Engineer.

Modern laser technology, batter boards and boning rod or survey techniques must be used to transfer the grade and alignment to the pipe.

Each pipe length must be checked by the above methods during construction.

Acceptable deviations from these lines for any manhole to manhole section shall be:

Pipe Size	Allowable Vertical Deviation	Allowable Horizontal Deviation
Up to and including 300mm	25 mm	50% of pipe dimension
375 mm - 525 mm	50 mm	50% of pipe dimension
600 mm - 1200 mm	75 mm	50% of pipe dimension
1350mm and greater	100 mm	50% of pipe dimension

In all cases, variation from vertical alignment resulting in a reverse sloping invert is unacceptable.

Misalignment beyond these limits shall be corrected by re-excavation and re-laying the pipe.

b) <u>Obstruction</u>

Sewer mains shall be tested for obstructions using a ball test. The sewer main shall be deemed unobstructed if a wood or metal ball having a diameter of 50mm less than the inside diameter of the pipe can be readily pulled through the sewer main.

c) <u>Deflection Testing</u>

The Engineer may require the Contractor to perform random deflection tests of pipe before final acceptance. Where closed circuit television inspection appears to indicate excessive deflections, the Engineer shall require the contractor to perform a deflection test in that section of pipe. All locations with excessive deflection shall be excavated and repaired by rebedding or replacement of pipe. All deflection testing shall be in accordance with CSA Standard B182.11-95. To ensure accurate testing, the lines must be clean.

d) <u>Exfiltration</u>

1. At least 10% of all <u>domestic</u> sewer lines shall be designated by the Engineer and tested for exfiltration. The exfiltration test and records shall be conducted in accordance with the procedure for Leakage Testing of Gravity Domestic Sewers prepared by Municipal Engineering Department (December 18, 1996). Copies of the Procedure are available from Municipal Engineering Department.

2. The maximum allowable exfiltration for 200mm to 600 mm diameter pipe is 4.6 litres/day/mm/km per CSA Standard B182.11. For larger than 600mm pipe, the maximum allowable exfiltration rate is 55 litres/day/mm/km. A tested section of domestic gravity sewer exceeding this limit shall not be accepted. Sections on either side of the failed section shall be immediately tested. The test failed section of the sewer line shall be rectified and retested.

3. At least 10% of all <u>domestic</u> sewer manholes shall be designated by the Engineer and tested for exfiltration potential in terms of their integrity of installed materials and construction procedures. The test procedure shall be as per ASTM 1244M-93 or the Hydrostatic Water Leakage Test procedure included in this specification.

If the manhole leakage rate is excessive, the Engineer shall require the manhole to be repaired or reconstructed. Retesting shall proceed until a satisfactory test is obtained.

e) Visual Inspection and T.V. Inspection

This test shall consist of the following:

1. Inspection of all in-place sewers, for installation/material defects

2. Completely wet the sewer with clean water to fill any sags prior to inspection.

3. Inspection by closed circuit T.V. camera for pipes 1200mm diameter and smaller. Pipes larger than 1200mm diameter shall be toured and viewed directly. For sewers greater than 750mm diameter, camera shall have pan, tilt, rotate and zoom capability. Inspect each joint along its' entire circumference. If extended camera capability is not available, direct tour and viewing is acceptable.

4. Documentation of all particulars, including service connections, shall be provided to the Engineer.

f) Cleaning Sewer Mains

Upon completion, all sewer mains and service connections, shall be flushed until all deposits of earth and/or debris are removed. Whenever practicable, flush mains in sections not greater then 250m in length. If the new work connects to an existing system, plug the outgoing line of the last manhole of the new work and remove dirt and debris there. Do not permit debris from new construction to enter the existing system. During flushing check all manholes for depth of flow and if any flow is greater than the anticipated flow, check for obstructions in pipe line. The Contractor shall repair all faults in construction. The Contractor shall be responsible for costs of water drawn from the municipal water system.

TEST PROCEDURE

1. Sewers are to be tested for leakage upon completion of backfilling. Pipe test section to be selected by Engineer.

2. Plug the downstream end of the sewer line and plug the upstream end with a "flow through type plug" at the upstream manhole. Ensure all connections in the test section have been capped and inspected by the Engineer. (See Standard Drawing No. S-10).

3. Fill the test section with water by adding it through the test vessel and the flow through type plug. Allow air to escape from the sewer line.

4. Fill the test vessel with water to a point of one metre above the top of the pipe. If the pipe is concrete**,** allow a minimum of 12 hours pretest absorption stabilization period before starting the test. If the pipe is PVC or other non concrete material, allow a minimum of 3 hours pretest absorption period.

5. After absorption into the pipe has stabilized, the water in the upstream manhole is to be brought to the test level of 1000mm above top (upstream end**)** of pipe.

6. Start the test and observe the water level in the test vessel. If the level drops to 600 mm above the top of the pipe, add water. Maintain head between 1000 and 600 mm. Continue the test for a total duration of 120 minutes and record the water volume lost over that time. Water volume lost includes all water added to maintain the head and water required at the end of the test to re-establish the 1000mm head.

7. Compute the maximum allowable volume loss for the main and for the service connections. Add the two values to find the total allowable loss.

8. Compare the actual volume of water lost to the total allowable volume loss to determine if the line segment passes or fails.

9. Remove the downstream plug, exercising care with respect to the rapid flow of water.

10. Submit the signed and witnessed test record form (Specification 1320, Page 5 of 7) to the City of Regina, Director of Municipal Engineering.

11. This test is to be applied to at least 10% of all new gravity domestic sewer lines installed.

City of Regina - Municipal Engineering Department
Domestic Gravity Sewer Exfiltration Test

Location: ______________________________ Key No.: ______________________________

From: ______________________________ To: ______________________________

MH (STA): ______________________________ MH (STA): ______________________________

Length of Domestic Main (A) ____________________ km Type of pipe: ______________________________

Diameter of pipe (B) ____________________ mm

Length of Service Connections (C) ______________ km Diameter of Service Connections (D) ____________ mm
(below the 1000mm head)

Pre Test Fill Time and date: ____________________ ______________________________

Date of Test: ______________________________

Time Test Started: ______________________________ Time Test Completed: ______________________________

Duration of Test (E) ____________________ hrs

Volume of Water Lost (F) ____________________ litres

Connections in place No ☐ Yes ☐ Number: ______ Plugs Inspected: No ☐ Yes ☐

CALCULATIONS:

1. Calculate L_1, the maximum allowable volume loss for Domestic Main

$L_1 = 4.6$ litres/day/mm/km $\times$ 1day/24hr $\times$ (E) $\times$ (A) $\times$ (B) NOTE: If pipe size is larger than 600mm, substitute 55 for 4.6 litres/day/mm/km in this calculation.

$L_1 = 4.6 \times 1/24 \times$ ______ $\times$ ______ $\times$ _____

$L_1 =$ ______ litres

2. Calculate L_2, the maximum allowable volume loss for Service Connections

$L_2 = 4.6$ litres/day/mm/km $\times$ 1day/24hr $\times$ (E) $\times$ (C) $\times$ (D)

$L_2 = 4.6 \times 1/24 \times$ ______ $\times$ ______ $\times$ ______

$L_2 =$ ______ litres

3. Calculate L_3, the total allowable loss

$L_3 = L_1 + L_2$

$L_3 =$ ____ + ____

$L_3 =$ ______ litres

4. Compare the volume of water lost (F) to the total allowable loss (L_3) CHECK ONE

If $F > L_3$, the test section **FAILS** ☐ Section Fails
If $F \leq L_3$, the test section **PASSES** ☐ Section Passes

Witnessed by: ______________________________ Contractor/Consultant ____________________ Date

______________________________ Inspection (City of Regina) ____________________ Date

CITY OF REGINA
MUNICIPAL ENGINEERING DEPARTMENT
PROCEDURE FOR HYDROSTATIC WATER LEAKAGE TESTING
OF DOMESTIC MANHOLES

(as required by Section 1320-3-d-3 of Standard Construction Specifications)

TEST PROCEDURE

1. Manholes are to be tested for leakage after backfilling is completed. Manholes to be tested shall be selected by the Engineer.

2 All lift holes (if any) shall have been previously plugged with an approved non-shrink grout.

3. Install watertight plugs or seals on inlets and outlets of the test manhole and fill with water to the top of the cone. Allow a minimum of 12 hours for pretest absorption stabilization period before starting the test.

4. To start the test, top up the manhole with water. Then add measured volumes of water to maintain the level in the manhole for one hour.

5. Calculate the volume of the manhole and express the leakage loss as a percentage of the volume of the manhole.

6. Submit the signed and witnessed test form (Specification 1320, Page 7 of 7) to the City of Regina, Director of Municipal Engineering.

7. This test is to be applied to at least 10% of all new manholes constructed.

NOTE: Leakage loss information if being collected for information purposes only at this time. The Canadian National Master Construction Specification stipulates a maximum allowable leakage rate of 0.3% volume of manhole per hour.

City of Regina - Municipal Engineering Department
Hydrostatic Leakage Test
Domestic Manholes

Location: ______________________ Key No.: ______________________

From: ______________________ To: ______________________

MH (STA): ______________________

Depth of Manhole ____________ m

Conical top section? _____YES _____NO

Pre Test Fill Time and date: ______________________

Date of Test: ______________________

Time Test Started: ______________________ Time Test Completed: ______________________

Duration of Test (T) ______________________ hrs

Volume of Water Lost (L) ______________________ litres

CALLCULATIONS:

1. Calculate V, the volume of the manhole in litres. ($1 m^3 = 1000$ litres)

   Volume of conical manhole section $V = 1/3\pi h\{(R_1)^2 + (R_2)^2 + R_1R_2\}$ where "R_1" and "R_2" are the radii at the top and bottom of the cone and "h" is the height of the conical section.

   Volume of cylindrical manhole section $V = \pi R^2 h$ where "R" is the radius of the cylindrical section and "h" is the height.

2. Calculate P, the leakage loss as a percentage of the volume of the manhole per hour.

   $P = \{(L \div V) \div T\} \times 100$

   $P = \{(\_\_\_\_\_ \div \_\_\_\_\_) \div \_\_\_\_\_\} \times 100$

   P = ________% per hour

3. Calculate P_1, the ratio of actual percentage of volume lost per hour (P) over the maximum acceptable leakage rate set by Canadian National Master Construction Specification (CNMCS), Section 02725, which is 0.3% per hour (P_{ma}).

   $P_1 = P \div P_{ma}$

   $P_1 = \_\_\_\_ \div 0.3$

   $P_1 = \_\_\_\_$

   CHECK ONE

   ☐ Meets CNMCS

   ☐ Does not meet CNMCS

   If $P_1 > 1.0$, the manhole does not meet the CNMCS standard

   If $P_1 \leq 1.0$, the manhole meets the CNMCS standard

Note: The leakage loss information is being collected for information purposes only at this time.

Witnessed by: ______________________ Contractor/Consultant ____________ Date

______________________ Inspection (City of Regina) ____________ Date

(E5379BW.FRM)

1330 SPECIFICATION FOR MANHOLE OR CATCHBASIN CONSTRUCTION

1330 - 1 GENERAL

The work shall consist of the construction, renovation or the adjustment of manholes and/or catchbasins as detailed on the plans or where designated by the Engineer in the field. Should the Contractor wish to propose alternate materials or methods, details must be submitted and approved in writing to the Engineer before proceeding.

1330 - 2 MATERIALS

a) Concrete Block and Brick

All block and brick solid concrete complying with the requirements of CSA A165.1 and A165.2, and ASTM C139. Cement shall be Type 50 Sulphate Resistant Portland Cement, meeting CAN/CSA-A5/A8/A362-M89.

Bricks shall be standard structural brick dimensions, true to shape, sound and free from cracks and surface defects.

Blocks shall be not less than 128 mm thick, having a comprehensive strength of not less than 17.5 MPa. After being thoroughly dried and immersed in water for 24 hours they shall absorb not more than eight percent (8%) of their weight of water.

If requested samples shall be submitted for testing and approval.

b) Precast Manhole or Catchbasin Units

Designed and constructed to the requirements of ASTM C478 with dimensions shown on the drawings and/or as designated by the Engineer in the field. Cement shall be Type 50 Sulphate Resistant Portland Cement meeting CAN/CSA-A5/A8/A362-M89.

Minimum wall thickness shall be 90 mm.

All manhole sections shall have single offset or grooved "O" ring rubber gasket joints manufactured in accordance with the provisions of ASTM C443. A rubber gasket shall be provided with each manhole section which is supplied.

Where PVC pipes penetrate domestic manholes, flexible gaskets shall be provided. Flexible gaskets will be factory installed as often as reasonably practical and field installed when necessary. Flexible gaskets shall conform to ASTM C923M-94, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals (Metric).

c) Frames and Covers

Close-grained grey cast iron meeting ASTM A48, Class 20 or cast steel conforming to ASTM A27, Grade 70-36. The substitution of ductile iron meeting ASTM.A445 for cast iron or cast steel shall be subject to the approval of the Engineer.

All frames and covers shall be true in form and dimension, free from faults, sponginess, cracks, blow holes, and other defects. Bearing surfaces shall be machined to prevent rocking.

Frames and covers shall be bitumen coated by dipping.

All manhole covers shall have only one lifting/vent hole.

d) Types of Frames and Covers

1. For all streets: Standard Manholes are to be floating manhole frame with vented solid cover. Use Norwood NF-80, Titan TF 80 or approved equal.

2. For NON Traffic Areas:
Standard Manholes are to be Norwood F-39, Titan TF 39 or approved equal.

3. Standard catchbasins: The gutter portion of side inlet grating shall be:

   i) Catchbasins on continuous grade Norwood F-35, Titan TF 35 (rolled curb) or Norwood F-36, Titan TF 36 (barrier curb) or approved equal. Where existing catchbasins do not permit the above frames and covers, use Norwood F-60, Titan TF 104 or approved equal.

   ii) Catchbasin on low point (rolled curb) Norwood F-35, Titan TF35 or approved equal.

   iii) Catchbasin at low point (barrier curb) Norwood F-36, Titan TF36 or approved equal.

4. Catchbasin in easements: Use Norwood F-39, Titan TF 39 or approved equal.

e) <u>Manhole Steps</u>

Shall be aluminum, conforming to the requirements of ASTM C478M.

f) <u>Concrete (Cast-In Place)</u>

Concrete shall conform to the following:

Type of Cement	Type 50 Sulphate Resistant Portland Cement
Specified Strength	30 MPa
Air	6.5 $\pm$ 1%
Maximum water/cementing materials ratio	0.50
Specified Slump	70 mm $\pm$ 10 mm

g) <u>Mortar</u>

Shall consist of one (1) part Type 50 Sulphate Resistant Portland Cement to three (3) parts clean sharp sand, mixed dry. Sufficient water shall be added after mixing to give optimum consistency for placement. <u>No additives shall be used</u>.

h) Details for reinforcing to be used in cast-in-place concrete shall be submitted and approved by the Engineer prior to construction.

<u>1330 - 3 CONSTRUCTION</u>

All manholes and catchbasins shall be constructed in accordance with the appropriate Standard Drawings. Unless otherwise specified, the type of manhole used shall be the standard manhole. The exact location of manholes and catchbasins shall be indicated by the Engineer in the field.

Where no road grades exist for the location at which the sewer is being constructed, the elevation of rims will be indicated on the design plans and/or grade sheet. The manhole or catchbasin shall then be constructed such that the rim elevation will conform accurately to the elevation specified. Manhole frames of the non-floating type shall be placed on top in a bed of cement mortar and shall be centred over the manhole bricks and set level within 15mm of correct grade. Manhole frame is to be set to match proposed roadway cross slopes as directed.

Placement of catchbasins shall be completed prior to the installation of curb and gutter or monolithic walk, curb and gutter.

Where manholes are being rebuilt, constructed, raised or lowered, and/or adjusted in conjunction with pavement surface construction or renewal, manhole frames shall be placed in accordance with Section 2350-Specification for the Placement of Asphaltic Concrete Surface Course of Full Depth Structure.

Support pipes at manholes and catchbasins to prevent shearing or settlement. Where not detailed use concrete fill, concrete or timber beam, suitable compacted gravel or site material as approved by the Engineer. During construction, plug pipes at manholes and catchbasins to prevent entry of concrete and mortar. Remove plugs immediately after construction is completed.

Manholes shall be constructed to details shown on Standard Drawings. Manholes constructed using batter blocks shall have three (3) to five (5) courses of brick over the batter blocks and under the manhole frames. Manholes/catchbasins constructed using brick only for battering purposes shall have a minimum of six (6) brick courses on the batter section plus at least four (4) straight courses over the batter section and under the manhole frame.

Precast concrete lift rings may also be used in order to raise the manhole or catchbasin cover to the finished grade.

Concrete blocks and bricks shall be thoroughly wetted prior to laying. All sections of the catchbasin or manhole (bricks, blocks, and precast units) shall be bonded together with mortar. Manhole rungs shall be firmly embedded in the manhole structure approximately 400 mm on centre vertically and shall be staggered 300 mm on centre. If 400 mm wide rungs are used, the rungs shall be positioned in line.

1330 - 4 RENOVATION OF EXISTING MANHOLES AND CATCHBASINS

a) Abandonment

During the course of construction it may be required that existing catchbasins may have to be abandoned. The frame, bricks and water blocks shall be removed to 0.3 m below the proposed subgrade. Salvageable material shall be returned to the City Yards. If the connection is no longer required, it shall be blocked and the catchbasin backfilled.

If the connection is to remain as a live connection, it shall be extended through the barrel portion of the catchbasin and a stub constructed on the opposite side for future extension.

Backfilling of the catchbasin barrel shall be made with a low shrink (non-shrink) backfill material, when native backfill material cannot be compacted adequately to specifications to subgrade elevation.

b) <u>Adjustment</u>

An adjustment shall be defined as the addition or removal of one or more courses of brick work.

All tops shall be firmly set into position at the required elevation and grouted. Re-setting disturbed grouting and change of rim elevations of less than one course of brickwork, even though required by the Engineer, is not considered an adjustment. An adjustment does not include the removal or addition of batter blocks, manhole blocks or precast rings.

It will be the responsibility of the Contractor to bring all manholes and catchbasins to the finished grade elevation designated by the Engineer. The manhole shall show no depressions or bumps exceeding 5mm under a straight edge three 3m (minimum) long, placed parallel to the road centre line.

Manhole frames shall be placed level with the road surface in accordance with clause <u>1330 - 3 CONSTRUCTION</u> of this specification.

The cost of renovating manholes or catchbasins damaged as a result of the Contractor's operations shall be borne by the Contractor.

c) <u>Raising and Lowering</u>

1. Raising of manholes and catchbasins shall be done in accordance with standard specification for construction.

   The Contractor shall be responsible for locating all manholes and catchbasins which require raising.

2. Where lowering of an existing manhole or catchbasin is required, the Contractor shall remove the frame, cover and any bricks, blocks or precast rings necessary to lower the manhole or catchbasin to a level where there is no danger of the manhole or catchbasin being damaged during excavation, compaction, grading or paving operations.

An approved steel cover shall be placed over the manhole or catchbasin until the manhole or catchbasin can be raised to its final elevation.

Salvageable material shall be returned to the City yards.

Manhole frames shall be placed level with the road surface in accordance with clause 1330 - 3 CONSTRUCTION of this specification.

d) Reconstruction

The existing rim, bricks, blocks, and base shall be removed and a new manhole or catchbasin constructed in accordance with standard specifications for construction.

Manhole frames shall be placed level with the road surface in accordance with clause 1330 - 3 CONSTRUCTION of this specification.

e) Changing Manhole and Catchbasin Frames and Covers

Floating type frames and covers shall be supplied and installed on all existing manholes in paved surfaces. When replacing existing frames and covers with floating type, the top rows of bricks shall be removed and replaced with a precast concrete lift ring (barrel). This will allow for proper fit of the frame within the barrel of the manhole.

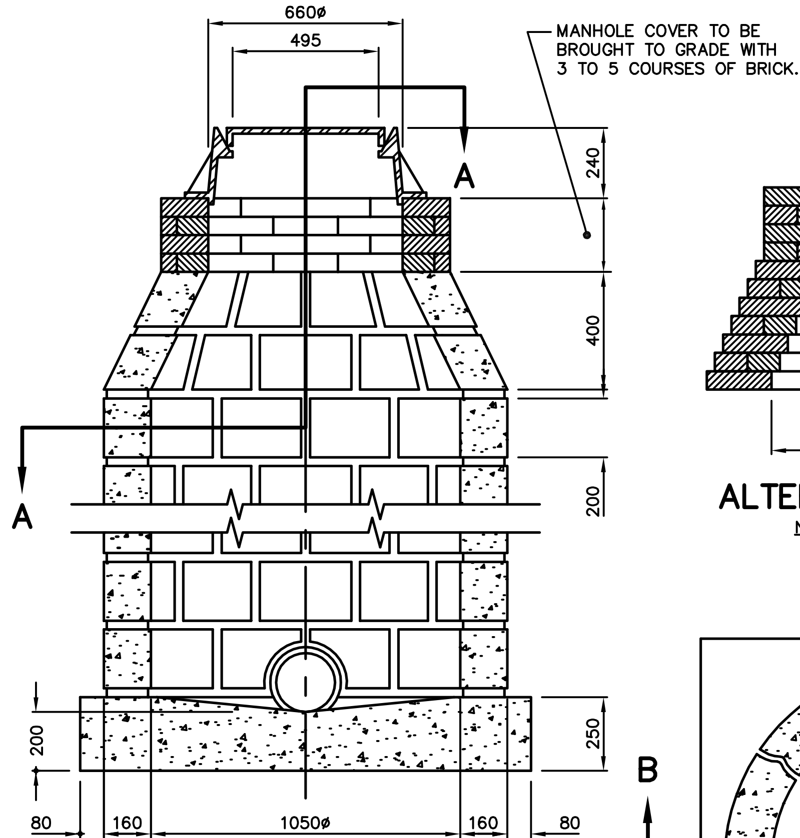
Side inlet style frames and covers shall be supplied and installed where an existing catchbasin barrel alignment allows the installation of the side inlet style.

1330 - 5 STORMWATER QUALITY UPGRADE DEVICES

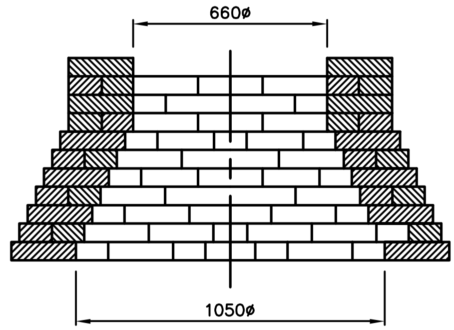
Approved Stormwater Quality Upgrade Devices are “Stormceptor” and “CDS Technologies”. Other manufacturers will require review and approval by the City.

1499 LISTING OF SEWER STANDARD DRAWINGS

S-1	Standard Manhole Concrete Block	Jan/03
S-2	Precast Manhole 1050mm Dia.	Mar/04
S-3	Precast Concrete Deep Manhole	Jan/03
S-4	Special Manhole T-Riser for Sewers of 1050 Dia. or Larger	Jan/03
S-5	Drop Manhole	Jan/03
S-5C	Precast Manhole Catchbasin 1050mm Dia. Detail	Jan/03
S-6	Cul-de-sac Service Connections	Jan/03
S-7	Standard Manhole Frame & Cover for Arterial Traffic	Jan/03
S-8	Standard Manhole Frame & Cover for Non Pavement Locations	Jan/03
S-9	Floating Manhole Frame and Cover	Jan/03
S-10	Typical Pipe Section Exfiltration Test	Jan/03
S-11	No Drawing Issued	
S-12	Standard Catchbasin Concrete Block	Jan/03
S-13	Standard Precast Concrete Catchbasin	Jan/03
S-14	Standard Side Inlet Catchbasin Frame & Cover (Rolled Curb & Gutter)	Jan/03
S-15	Standard Side Inlet Catchbasin Frame & Cover (Barrier Curb) for 190mm Curb & Gutter	Jan/03
S-16	Standard Catchbasin Frame and Cover	Jan/03
S-17	No Drawing Issued	
S-18	Service Connection Integral Tee/Wye	Jan/03
S-19	Typical Commercial Connection	Jan/03
S-20	Standard Flexible Pipe Bedding & Trench Backfill	Jan/03
S-21	Standard Rigid Pipe Bedding & Trench Backfill	Jan/03
S-22	Storm Sewer Outlet	Jan/03
S-23	Erosion Control at Culverts	Jan/03
S-24	Precast Concrete Manhole Integral Base & Thru-Pipe Type	Jan/03
S-25	Precast Concrete Manhole End Section 1050 Dia. Manhole	Jan/03
S-26	No Drawing Issued	
S-27	Establishment of Grade for Sewer Construction	Jan/03
S-28	Impervious Material Barriers for Utility Service Trenches	Jan/03
S-29	Manhole Frame & Cover for 1200 mm Dia. Manholes	Jan/03
S-30	Hi-Capacity Catchbasin Frame and Grate (4 sheets)	Jan/03

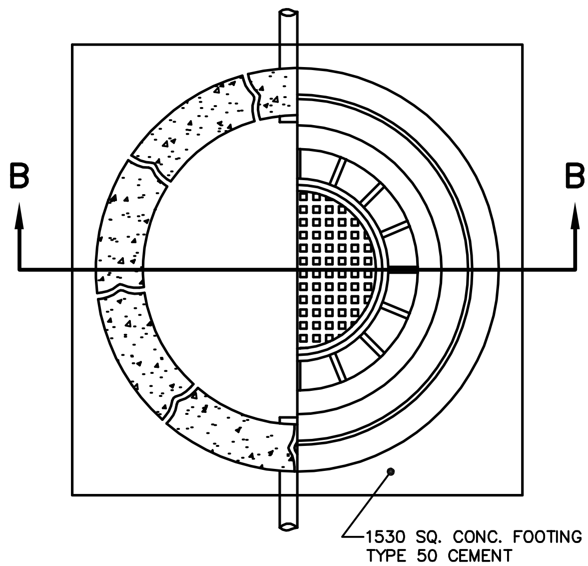


SECTION B–B

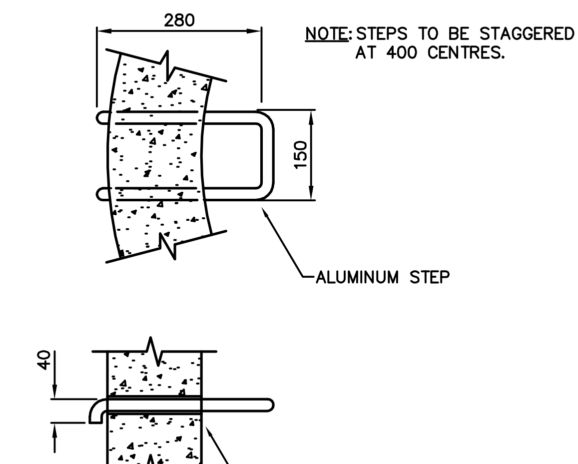


ALTERNATIVE BRICK TOP

NOTE: BRICK TOP TO BE USED AS DIRECTED BY THE ENGINEER.



PLAN THROUGH A–A



DETAIL OF STEPS

NOTE:

1. MANHOLE CAN BE ENLARGED TO 1200mm DIA BY USING 10 BLOCKS PER ROUND AND 3 COURSES OF BATTER BLOCKS.
2. FOR SEWERS 750mm TO 1200mm DIA. USE SPECIAL MANHOLE CONCRETE BASE – DRAWING S–4.
3. MANHOLES CONSTRUCTED TO THESE DIMENSIONS WITH PRECAST RINGS ARE ACCEPTABLE.
4. ALL DIMENSONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

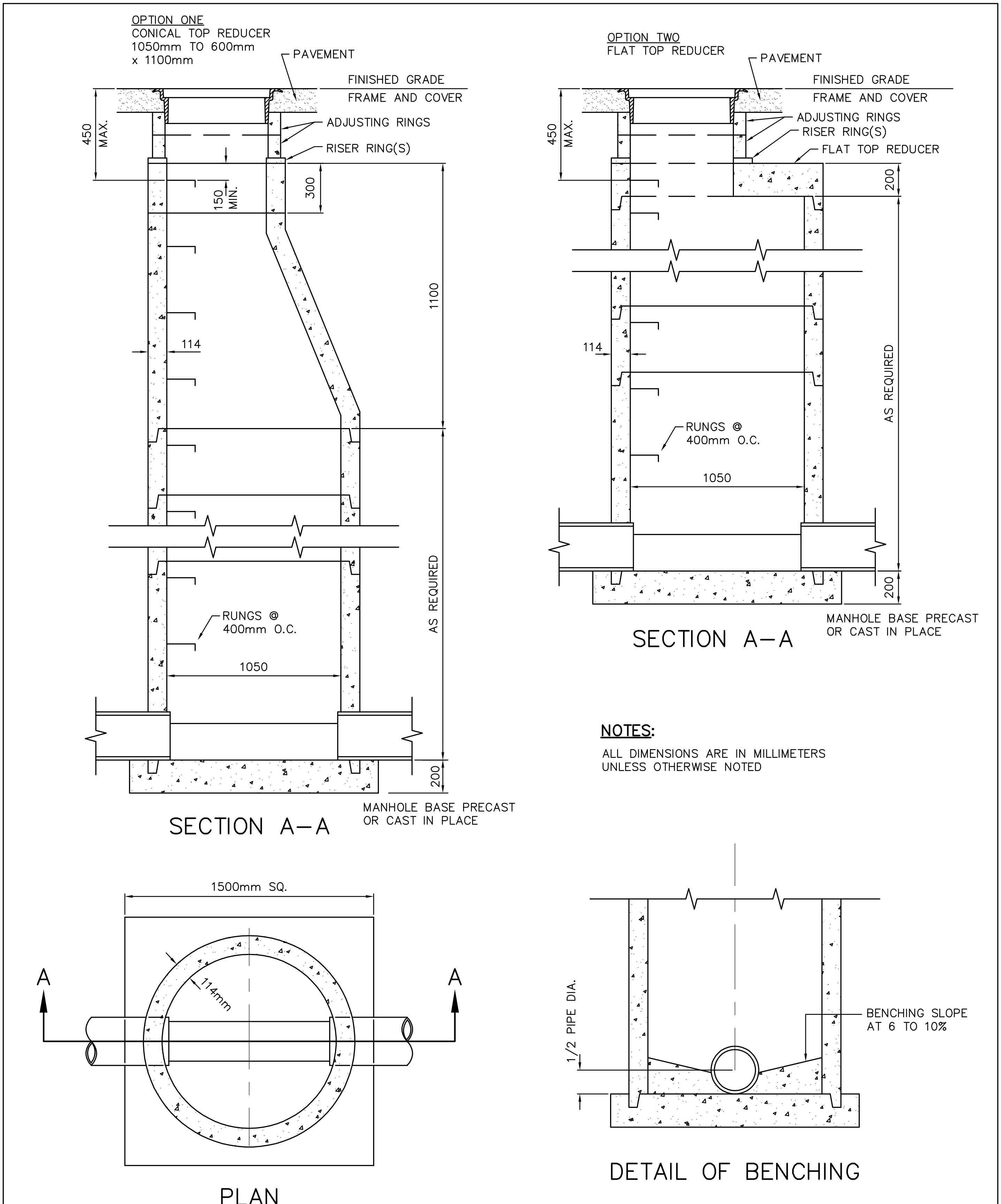
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:

STANDARD MANHOLE CONCRETE BLOCK

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-1
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-1



Date	Revisions	By
Jan/03	TITLE BLOCK	MLG
Mar/04	ADDED FLAT TOP OPTION	CJK

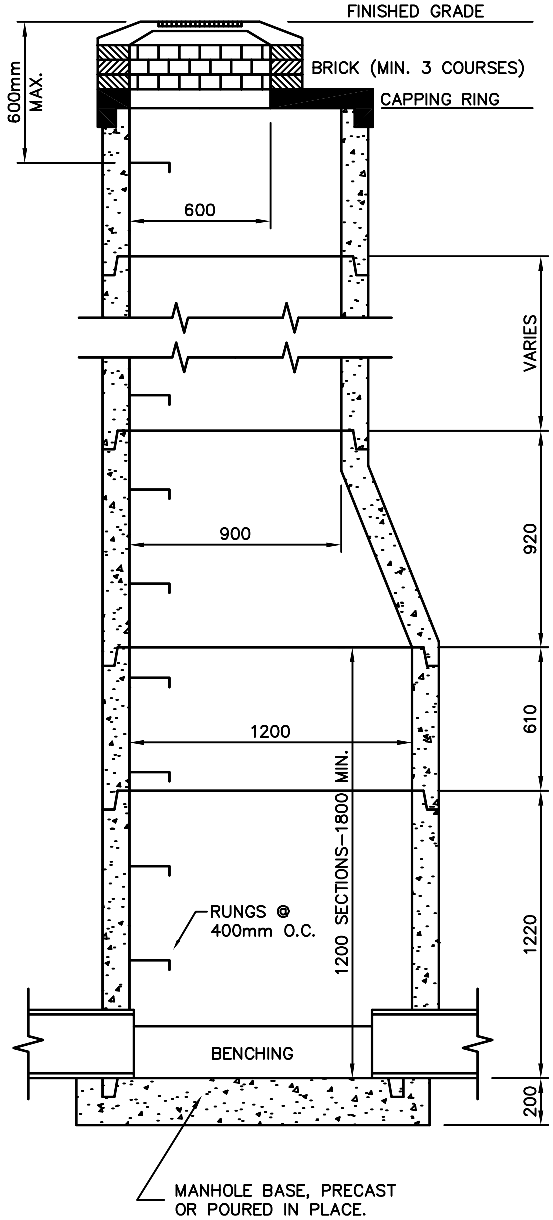
CITY OF REGINA

Engineering and Works

Description:

PRECAST MANHOLE 1050mm DIA.

Manager	Date	Digital File:
KEN WIENS	Jan. / 01	STDS-2
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-2



NOTE

1. INSTALL RUNG 150mm BELOW TOP EDGE OF FIRST RISER
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

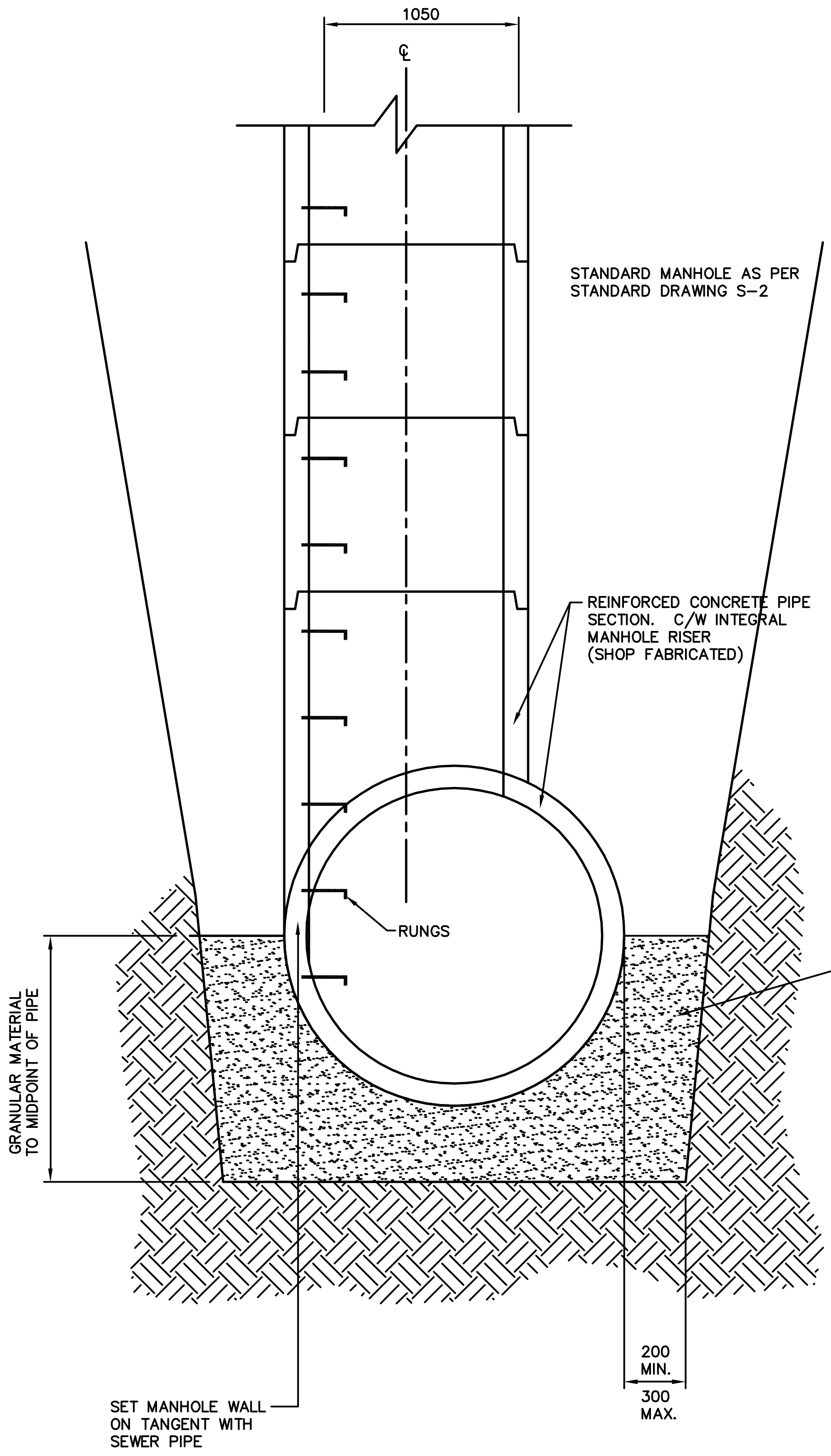
CITY OF REGINA

Engineering and Works

Description:

PRECAST CONCRETE DEEP MANHOLE

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-3
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-3



NOTE

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

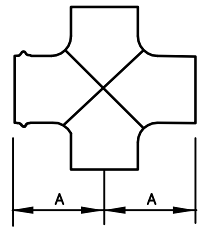
Regina
CITY OF REGINA
Engineering and Works

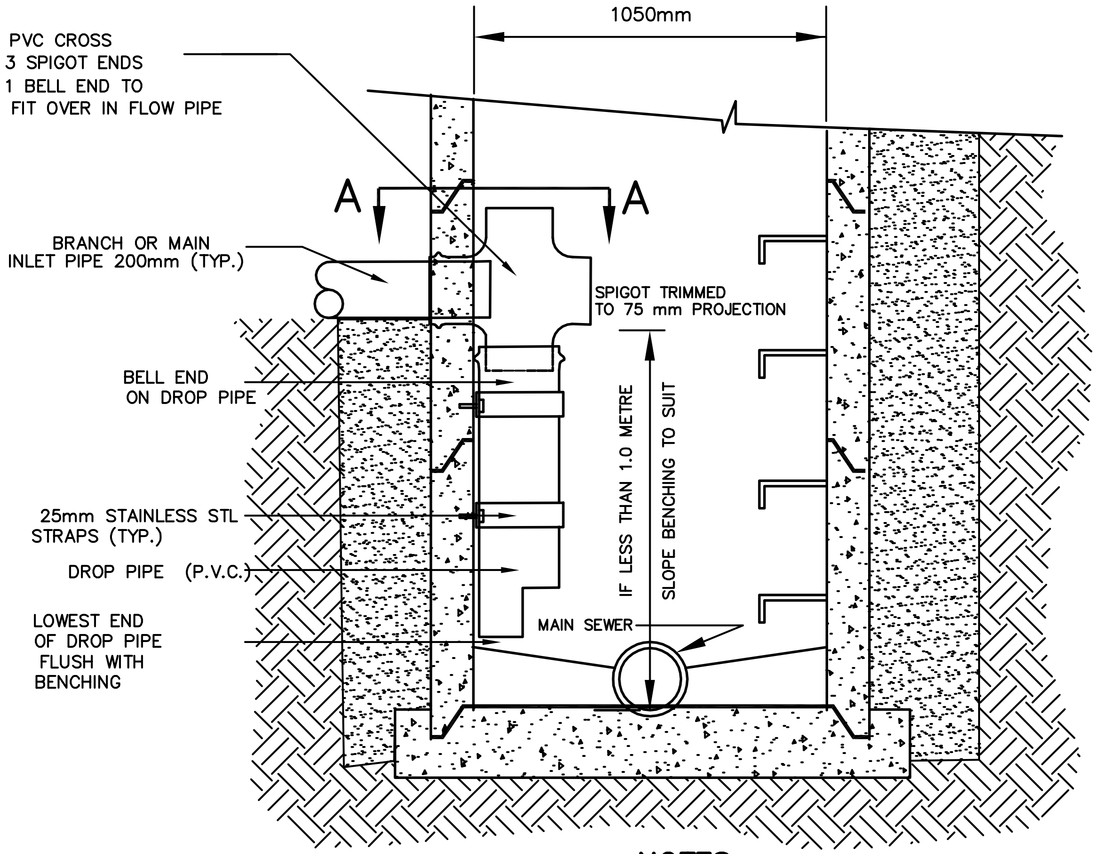
Description:
SPECIAL MANHOLE T-RISER FOR SEWERS OF 1050 DIA. OR LARGER

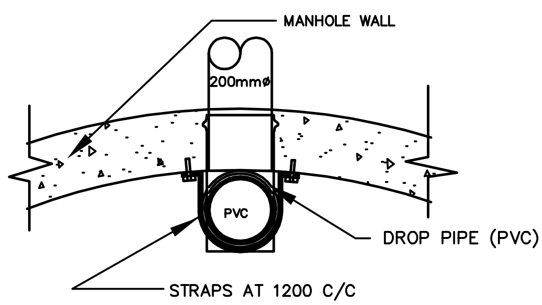
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-4
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-4

SPECIAL ORDER
PSM CROSS

SIZE I.D.	A
200ø	381mm
250ø	406mm
300ø	457mm







SECTION A–A

NOTES

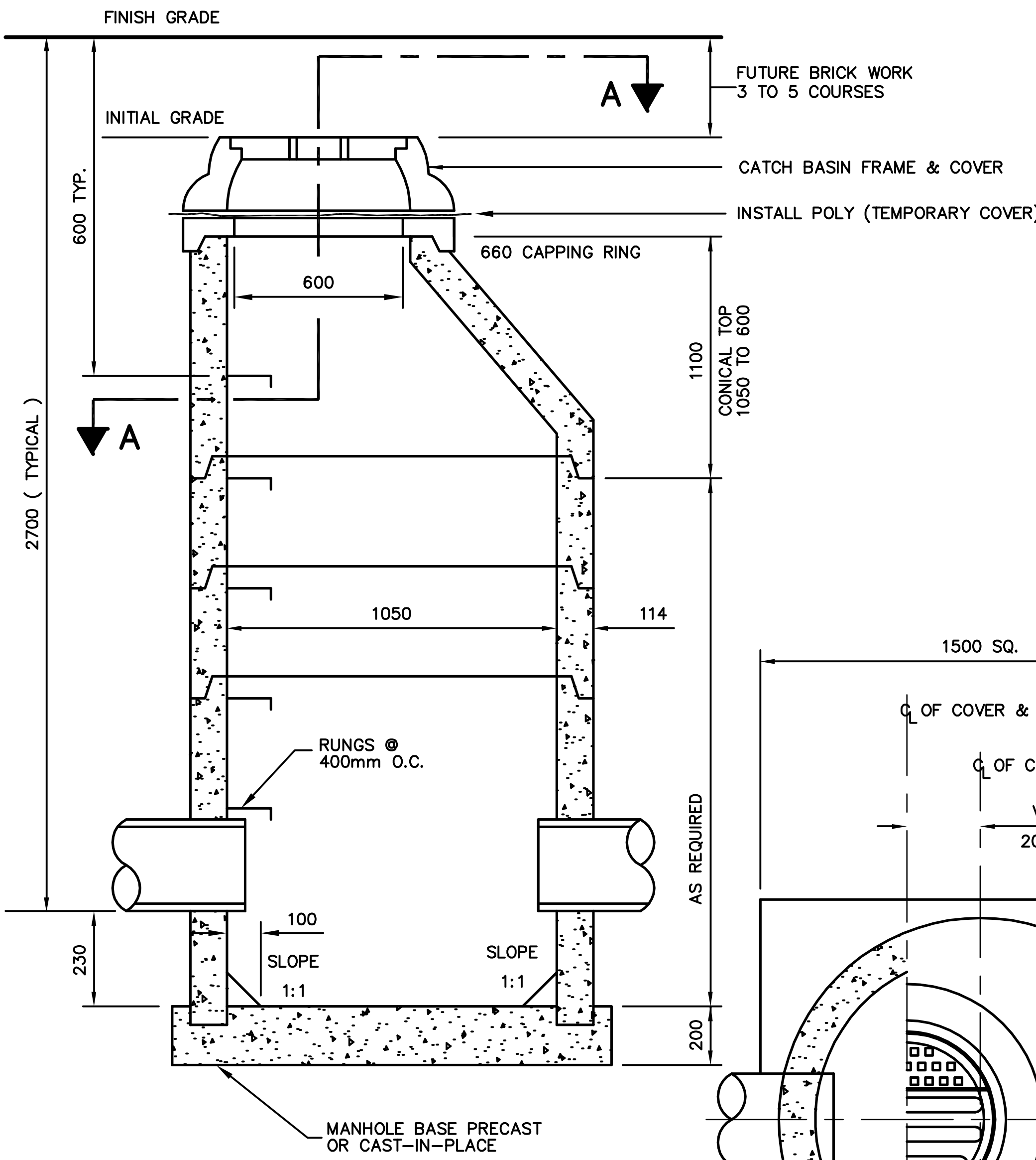
1. DROP PIPE AND CROSS TO BE SAME DIAMETER AS INLET SEWER
2. FOR INLET SEWERS GREATER THAN 300mm OR WITH MORE THAN ONE INLET, DROP STRUCTURES ARE TO BE APPROVED BY THE ENGINEER
3. INSTALL STRAPS TO MANHOLE WALL WITH 15.875 X 56.350 SLEEVE ANCHORS TYPE SLE HEX. NUT ZINC CHROMATE PLATED
4. REPAIR DAMAGE CAUSED BY ANCHOR INSTALLATION
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

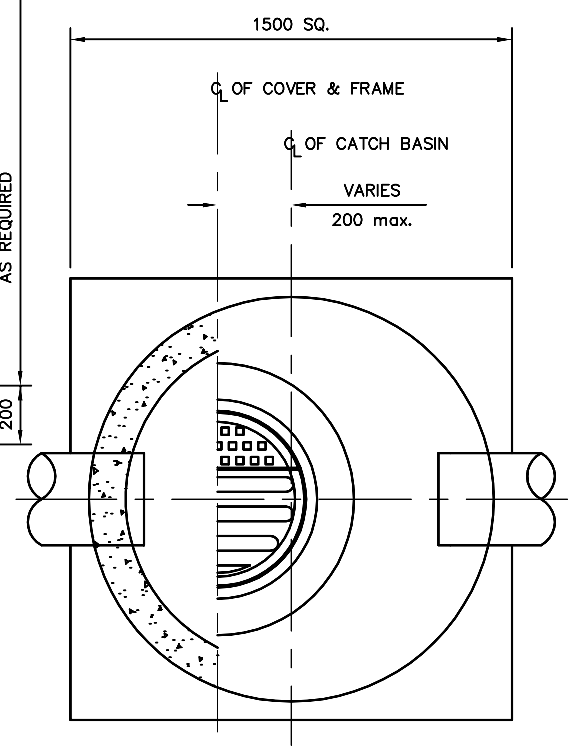
CITY OF REGINA
Engineering and Works

Description:
DROP MANHOLE

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-5
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-5



ELEVATION



SECTION A–A

NOTE:

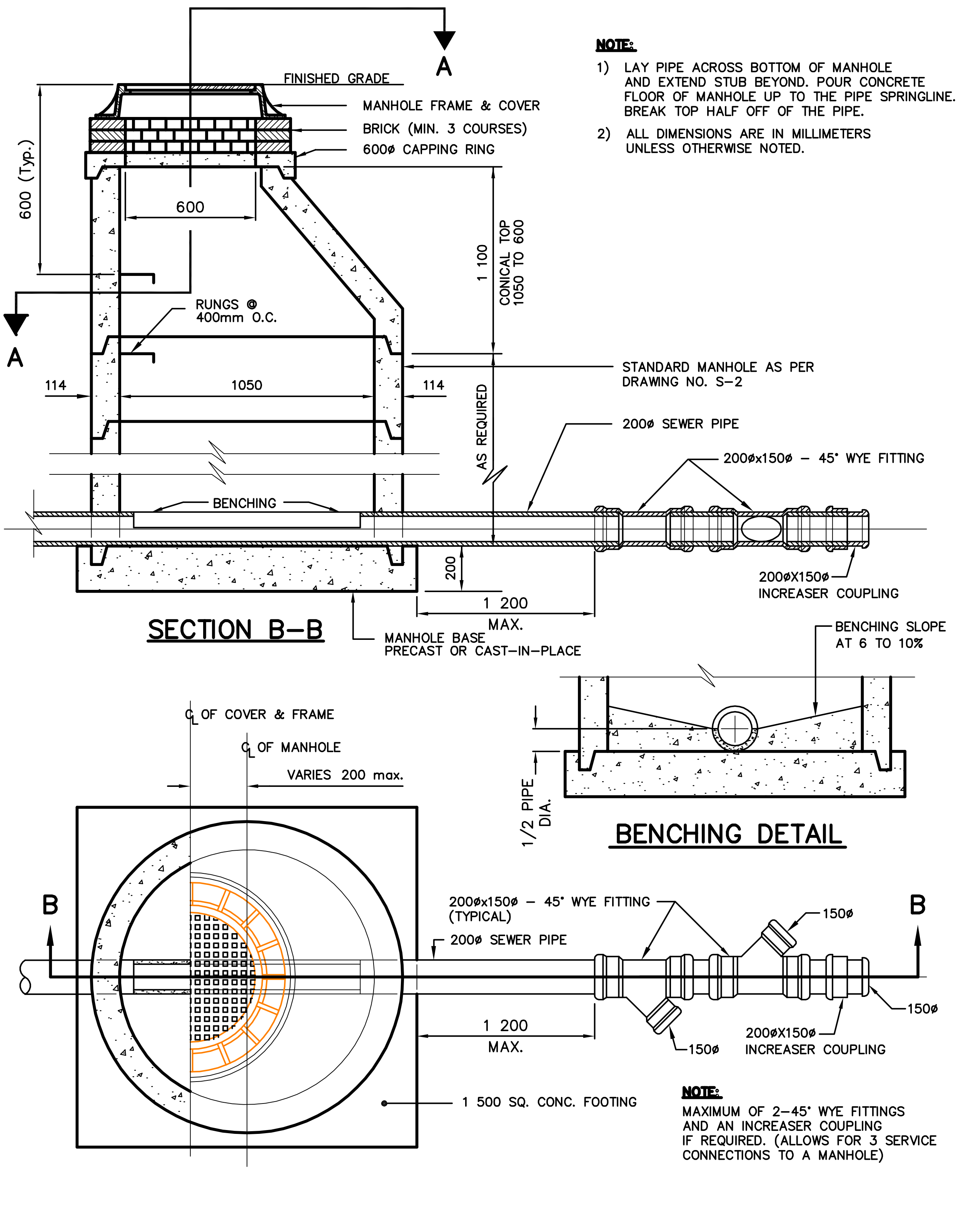
1) MAXIMUM PIPE DIAMETER, 450ømm
2) ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:
PRECAST MANHOLE CATCHBASIN 1050mm DIA. DETAIL

Manager: GARY NIEMINEN	Date: Jan. / 01	Digital File: STDS-5C
Approved: DAVID CALAM	Scale: NTS	Dwg: S-5C

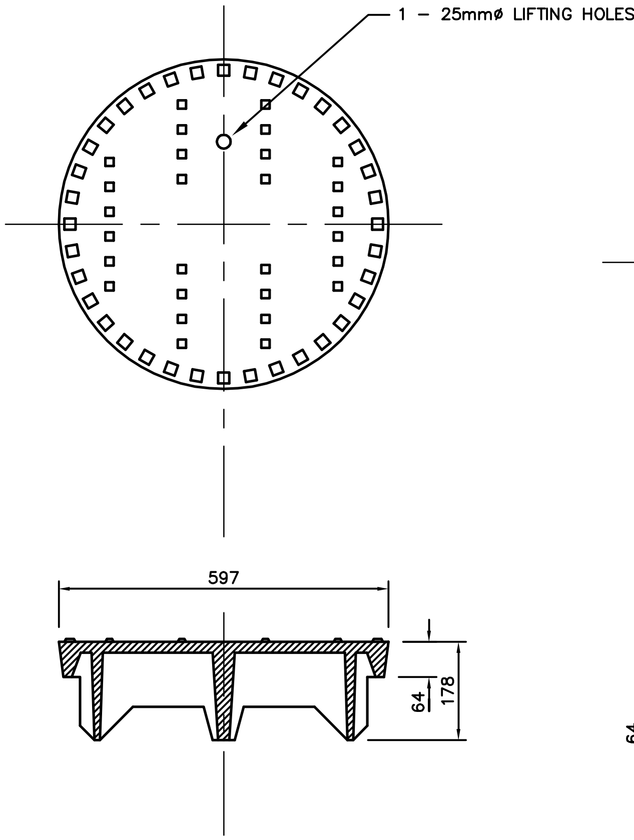


Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

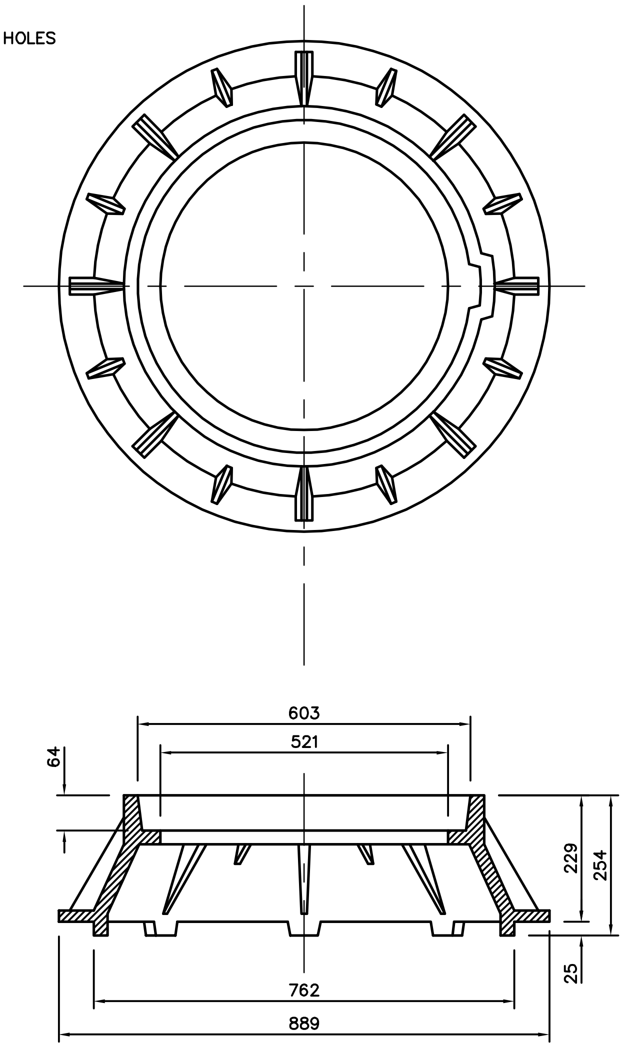
Regina
CITY OF REGINA
Engineering and Works

Description:
CUL-DE-SAC SERVICE CONNECTIONS

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-6
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-6



MANHOLE COVER WT. 76kg



FRAME WT. 103kg

SPECIFICATIONS:

- Manhole frame and covers shall be Norwood Foundry, Model No. F42, Titan Foundry 101M, or approved equal.
- Manhole frames and covers shall be grey cast iron construction or with dimensions as shown.
- Minimum clear opening for frames shall be 520mm diameter.
- The cover shall be of solid–type with extended depth plug and 2–25mm diameter lifting holes.
- Weight of frame shall be at least 103kg.
- Weight of cover shall be at least 76kg.
- Seating faces between frame and cover shall be machined so as to provide a uniform all–around fit.

NOTE:

1. THIS FRAME AND COVER SHALL NOT BE USED UNLESS SPECIFIED ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

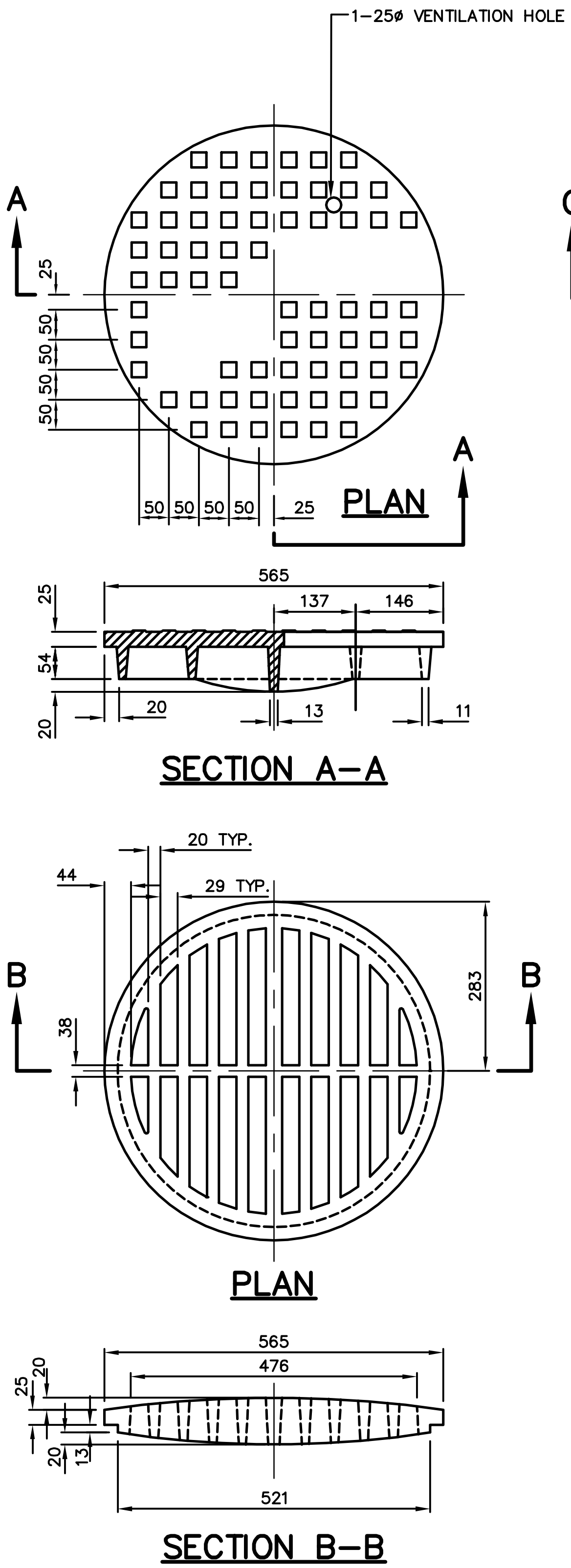
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

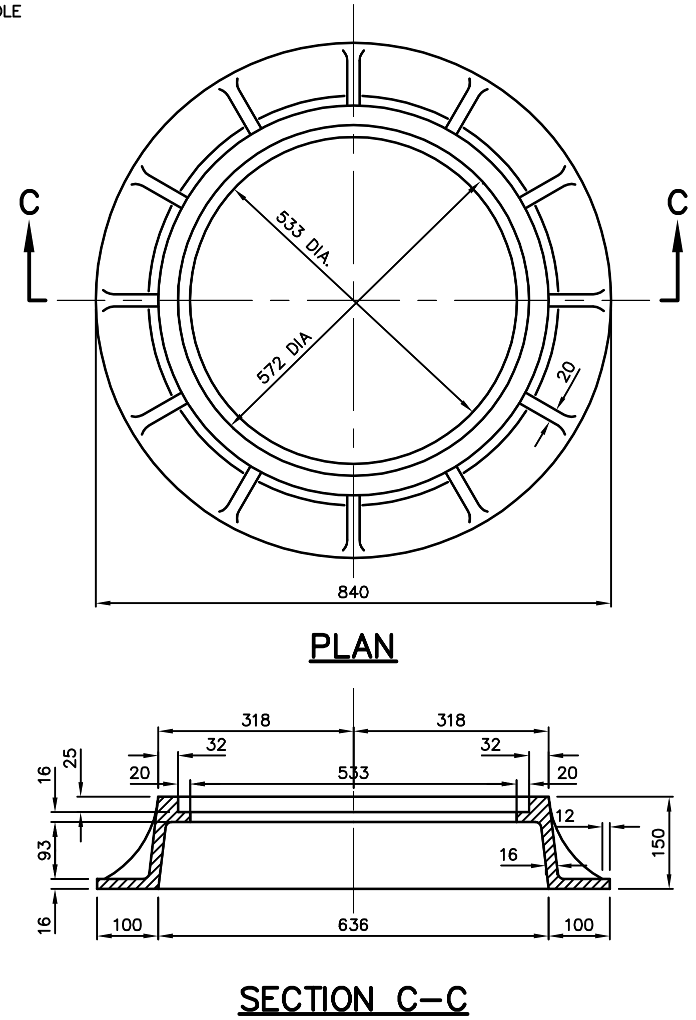
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

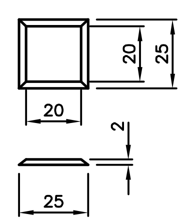
Regina
CITY OF REGINA
Engineering and Works

Description:
STANDARD MANHOLE FRAME & COVER FOR ARTERIAL TRAFFIC

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-7
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-7







NOTES:

1. MACHINE OR GRIND FRAMES, COVERS, AND GRATES TO EVEN NON-ROCKING BEARING SURFACES.
2. FRAME AND COVER SHALL BE NORWOOD F-39, TITAN TF-39 OR APPROVED EQUAL.
3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

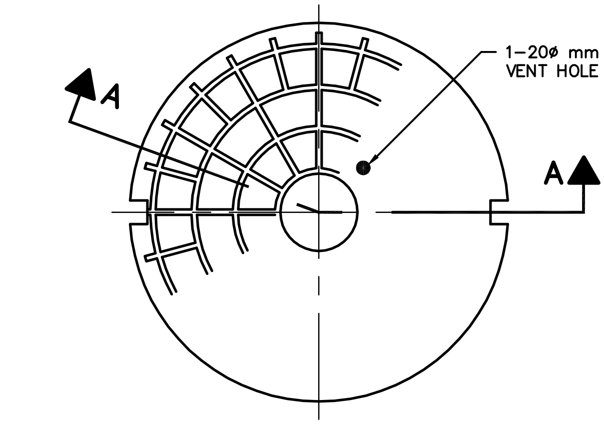
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

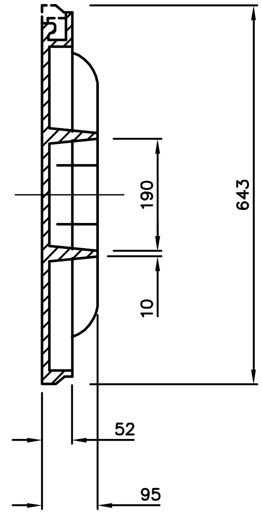
Description:

STANDARD MANHOLE FRAME & COVER FOR NON PAVEMENT LOCATIONS

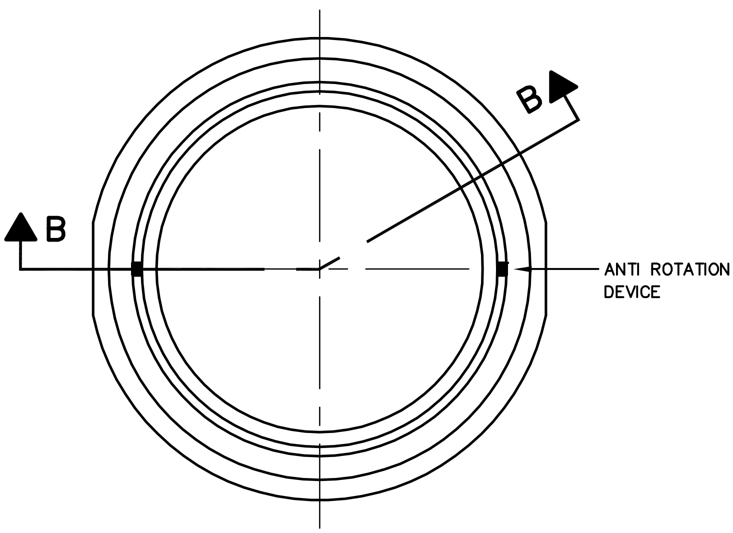
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-8
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-8



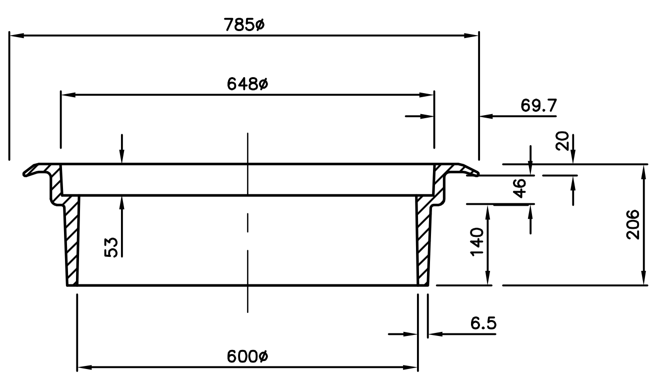
PLAN – (COVER)



SECTION A–A



PLAN – (FRAME)



SECTION B–B

NOTES:

1. FRAME AND COVER SHALL BE NORWOOD F–80 ULEFOS, TITAN TF–80 OR APPROVED EQUAL
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

MATERIAL SPECIFICATION

DUCTILE IRON GRADE 80–60–03

BEARING SURFACE SHALL BE MACHINED TO PREVENT ROCKING

COVER WEIGHT 48.0 Kg.

FRAME WEIGHT 53.0 Kg.

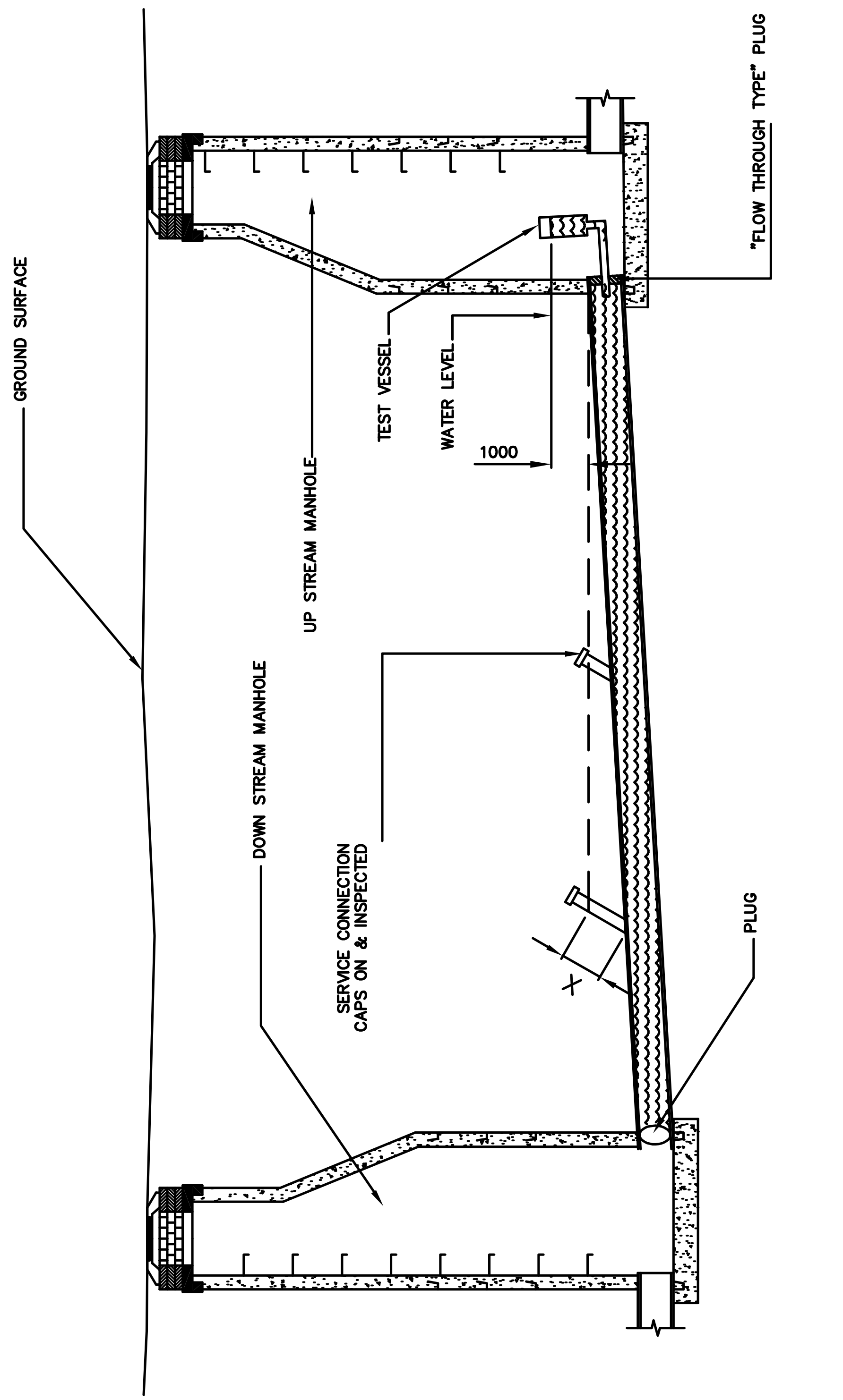
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:

FLOATING MANHOLE FRAME AND COVER

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-9
Approved	Scale	Dwg:
DAVID CALAM	NTS	S-9



X = Length of Service Connection to be included in Exfiltration test calculation.

NOTE

1. THE ENTIRE LENGTH OF SERVICE IS NOT INCLUDED. ONLY THE PORTION BELOW THE 1 METRE HEAD IS INCLUDED IN THE EXFILTRATION TEST.

2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

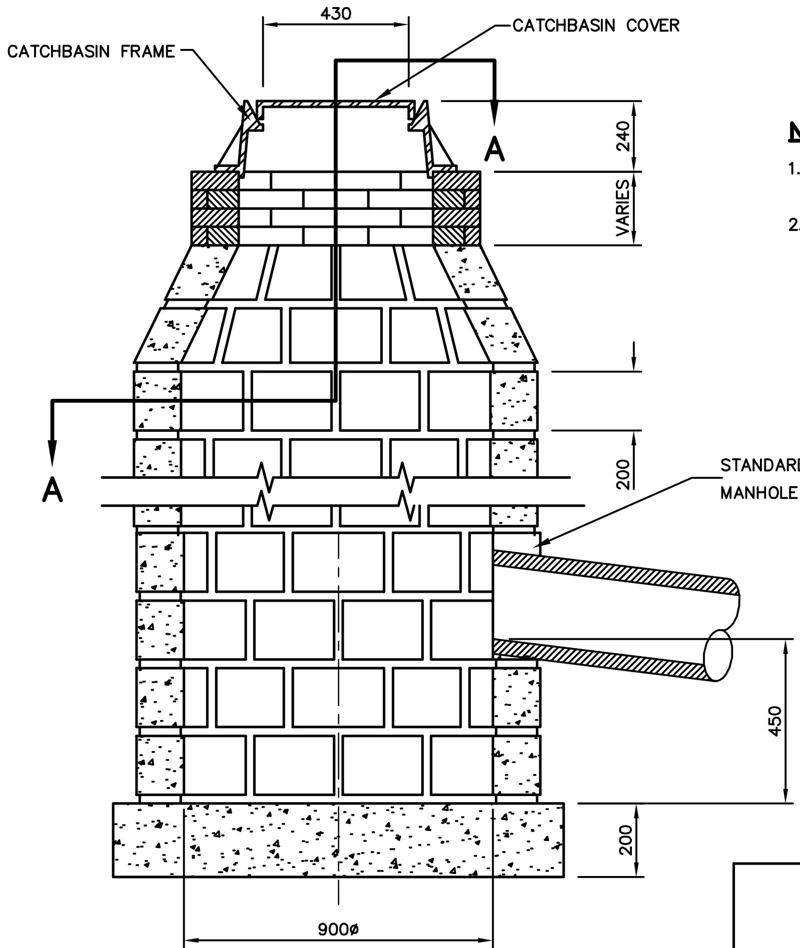
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:

TYPICAL PIPE SECTION EXFILTRATION TEST

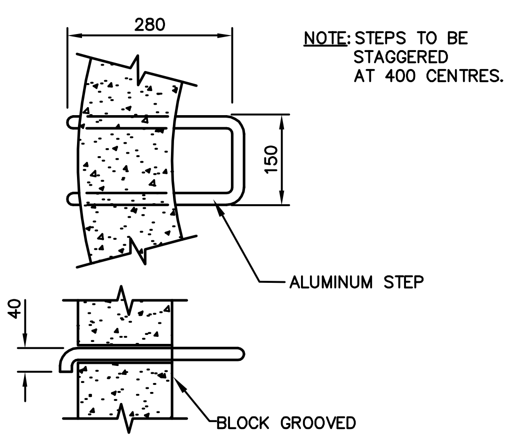
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-10
Approved	Scale	Dwg:
DAVID CALAM	NTS	S-10



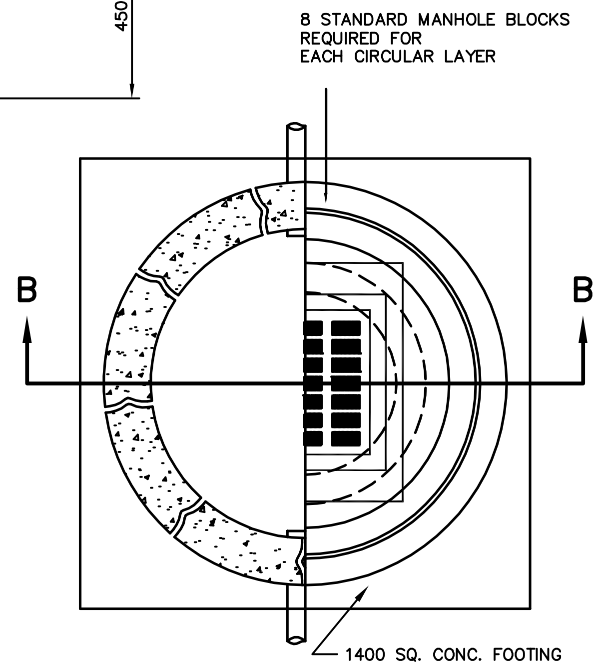
SECTION B–B

NOTE:

1. CATCHBASIN CONSTRUCTED TO THESE DIMENSIONS WITH PRECAST RINGS ARE ACCEPTABLE.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.



DETAIL OF STEPS



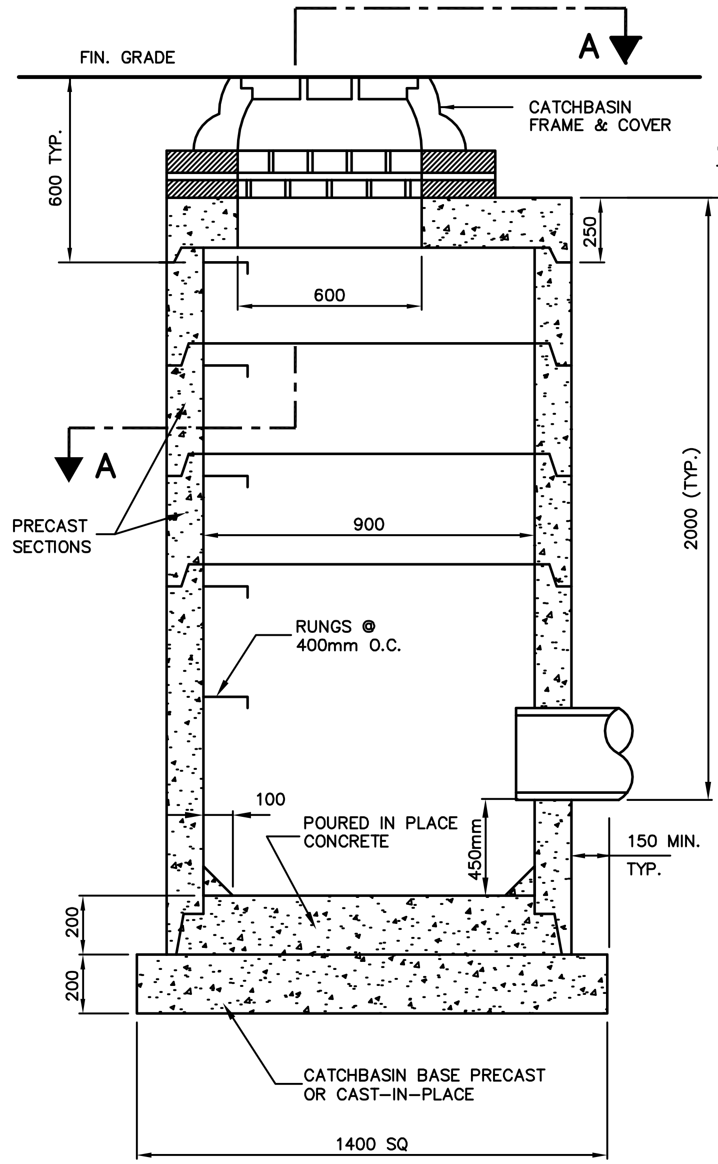
PLAN THROUGH A–A

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

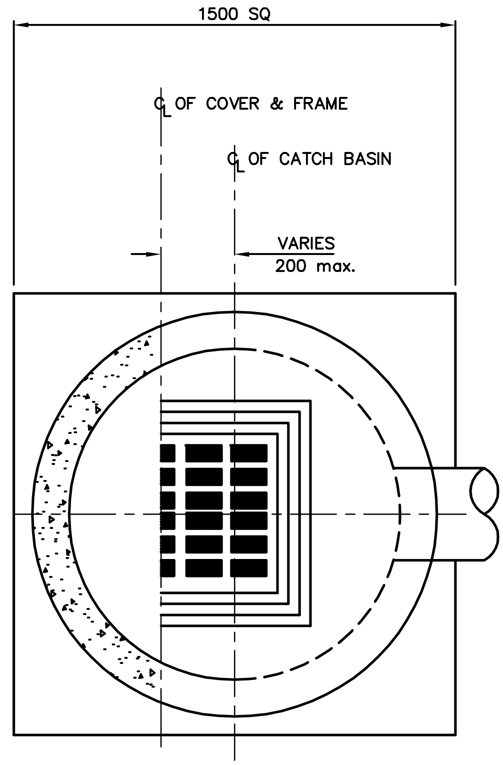
Regina
CITY OF REGINA
Engineering and Works

Description:
STANDARD CATCHBASIN CONCRETE BLOCK

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-12
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-12



ELEVATION



SECTION A–A

NOTE:

1. FOR POURED IN PLACE BASE
   SET C.B. BARREL IN WET CONCRETE
2. ALL DIMENSIONS ARE IN MILLIMETERS
   UNLESS OTHERWISE NOTED.

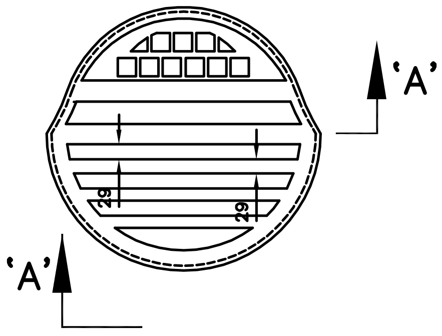
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

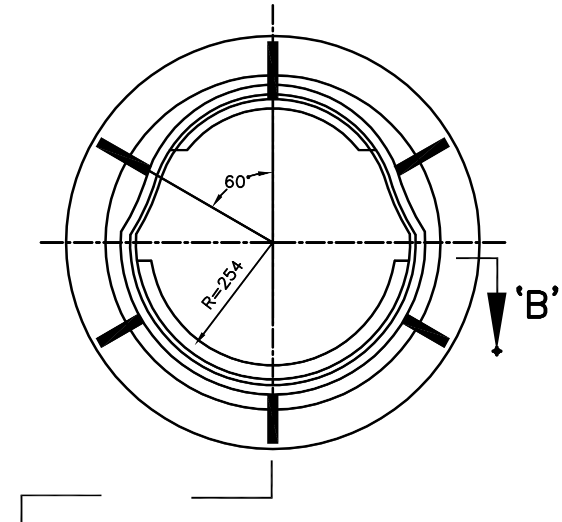
Description:

STANDARD PRECAST CONCRETE CATCHBASIN

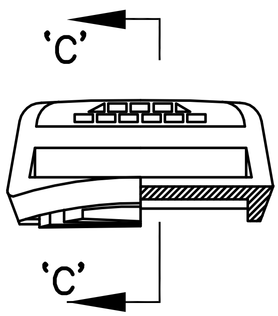
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-13
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-13



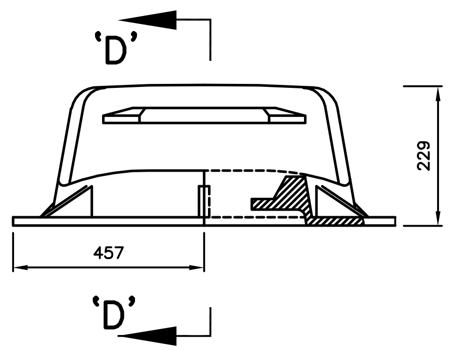
PLAN OF COVER



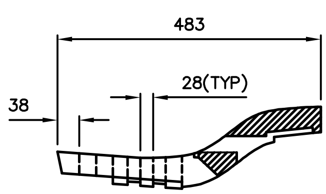
PLAN OF FRAME



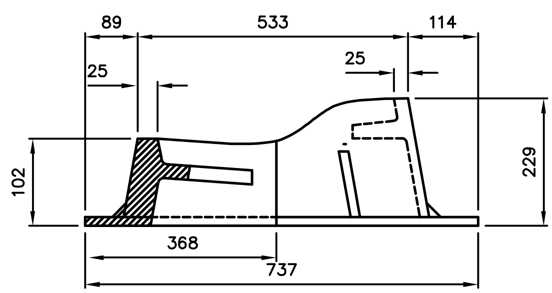
SECTION A–A



SECTION B–B



SECTION C–C



SECTION D–D

NOTE

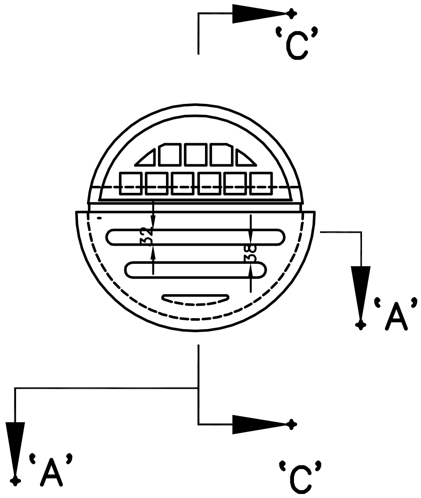
1. FRAME AND COVER SHALL BE NORWOOD F–35, TITAN TF–35 OR APPROVED EQUAL
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

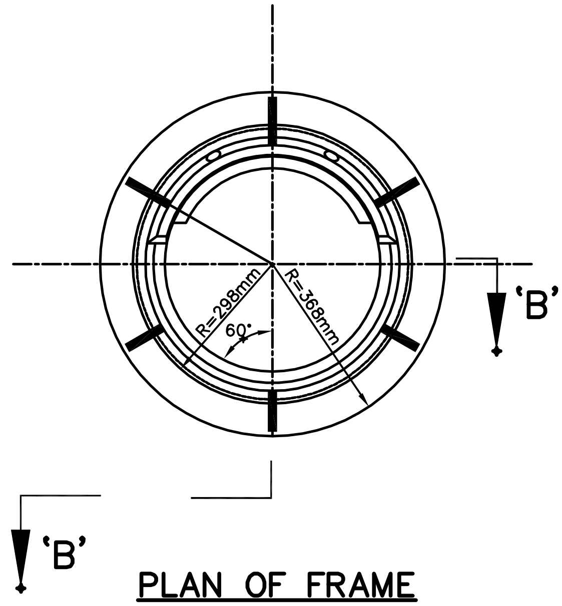
Regina
CITY OF REGINA
Engineering and Works

Description:
STANDARD SIDE INLET CATCH BASIN FRAME & COVER (Rolled Curb & Gutter)

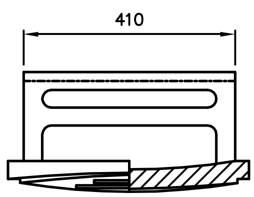
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-14
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-14



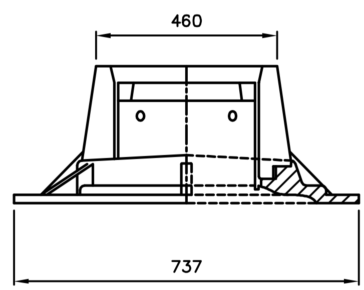
PLAN OF COVER



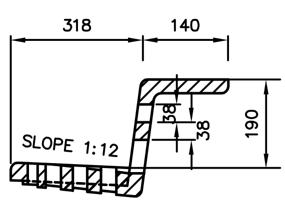
PLAN OF FRAME



FRONT ELEVATION
SECTION A–A



FRONT ELEVATION
SECTION B–B



SECTION C–C

NOTE

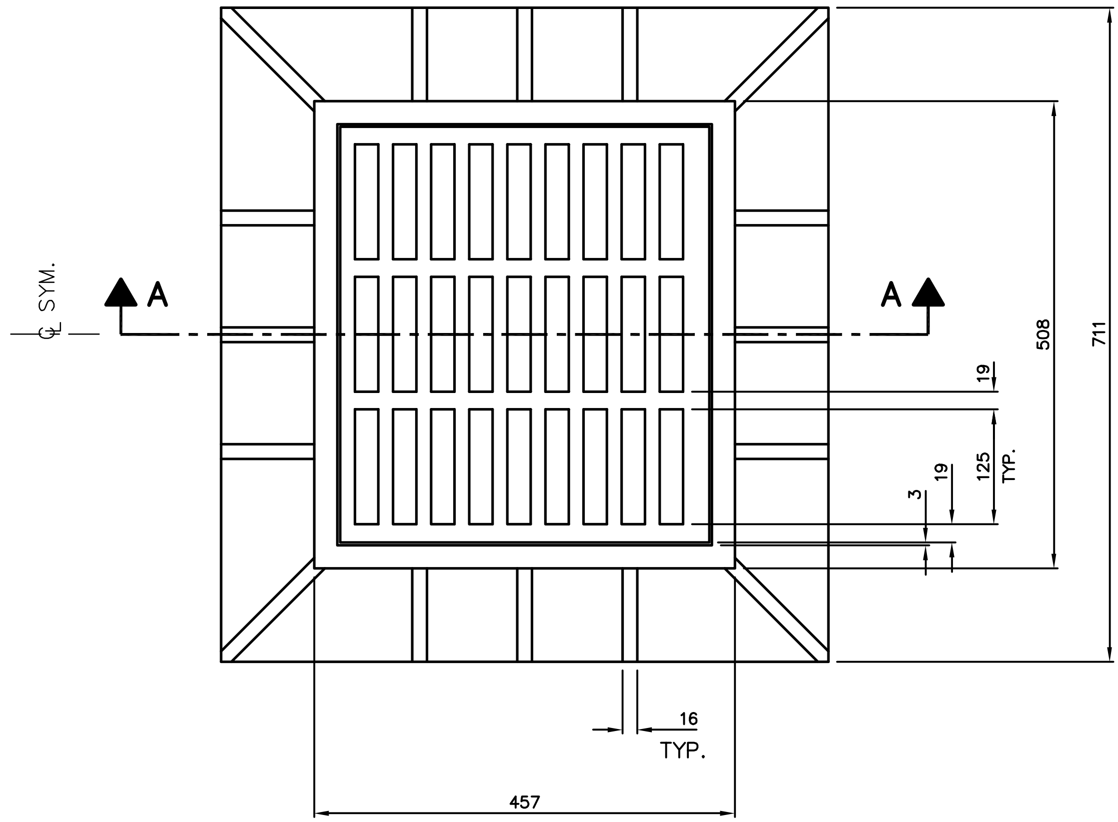
1. FRAME AND COVER SHALL BE NORWOOD F–36, TITAN TF–36 OR APPROVED EQUAL
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

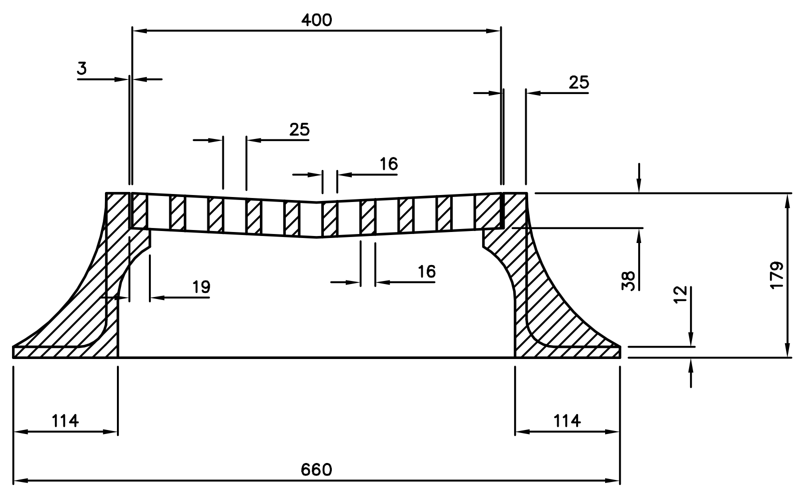
Regina
CITY OF REGINA
Engineering and Works

Description:
STANDARD SIDE INLET CATCH BASIN FRAME & COVER (Barrier Curb) FOR 190mm CURB & GUTTER

Manager	Date	Digital File:
GARY NIEMINEN	Jan / 01	STDS-15
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-15



PLAN



SECTION A–A

NOTES:

1. END FRAME SEAT DISHED TO CONFORM WITH COVER.
2. FRAME & COVER SHALL BE NORWOOD F–60, TITAN TF–104 OR APPROVED EQUAL
3. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISES NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

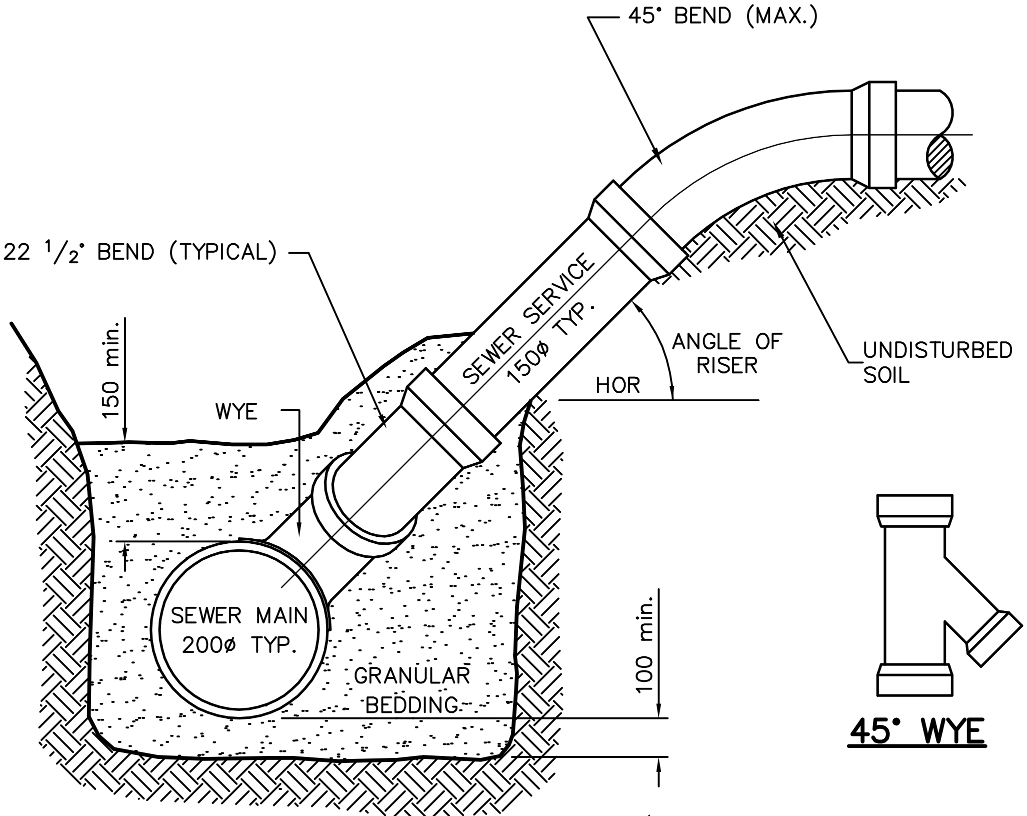
CITY OF REGINA

Engineering and Works

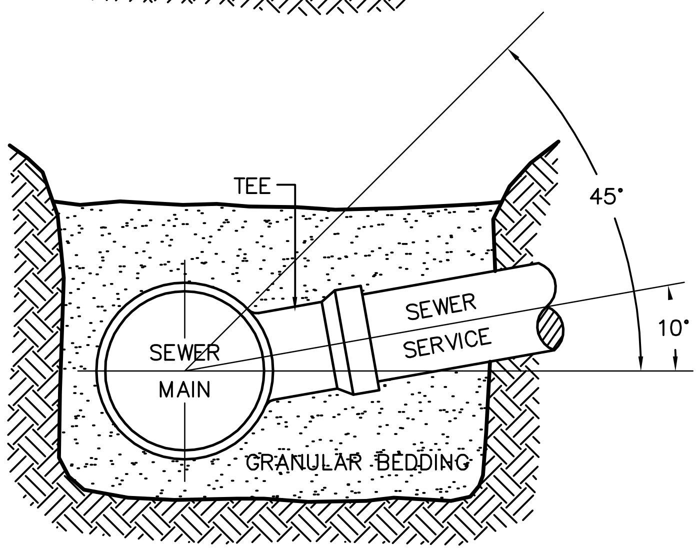
Description:

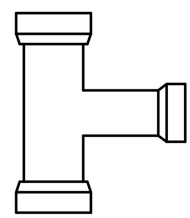
STANDARD CATCH BASIN FRAME & COVER

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-16
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-16



45° WYE





TEE

NOTES:

1) CONNECTION TO JOIN MAIN WITH SLOPE BETWEEN 10° AND 45°

2) RISER REQ'D WHERE DEPTH OF MAIN IS 4250 OR GREATER

3) ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

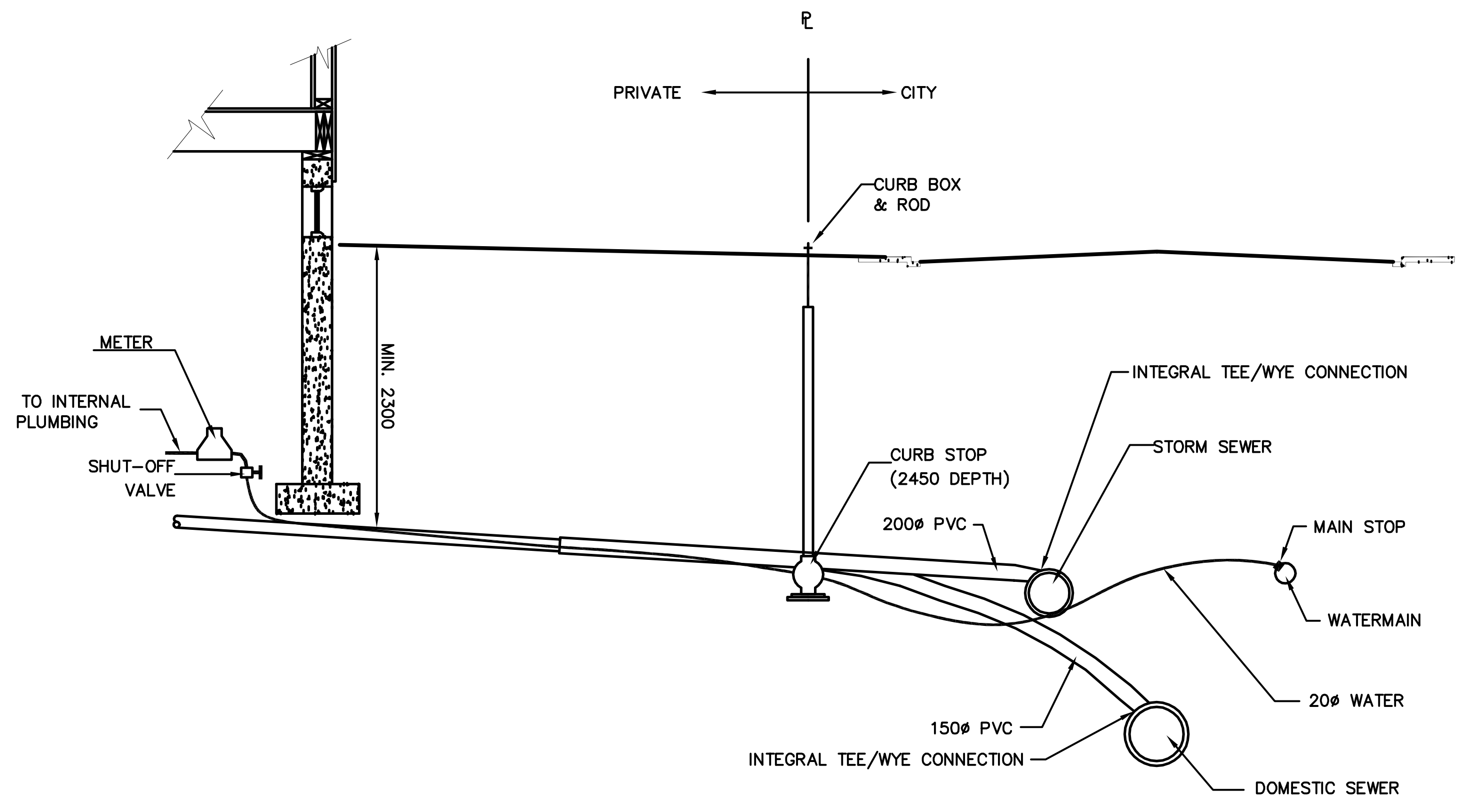
CITY OF REGINA

Engineering and Works

Description:

SERVICE CONNECTION INTEGRAL TEE/WYE

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-18
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-18



PIPE POSITION

THE SERVICE PIPES IN EACH TRENCH SHALL BE POSITIONED AS FOLLOWS WHEN FACING THE BUILDING

- DOMESTIC SEWER IN CENTRE
- WATER ON RIGHT SIDE OF DOMESTIC SEWER
- STORM, IF ANY, ON LEFT SIDE OF DOMESTIC SEWER

NOTE

1. STORM SEWER SERVICE NOT ALLOWED FOR SINGLE FAMILY DWELLING
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

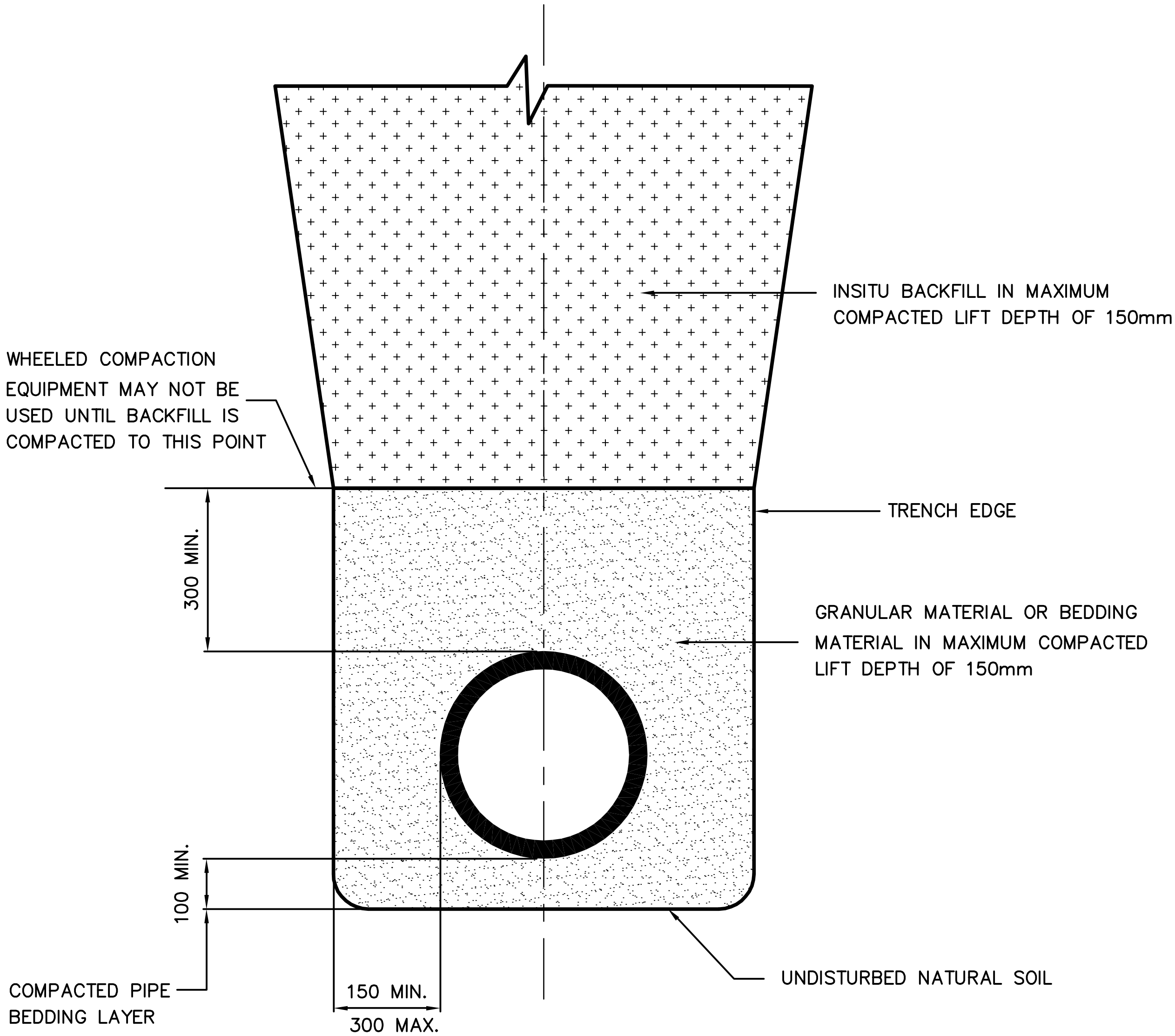
CITY OF REGINA

Engineering and Works

Description:

TYPICAL COMMERCIAL CONNECTION

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-19
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-19



NOTE

1. BACKFILL COMPACTION TO BE A MINIMUM OF 95% STANDARD PROCTOR DENSITY.
2. INSITU BACKFILL MOISTURE CONTENT TO BE +/− 3% OF ADJACENT UNDISTURBED TRENCH SIDE.
3. SIDE CLEARANCE MUST BE ADEQUATE TO PERMIT COMPACTION OF BACKFILL AT SIDE OF PIPE
4. THE GUIDELINE MINIMUM FOR COMPACTION TESTING IS ONE TEST FOR EACH $1000m^2$ FOR EACH LIFT IN THE PIPE BEDDING ZONE AND TRENCH BACKFILL ZONE.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

Date	Revisions	By
Jan/02	NOTES 1 & 2 CORRECTED	BW
Jan/03	GENERAL REVISIONS	BW
Jan/03	TITLEBLOCK	MLG

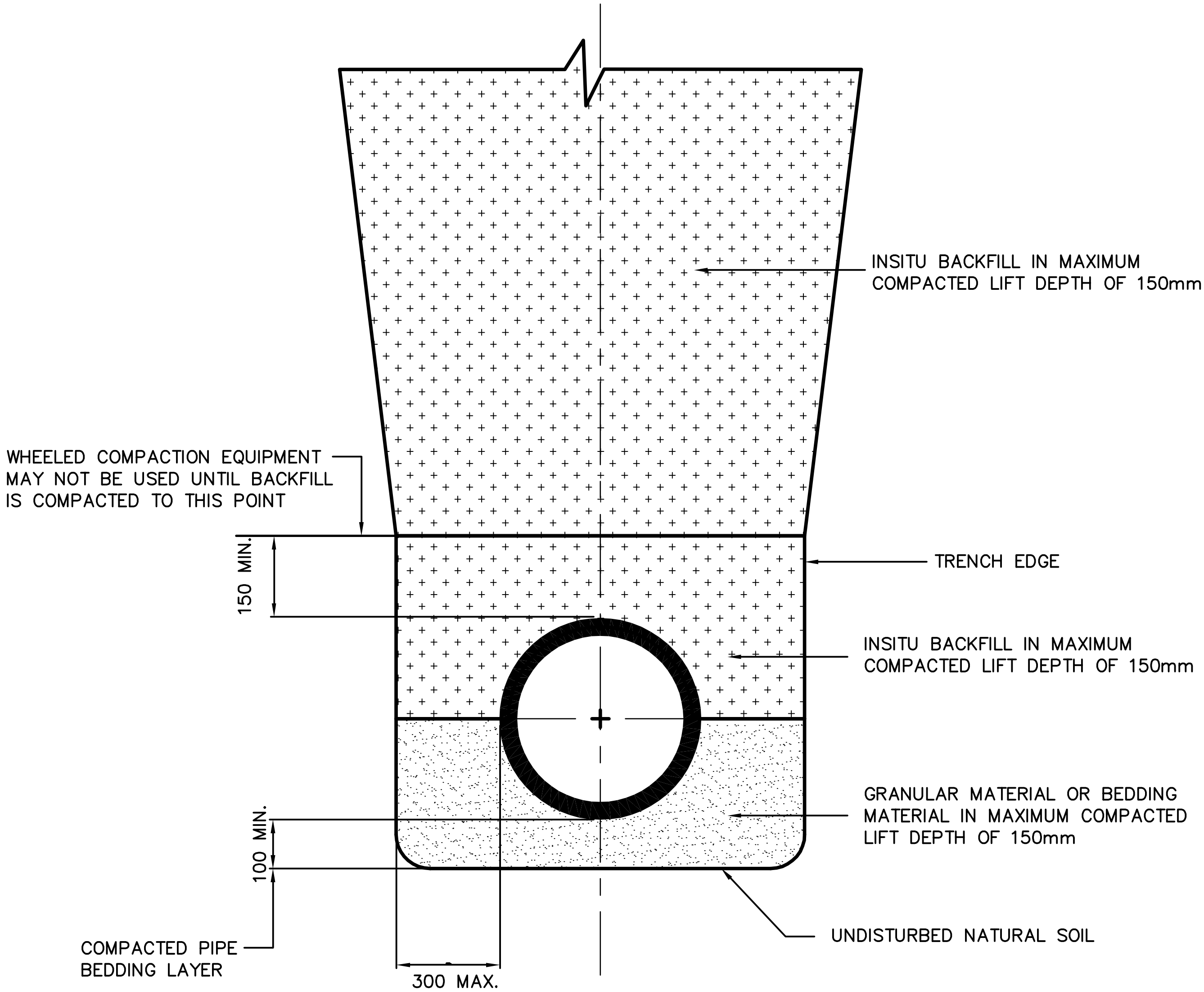
CITY OF REGINA

Engineering and Works

Description:

Standard Flexible Pipe Bedding & Trench Backfill

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-20.dwg
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-20



NOTE

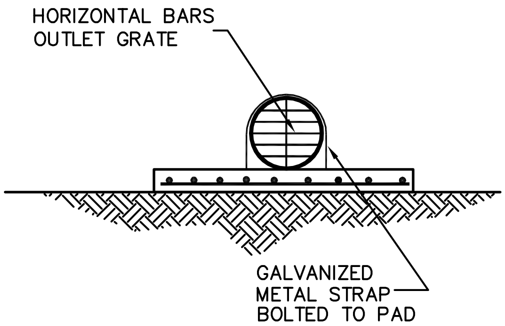
1. BACKFILL COMPACTION TO BE MINIMUM OF 95% STANDARD PROCTOR DENSITY.
2. INSITU BACKFILL MOISTURE CONTENT TO BE +/− 3% OF ADJACENT UNDISTURBED TRENCH SIDE.
3. SIDE CLEARANCE MUST BE ADEQUATE TO PERMIT COMPACTION OF BACKFILL MATERIAL AT THE SIDE OF PIPE
4. THE GUIDELINE MINIMUM REQUIREMENT FOR COMPACTION TESTING IS ONE TEST FOR EACH 1000m² FOR EACH LIFT IN THE PIPE BEDDING ZONE AND TRENCH BACKFILL ZONE.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

Date	Revisions	By
Jan/02	NOTES 1 & 2 CHANGED	BW
Jan/03	GENERAL REVISIONS	BW
Jan/03	TITLEBLOCK	MLG

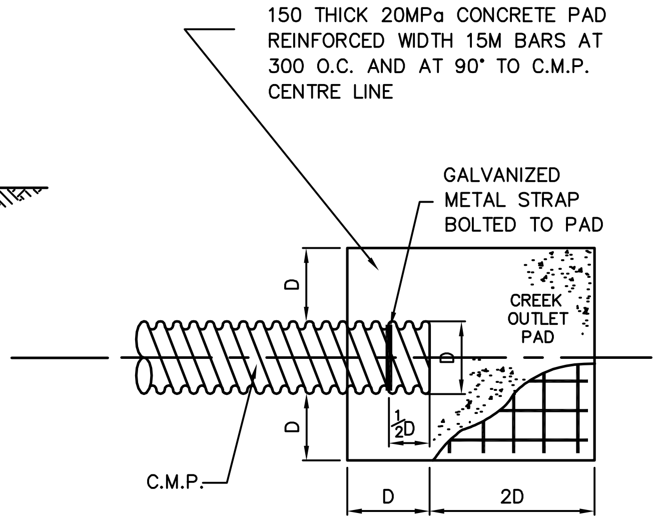
CITY OF REGINA
Engineering and Works

Description:
Standard Rigid Pipe Bedding & Trench Backfill

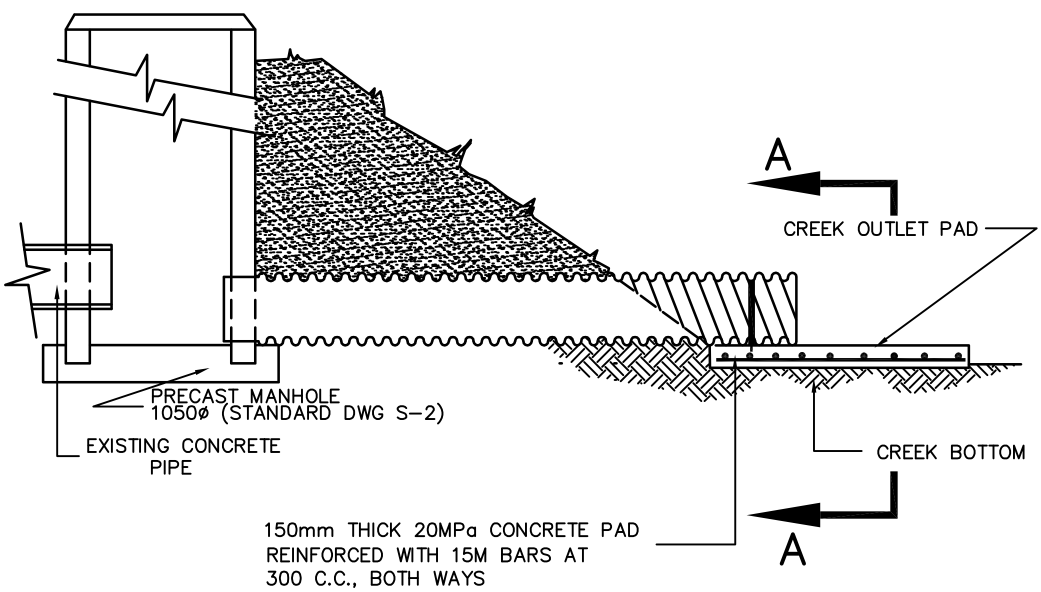
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-21.dwg
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-21



SECTION A–A

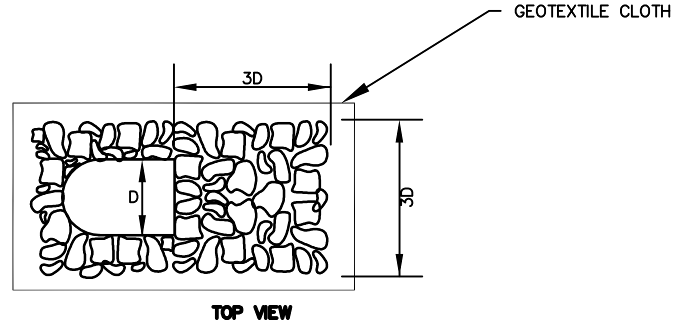


PLAN



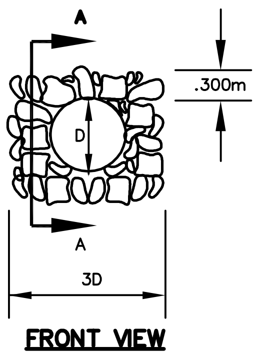
Date	Revisions	By		Description:		
Jan/03	TITLEBLOCK	MLG	CITY OF REGINA	**STORM SEWER OUTLET**		
				Manager: GARY NIEMINEN	Date: Jan. / 01	Digital File: STDS-22
			Engineering and Works	Approved: DAVID CALAM	Scale: NTS	Dwg: S-22

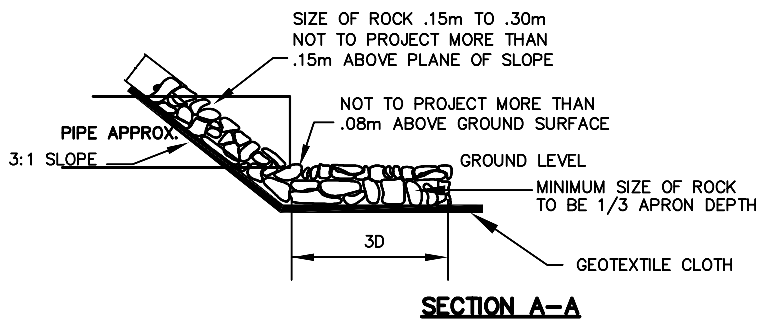
OUTLET



NOTE

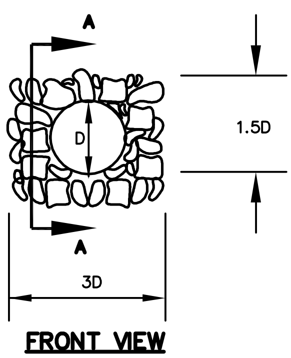
1. RIP RAP TO VBE UNDERLAIN BY MEDIUM THICKNESS GEOTEXTILE FILTER CLOTH THAT IS KEYED INTO NATIVE MATERIAL AT ALL EDGES OF CLOTH.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

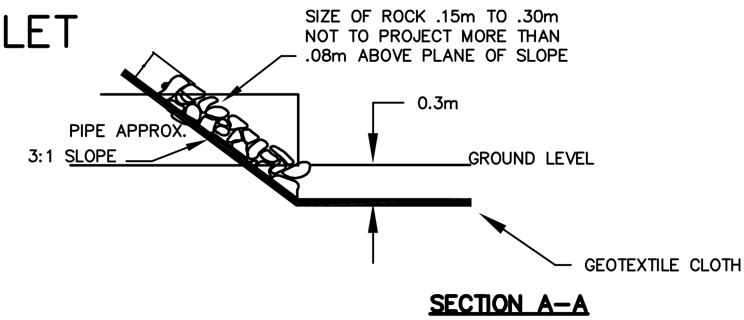




D (mm)	400	450	500	600	700	800	900	1000	1200	1400	1600	1800	2000
APRON DEPTH	.45m							.60m				.75m	

INLET





TOTAL QUANTITIES OF RIP–RAP IN CUBIC METRES

D (mm)	400	450	500	600	700	800	900	1000	1200	1400	1600	1800	2000
INLET	.56	.71	.88	1.27	1.73	2.26	2.85	3.52	5.07	6.91	9.02	11.42	14.10
OUTLET	1.42	1.73	2.08	2.86	3.77	4.80	5.95	8.65	12.19	16.32	21.05	30.89	37.86
TOTAL	1.98	2.44	2.96	4.13	5.50	7.06	8.80	12.17	17.26	23.23	30.07	42.31	51.96

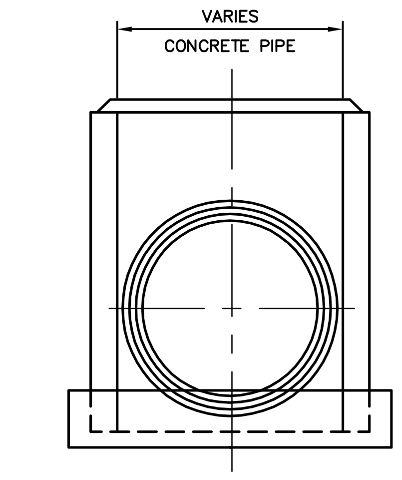
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

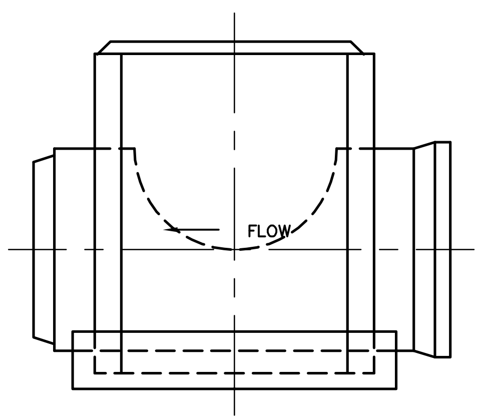
Description:

EROSION CONTROL AT CULVERTS

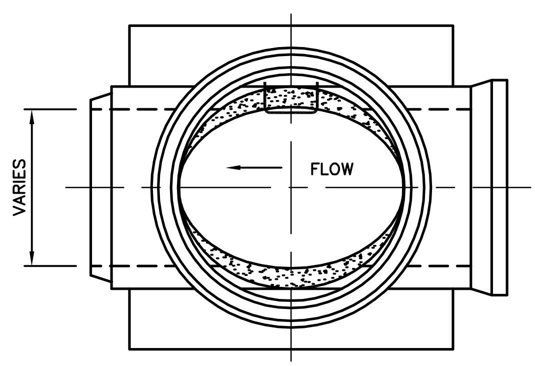
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-23
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-23



FRONT VIEW



SIDE VIEW



TOP VIEW

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

CITY OF REGINA

Engineering and Works

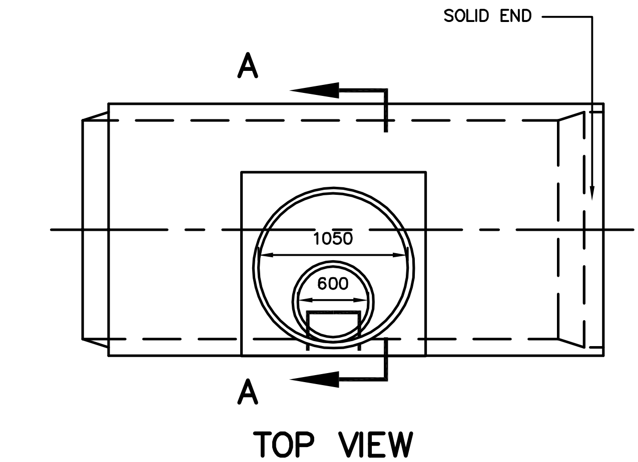
Description:

PRECAST CONCRETE MANHOLE INTEGRAL BASE & THRU-PIPE TYPE

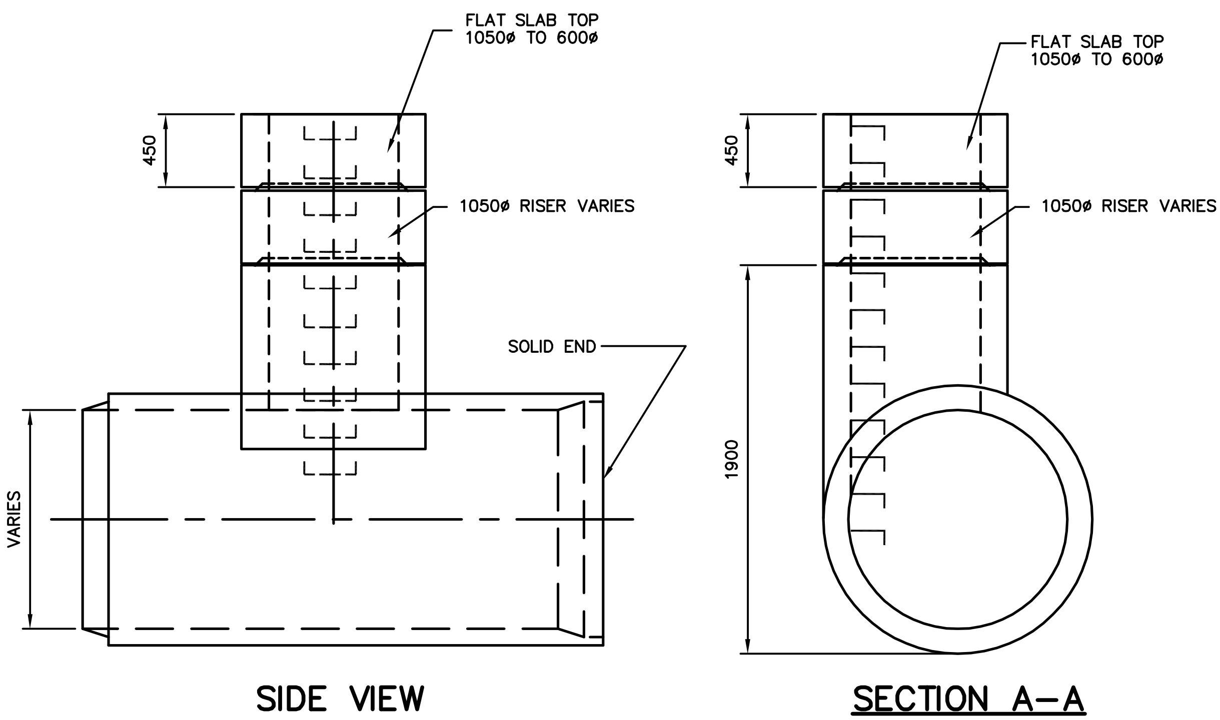
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-24
Approved	Scale	Dwg:
DAVID CALAM	NTS	S-24

NOTE

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED



TOP VIEW



SIDE VIEW

SECTION A–A

1) SHALL COMPLY WITH DESIGN REQUIREMENTS FOR CLASS IV REINFORCED PIPE
2) PIPE LEADS INTO MANHOLE END SECTION TO SUITE PARTICULAR SITUATION
3) ADD BRICKS, FRAME AND COVER TO FINISHED GRADE
4) ADD RISERS

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

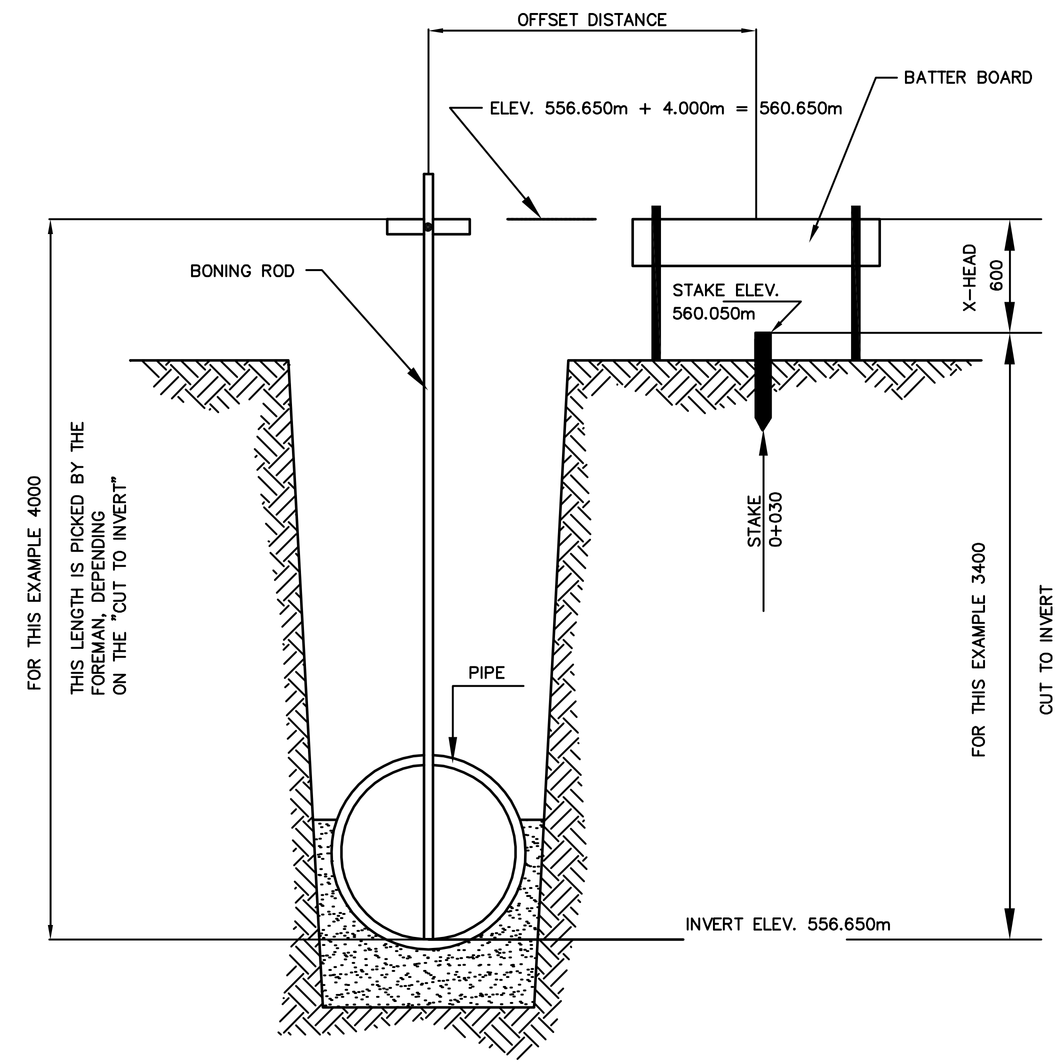
Regina
CITY OF REGINA
Engineering and Works

Description:
PRECAST CONCRETE MANHOLE END SECTION 1050 DIA. MANHOLE

Manager GARY NIEMINEN	Date Jan. / 01	Digital File: STDS-25
Approved DAVID CALAM	Scale NTS	Dwg: S-25

EXAMPLE OF
TYPICAL GRADE SHEET

STATION	STAKE ELEV.	INVERT ELEV.	CUT TO INVERT	X–HEAD	
0+030	560.050m	556.650m	3 400	600 (4 000–3 400)	DO THIS PROCESS FOR EACH STAKE ELEVATION



NOTE:

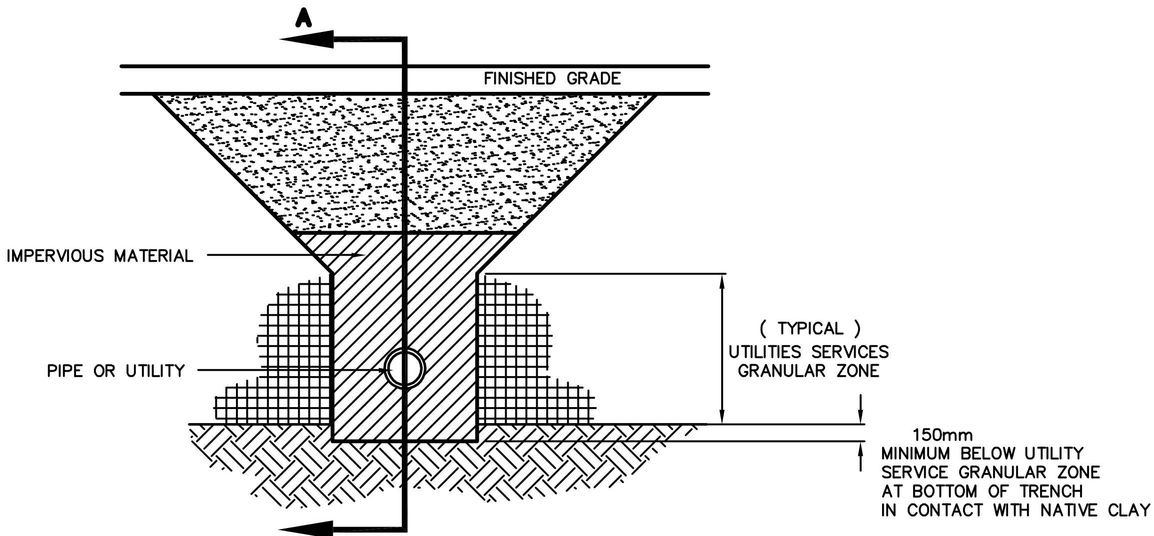
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

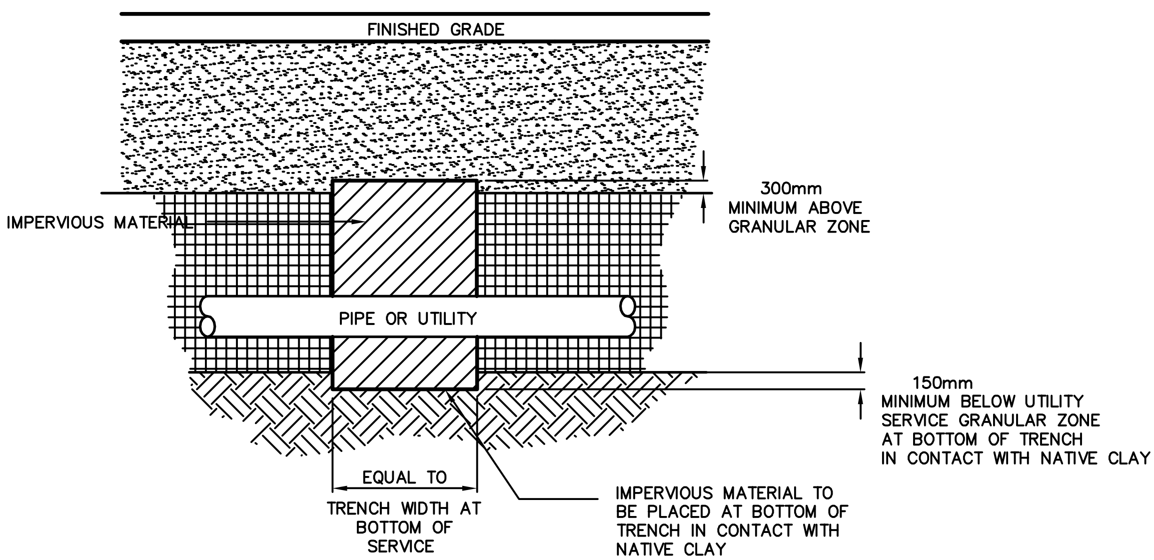
CITY OF REGINA
Engineering and Works

Description:
ESTABLISHMENT OF GRADE FOR SEWER CONSTRUCTION

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-27
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-27



TRENCH CROSS-SECTION



SECTION A–A

NOTE

1. FOR UTILITY SERVICES, REFER TO CITY SPECIFICATIONS, SECTION 01400
2. FOR BEDDING MATERIAL, REFER TO CITY SPECIFICATIONS, SECTION 01000

IMPERVIOUS MATERIAL BARRIERS FOR UTILITY SERVICE TRENCHES AT THE PROPERTY LINES SHOULD BE WELL MIXED, CONSISTING OF 20% BENTONITE CLAY AND 80% PIPE BEDDING MATERIAL.

ANY OTHER DESIGNS ARE TO BE SUBMITTED FOR REVIEW AND APPROVAL TO THE ENGINEER

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

CITY OF REGINA

Engineering and Works

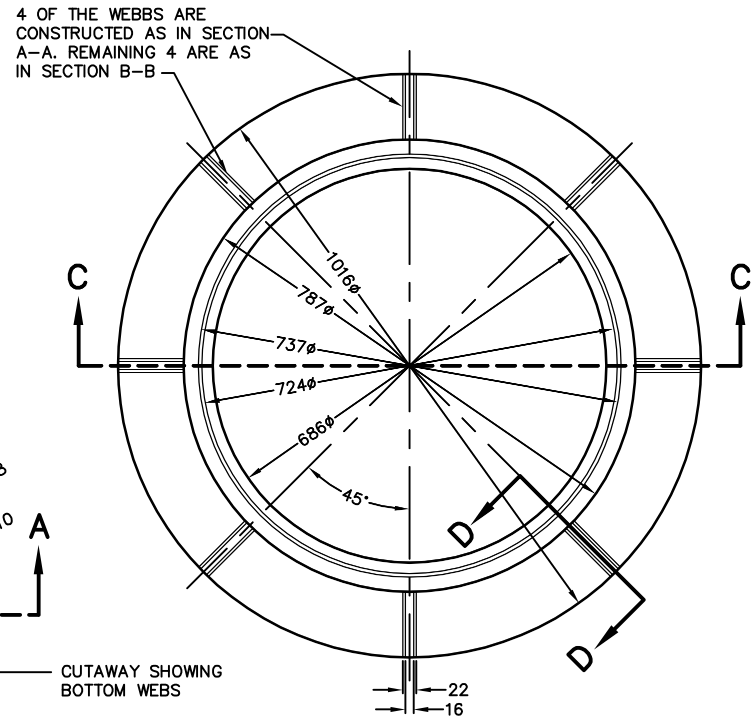
Description:

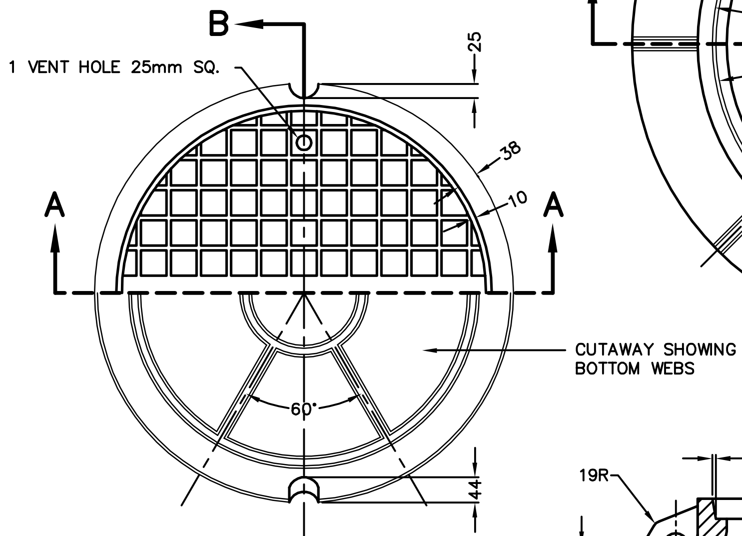
IMPERVIOUS MATERIAL BARRIERS FOR UTILITY SERVICE TRENCHES

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-28
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-28

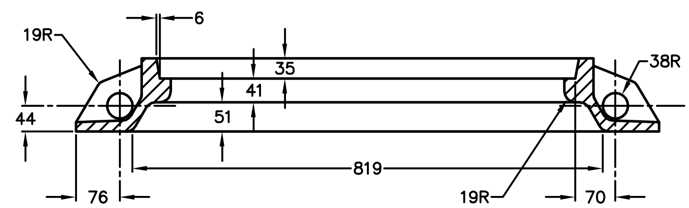
SPECIFICATIONS

- FRAME AND COVER SHALL BE NORWOOD F–40, TITAN TF–40 OR APPROVED EQUAL
- MANHOLE FRAMES AND COVERS SHALL BE GREY CAST IRON CONSTRUCTION
- WEIGHT OF FRAME SHALL BE AT LEAST 115 Kg
- WEIGHT OF COVER SHALL BE AT LEAST 110 Kg

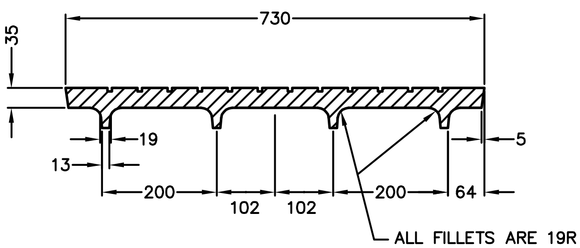




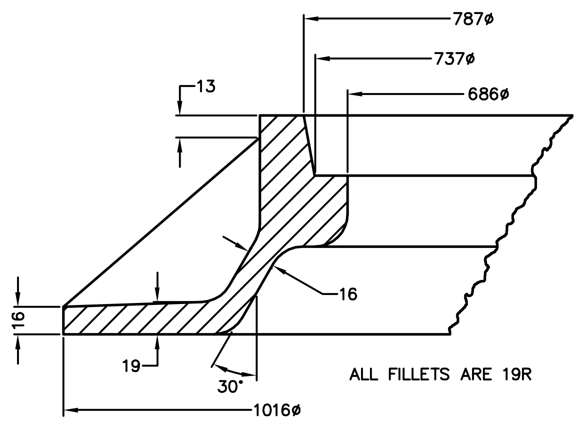
PLAN



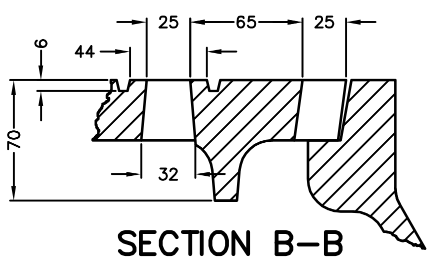
SECTION C–C



SECTION A–A



SECTION D–D



SECTION B–B

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

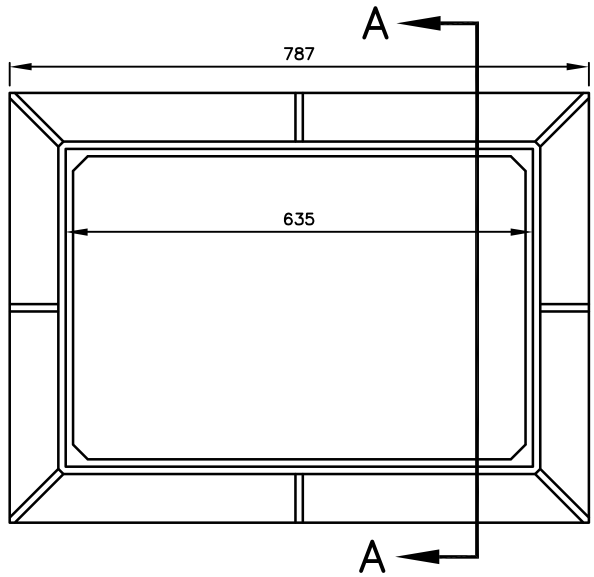
Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

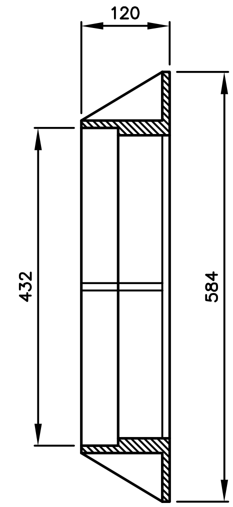
Description:

MANHOLE FRAME & COVER FOR 1200 DIA. MANHOLES

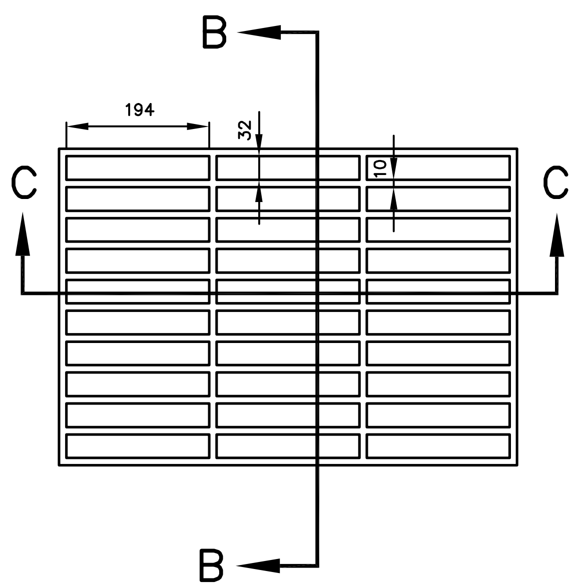
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-29
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-29



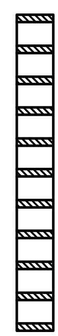
PLAN OF FRAME



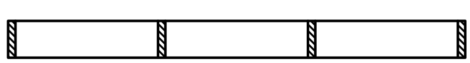
SECTION A–A



PLAN OF GRATE



SECTION B–B



SECTION C–C

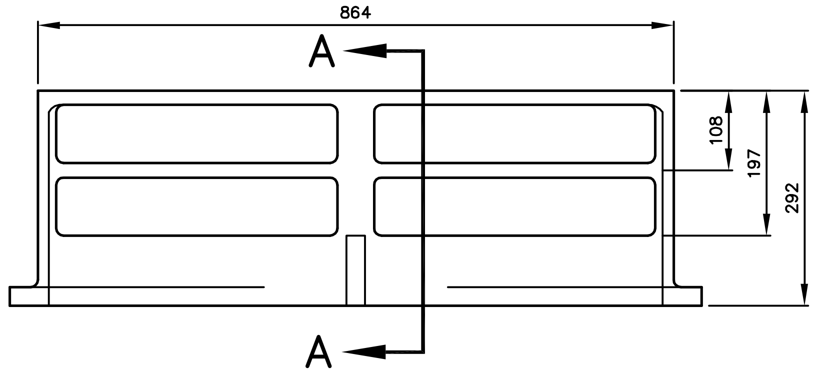
NOTE:
FRAME AND GRATE SHALL BE
NORWOOD F–51–G OR APPROVED EQUAL

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

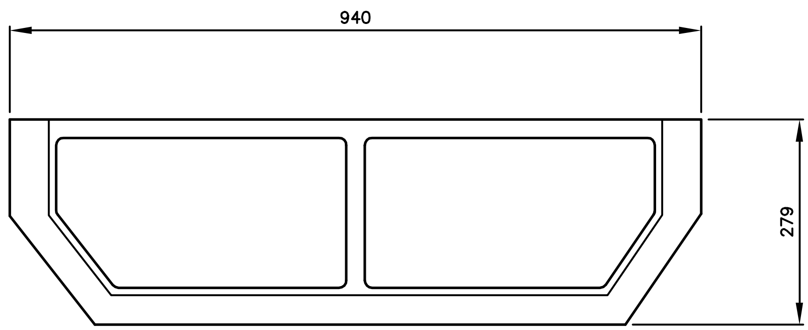
Regina
CITY OF REGINA
Engineering and Works

Description:
HI-CAPACITY CATCHBASIN FRAME & GRATE

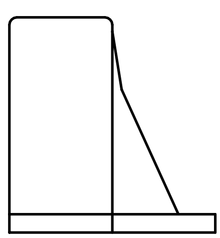
Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-30
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-30 PAGE 1 OF 4



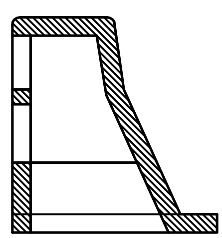
FRONT VIEW



BOTTOM VIEW



END VIEW



SECTION A–A

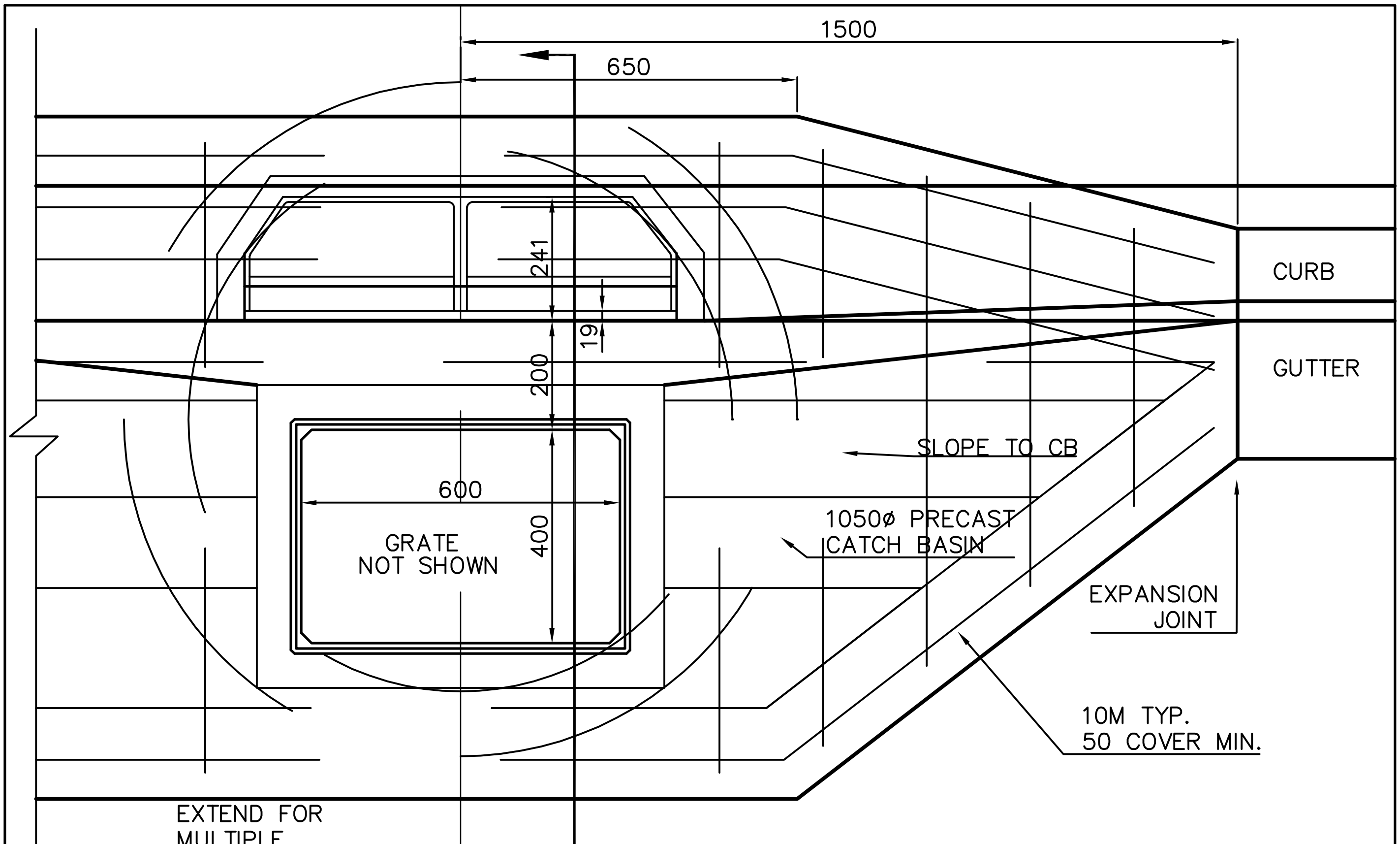
NOTE:
FRAME AND GRATE SHALL BE
NORWOOD F–51–S OR APPROVED EQUAL

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

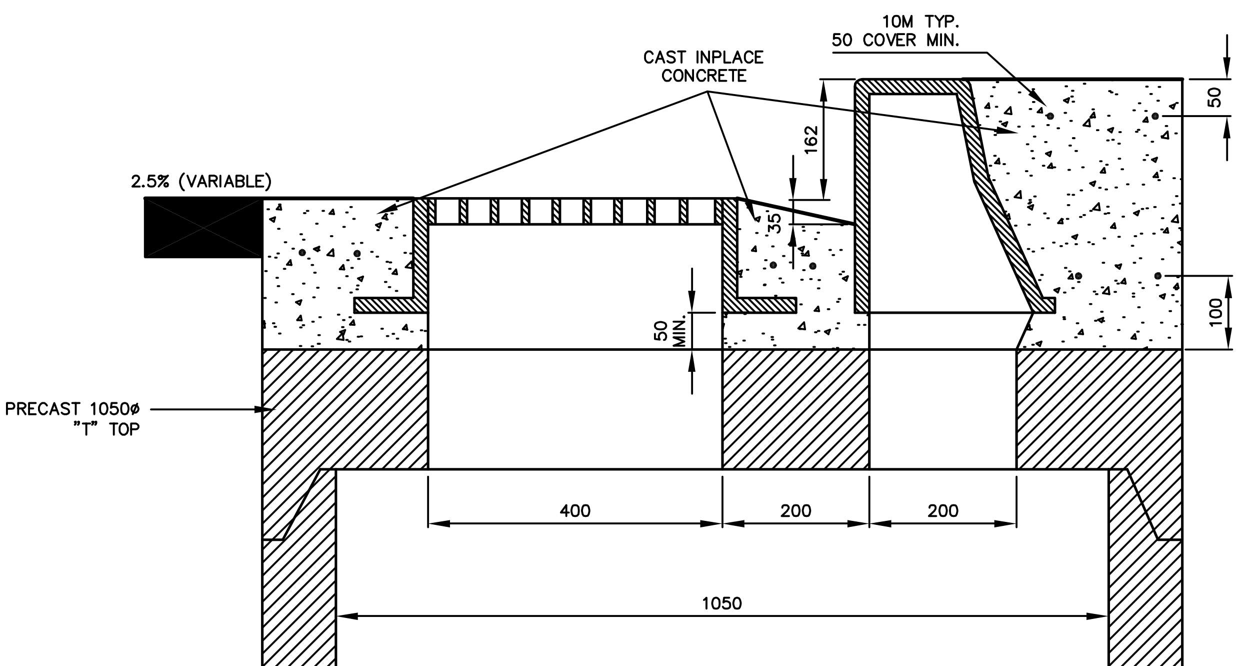
Regina
CITY OF REGINA
Engineering and Works

Description:
HI-CAPACITY CATCHBASIN FRAME & GRATE

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-30
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-30 PAGE 2 OF 4



SIDE INLET CATCHBASIN



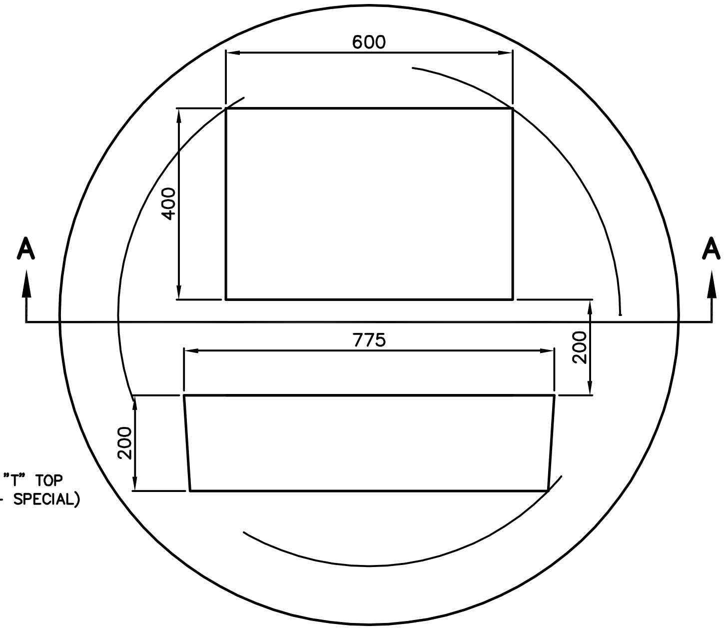
SECTION–SIDE INLET CATCHBASIN

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

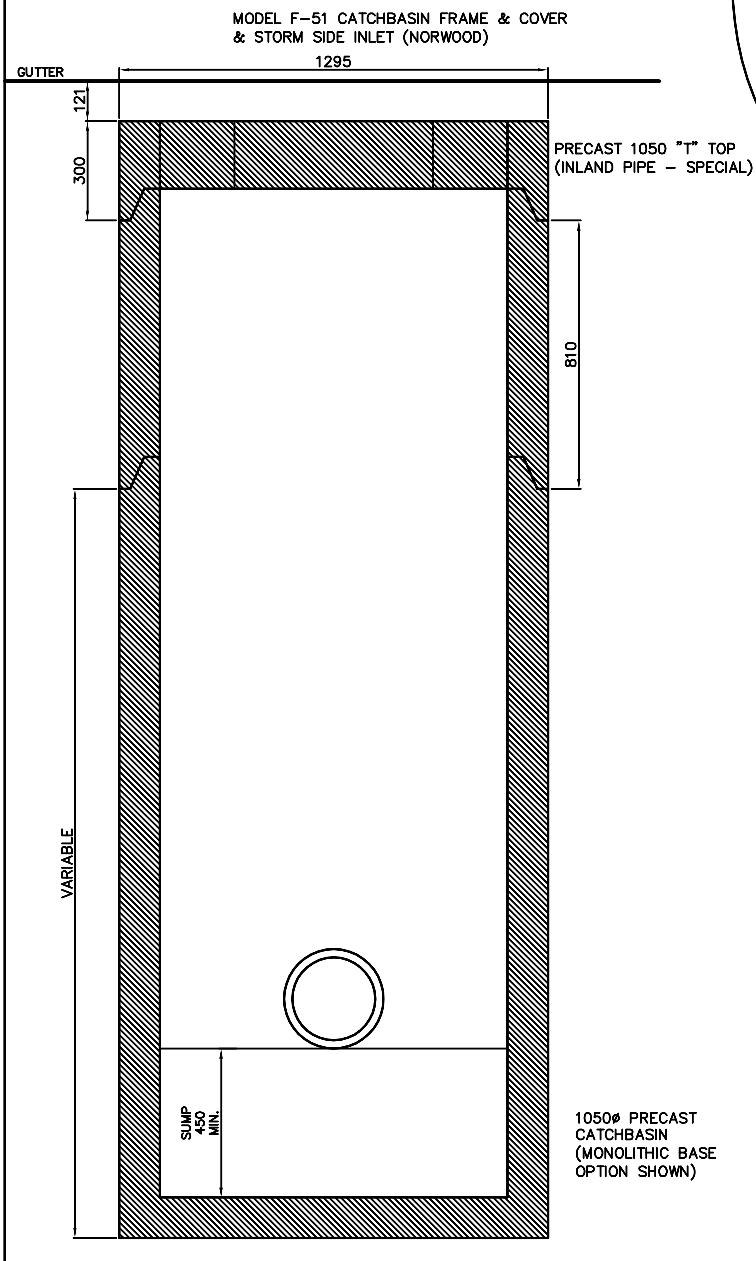
Regina
CITY OF REGINA
Engineering and Works

Description:
HI-CAPACITY CATCHBASIN FRAME & GRATE

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-30
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	S-30



TOP VIEW – PRECAST TOP



SECTION A–A

TYPICAL INSTALLATION

HI–CAPACITY CATCHBASIN

Date	Revisions	By
Jan/03	TITLEBLOCK	MLG

CITY OF REGINA

Engineering and Works

Description:

HI-CAPACITY CATCHBASIN FRAME & GRATE

Manager	Date	Digital File:
GARY NIEMINEN	Jan. / 01	STDS-30
Approved	Scale	Dwg:
DAVID CALAM	NTS	S-30 PAGE 4 OF 4

CITY OF REGINA

Engineering and Works Department

ROADWAYS SPECIFICATIONS SECTION

2000 **SPECIFICATION FOR CLEARING AND GRUBBING**

2000 - 1 GENERAL

The work shall consist of clearing and grubbing within the right-of-way and from other areas designated on the plans or by the Engineer.

2000 - 2 MATERIALS

2000 - 3 CONSTRUCTION

All shrubbery, brush, weeds, other vegetation, downed timber, branches and roots, rubbish and other objectionable material shall be cleared and disposed of at the City Landfill unless otherwise approved by the Engineer.

No trees shall be cut down or pruned without the expressed permission of the Engineer in writing, and in accordance with the *Regina Urban Forest Management Strategy* (Appendix G) and the *Forestry Bylaw #9607*. It shall be the responsibility of the Contractor to preserve any tree for which the special provisions or plans provide or which the Engineer may direct to be preserved. All trees requiring removal shall be removed to a minimum of 250mm below grade and if required the stump removed.

The ground shall be restored and levelled where designated on the Plans or by the Engineer.

Landfill charges are the responsibility of the Contractor.

2010 **SPECIFICATION FOR SAWCUTTING**

2010 - 1 GENERAL

The work shall consist of sawcutting concrete, reinforced concrete, concrete base, soil cement, and asphaltic concrete or concrete pavements.

2010 - 2 MATERIALS

2010 - 3 CONSTRUCTION

Proper barricades and traffic diversion shall be erected by the Contractor for protection as set out in the City of Regina Temporary Traffic Control Manual.

Sawcutting shall be carried out for all removal or trenching operation in order to leave a clean, straight edge for repair. The cut shall be of sufficient depth to permit removal without damage to the remaining structure.

During sawcut operations the Contractor shall take necessary steps to protect adjacent properties and structures from sawcut residue.

2050 **SPECIFICATION FOR REMOVAL OF CONCRETE**

2050 - 1 GENERAL

The work shall consist of the removal and satisfactory disposition of existing concrete walks, curb or curb and gutter or other in place concrete designated on the plans or by the Engineer.

2050 - 2 MATERIALS

2050 - 3 CONSTRUCTION

When the Contractor receives written instruction from the Engineer or one of his representatives, to remove certain concrete, he shall do so in a safe manner. In addition the Contractor shall notify abutting property owners at least seventy-two (72) hours prior to the removal of any concrete that work is to commence and indicate to them the approximate length of disruption.

Proper barricades and traffic diversion shall be erected by the Contractor for protection as set out in the City of Regina Temporary Traffic Control Manual.

Concrete material thus salvaged will be kept as free as possible of extraneous material such as soil, roots, or other rubbish. Stockpiling of removed concrete shall be at a site or sites designated by the Engineer. Disposal shall be at the City Landfill unless otherwise approved by the Engineer.

Landfill charges are the responsibility of the Contractor.

2070 **SPECIFICATION FOR REMOVAL OF ASPHALT PAVEMENT OR PLAIN CONCRETE PAVEMENT**

2070 - 1 GENERAL

The work shall consist of the removal and satisfactory disposition of Asphalt or Plain Concrete Pavements.

2070 - 2 MATERIALS

2070 - 3 CONSTRUCTION

The removal and satisfactory disposition of asphalt pavement and plain concrete shall be done in a safe manner, satisfactory to the Engineer.

Proper barricades and traffic diversion shall be erected by the Contractor for protection as set out in the City of Regina Temporary Traffic Control Manual.

Removal of asphalt pavement and plain concrete pavement when required for the removal and replacement of sidewalks curb and gutters shall be considered a subsidiary obligation under removal of curb or curb and gutter and shall be done in a manner satisfactory to the Engineer. Any excess removal of pavement, unless directed by the Engineer shall be replaced at the Contractors own expense.

Asphalt or concrete pavements that has been removed shall be stockpiled of at a site or sites designated by the Engineer. Disposal shall be at the City Landfill unless otherwise approved by the Engineer.

Landfill charges are the responsibility of the Contractor.

2075 **SPECIFICATION FOR COLD PLANING**

2075 - 1 GENERAL

The work shall consist of the removal of asphaltic concrete pavement by cold planing to the lines, grades and cross-sections shown on the plans or as designated by the Engineer. Included shall be all planing, sweeping, loading, handwork along gutter lines, additional work around manholes, catchbasins, valves and other appurtenances as well as the supply and replacement of all milling teeth required to complete the job.

2075 - 2 MATERIALS

a) Equipment

The equipment for removing the asphaltic concrete pavement shall be a machine capable of performing the work in a manner satisfactory to the Engineer.

The machine shall be power-operated and self-propelled, and shall have sufficient power, traction and stability to remove a thickness of bituminous surface to a specified depth, and provide a uniform profile and cross slope. The machine shall be capable of accurately and automatically establishing profile grades (within $\pm$ 10 mm) along each edge of the machine by referencing from the existing pavement by means of a ski or matching shoe, or from an independent grade line. The machine shall have an automatic system for controlling grade elevation and cross slope. The machine shall be equipped with a means to effectively control dust generated by the cutting operation.

2075 - 3 CONSTRUCTION

The surface resulting from the cold planing operation shall be in accordance with the plans and specified grades, and shall be characterized by uniform, discontinuous longitudinal striations or other uniform pattern and shall not be gouged or torn.

All loose material shall be removed from the milled surface and surface swept clean with a power broom. Employ dust control measures specified in Section 01001 General Requirements, Article 1.7 Dust Control.

If the road is to remain open to traffic, longitudinal, vertical drop-offs in excess of two inches at a lane line or at centerline shall not be left overnight.

Transverse faces existing at the end of a work period should be tapered in a manner approved by the Engineer to avoid a hazard for traffic.

Asphaltic concrete that cannot be removed by cold planing equipment because of physical or geometrical restraints should be removed by other methods acceptable to the Engineer.

If independent grade reference is required, it shall be designated in the plans and contract documents, and elevations shall be provided by the Engineer. Milled material shall be disposed of as specified or as directed by the Engineer.

2110 SPECIFICATION FOR EXCAVATION

2110 - 1 GENERAL

The work shall consist of the excavation of all materials other than rock excavation and shall include soil, frozen earth, roots and plain or bituminous bound base courses. Excavation shall be to the finished grade and cross-section shown on the drawings or designated by the Engineer.

Rock Excavation is defined as all individual boulders, or concrete masses over 0.25 cubic metres in volume.

Waste excavation shall consist of removing unsuitable materials and stockpiling or disposing of material not incorporated into an embankment at a site designated by the Engineer.

2110 - 2 MATERIALS

2110 - 3 CONSTRUCTION

The Contractor shall shape the cut section to the depth and grades established by the Engineer. Suitable excavated material shall be used as far as practicable in the formation of fills or for other backfill. Excavated material not used in the subgrade construction shall be disposed of at the City landfill unless otherwise approved by the Engineer.

If the material below the subgrade surface is unacceptable as a foundation, it shall be removed and disposed of as designated by the Engineer. This work will be referred to as "sub-cut". Suitable excavated material from another portion of the project shall be used to fill the "sub-cut" area. If sufficient suitable excavated material is not available from the excavation, upon authorization of the Engineer, material shall be obtained from a borrow pit or other approved source.

Construction of embankments and reconstruction of sub-cut areas are to be in accordance with Specification 2120 for Embankments.

The Contractor will be required to repair any damage caused to existing pavements, sidewalks or underground facilities during excavation, at his own expense to the satisfaction of the Engineer.

The Contractor will be responsible for constructing and maintaining any or all haul roads required in the execution of the work. The Contractor will be responsible for removing, trimming, scarifying and cleaning of the haul road sites to restore them to their original condition to the satisfaction of the Engineer.

Protect trees including root systems and canopy from damage in accordance with the *Regina Urban Forest Management Strategy* (Appendix G) and the *Forestry Bylaw #9607*.

2120 **SPECIFICATION FOR EMBANKMENTS**

2120 - 1 GENERAL

The work shall consist of constructing embankments or miscellaneous backfills with excavated materials to the grades and cross-sections shown on the Plans or as designated by the Engineer.

2120 - 2 MATERIALS

2120 - 3 CONSTRUCTION

Embankments shall be constructed with side slopes of five (5) metres horizontally to one (1) metre vertically, unless otherwise specified.

The material shall be placed in compacted layers of uniform 150 mm thickness. The layers shall be carried up full width from the bottom of the fill to avoid the widening of the edges after final grade has been reached.

The compaction equipment may be of any type, provided it is capable of compacting each lift of the material to the specified density. The Engineer has the right to order that any particular compaction unit be removed from the work if it is not capable of compacting the material to the required density in a reasonable time. Hauling equipment will not be accepted in lieu of compaction equipment.

Subgrade areas, encountered in the construction of the embankment which are not consolidated sufficiently to properly support the embankment and traffic, shall be re-compacted as required by the Engineer. Where directed by the Engineer unsuitable material shall be removed and replaced with approved material.

All subgrade and embankment fill materials shall be compacted in layers not exceeding 150 mm. The 150 mm layers shall be brought to within the limits of optimum and three (3%) percentage above optimum moisture content. Water shall be added if required for proper compaction. If the soil contains excess moisture, it shall be aerated until the moisture content has been reduced to within the limits stated above.

The 150 mm layers shall be compacted to between ninety-five percent (95%) and one hundred percent (100%) of its maximum Standard Proctor dry density as determined by ASTM Test Designation D698.

Measurement of the field density and moisture content shall be in accordance with ASTM Test Designations D2922 and D3017, for determination of Density and Moisture content of soil in place by Nuclear Methods.

Field density and moisture content tests will be made by the Engineer or his representative at the Owner's expense to ensure that the material is being compacted to the moisture content and density specified.

2130 **SPECIFICATION FOR SUBGRADE PREPARATION AND COMPACTION - NON GRANULAR**

2130 - 1 GENERAL

The work shall consist of the shaping watering or drying and compacting existing subgrade or fill material to obtain the grades lines and cross-sections as shown on the Plans or as designated by the Engineer.

2130 - 2 MATERIALS

2130 - 3 CONSTRUCTION

All soft, spongy or yielding spots and all organic or other objectionable matter shall be entirely removed and the space recompacted with approved native material.

The subgrade surface shall be trimmed to $\pm$20 mm vertically and 100 mm horizontally. The final subgrade shall be tight and smooth surface, true to grade and cross-section, and free from irregularities caused by compaction equipment. The average level of the finished grade shall neither be consistently high or low from the design grade. Before approval by the Engineer, the subgrade surface shall be true to cross-section and grade.

The top 150 mm of the subgrade shall be brought to within the limits of moisture content and compacted in accordance with 2120 Specification for Embankments. Reconstruction of trenches are to be in accordance with 2120 Specification for Embankments.

After preparing the subgrade as above specified, it shall be the Contractor's responsibility to maintain the required density at his expense, and all unnecessary traffic must be kept off. Should it be found necessary to haul over prepared subgrade, prepared base or existing asphalt, all cuts, ruts and breaks in the surface so resulting shall be repaired in a manner satisfactory to the Engineer immediately preceding the placement of surface or base materials.

2140 **SPECIFICATION FOR SUBGRADE PREPARATION AND COMPACTION - GRANULAR**

2140 - 1 GENERAL

The work shall consist of preparing the subgrade for granular base pavement structures. The requirements for compaction and moisture density control is waived for granular base pavement structures if the conditions set forth in this specification are met.

2140 - 2 MATERIALS

2140 - 3 CONSTRUCTION

a) Excavation and Shaping

The Contractor shall not excavate to final subgrade level unless perforated drainage pipe and sub-drainage sand are to be placed on the subgrade within 24 hours. Otherwise the subgrade shall be left a minimum of 100 mm high of final grade until the placement of sub-drainage sand can follow.

Shaping tolerances for the completed subgrade surface shall be ± 20 mm vertically and 100 mm horizontally. The average level of the finished grade shall neither be consistently high or low from the designed grade.

b) Subgrade

Areas encountered in the construction of the subgrade which have not consolidated sufficiently to properly support the subgrade and traffic shall be compacted as required by the Engineer. Where directed by the Engineer, unsuitable material shall be removed and replaced with suitable native material in accordance with Specification 2120 for Embankments.

Reconstruction of trenches are to be in accordance with 2120 Specification for Embankments.

b) Placement of Subdrainage Sand and Sub-base

The placement of subdrainage sand will be carried out in a manner such that hauling and placing operations do not deform the subgrade or over compact the surface along defined routes, resulting in non uniform density. In general the hauling operation should be carried out in such a manner that traffic on the subgrade is limited to unloaded vehicles.

Ideally the placement would involve a dump and doze operation from a working pad of subdrainage sand and sub-base, with no equipment travelling across the prepared subgrade. The contractor shall place the sub-base in a manner such that rutting of the in place sub-drainage sand does not occur.

The Contractor will be required to reinstate the subgrade to proper line and grade should the hauling or placing operations deform or rut the subgrade.

If the Contractors operations results in a continual problem of deformation of the subgrade the Engineer may direct that either, full subgrade preparation and compaction be undertaken, or that the placement be undertaken in a manner that will not deform or over compact the subgrade.

It is the intention of this specification that the Contractor provided a subgrade which, as close as possible, matches the natural moisture and density conditions found in the area, and that the subgrade be true to line and grade after placement of sub-drainage sand and sub-base course.

2150 **SPECIFICATION FOR LIME MODIFIED SUBGRADE**

2150 - 1 GENERAL

The work shall consist of soil and hydrated lime uniformly mixed, moistened, compacted, finished and cured in accordance with these specifications and it shall conform to the lines, grades, thickness and typical cross-section shown on the plans or as designated by the Engineer.

Lime Modified Subgrade shall be required for all road structures except granular or concrete options or as directed by the Engineer.

2150 - 2 MATERIALS

a) Hydrated Lime

Shall be of an approved brand and shall conform to the requirements of A.S.T.M. Designation C110.

b) Water

Shall be free from substances deleterious to the hardening of the lime-soil mixture.

c) Soil

Shall consist of an approved material in the area to be stabilized.

2150 - 3 CONSTRUCTION

Lime modified subgrade may be constructed with any machine or combination of machines that will produce results that meet the requirements of the specification with regard to pulverization, lime application, mixing, water application, compaction, finishing and curing.

The Contractor shall prepare the area to be paved by grading and shaping as required to construct the subgrade courses in conformance with the lines, grades, cross-section and depth as shown on the plans. Lime modified subgrade shall be constructed in lifts not exceeding 150 mm compacted depth. Unsuitable soil shall be removed by the Contractor and replaced with suitable soil approved by the Engineer.

The quantity of earth material required for one (1) lift shall be pulverized prior to the addition of lime. Pulverization shall continue until all lumps of soil have been reduced to a dimension of not more than 50 mm when measured in any direction.

Lime shall be applied to the prepared surface in the dry or slurry form, uniformly over the surface at the rate designated by the Engineer. The rate shall be generally four (4%) percent hydrated lime by weight of the dry soil. The rate of application shall be controlled within $\pm$ one-half ($\pm$ 1/2) of one percent (1%). The average application rate shall neither be consistently high or low of required rate.

Lime shall not be applied when the wind velocity on the road surface is greater than 25 kilometres per hour, unless a higher limit is approved by the Engineer.

Immediately following application of the lime, it shall be mixed with the soil to the full depth of the lift being treated. Rotary action mechanical mixers shall be used.

The lime and soil shall be dry-mixed by one (1) complete pass of the mixing unit. After dry mixing, water shall be added by means of pressure distributing equipment, to at least five (5) percent over optimum moisture content of the modified soil.

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

The subgrade surface shall be trimmed to $\pm$ 20 mm vertically and 100 mm horizontally. The average level of the finished grade shall neither be consistently high or low from the designed grade.

The lime-soil mixture shall cure for a period of up to forty-eight (48) hours as specified by the Engineer.

Mixing and pulverization shall continue until the lime is uniformly distributed throughout the soil. The number of passes required shall be as directed by the Engineer. The lime-treated layer shall be maintained within the specified moisture range until mixing has been completed.

The lime-soil mixture shall be compacted to a minimum ninety-five percent (95%) of the maximum Standard Proctor dry density as determined by A.S.T.M. Test Designation D698.

After final compaction, the surface shall be smooth and free from cracks, ridges and loose material.

The subgrade surface shall be trimmed to $\pm$ 20 mm vertically and 100 mm horizontally. The average level of the finished grade shall neither be consistently high or low from the designed grade.

Before approval by the Engineer, the subgrade shall be true to cross-section and grade and shall conform to the density specified. Field density and moisture content tests will be made by the Engineer or his representative to ensure that the material is being compacted to the moisture content and density specified. All soft, spongy or yielding spots, and all organic or other objectionable matter shall be entirely removed and the space refilled with suitable compactible material.

After preparing the subgrade as above specified, it shall be the Contractor's responsibility to maintain the required density at his expense, and all unnecessary traffic must be kept off. Should it be found necessary to haul over the prepared subgrade, all cuts, ruts and breaks in the surface of the subgrade so resulting shall be repaired in a manner satisfactory to the Engineer.

2170 **SPECIFICATION FOR PERFORATED DRAINAGE PIPE**

2170 - 1 GENERAL

The work shall consist of installing Perforated Drainage Pipe to the lines, grades, and cross-sections shown in the plans or as directed by the Engineer.

2170 - 2 MATERIALS

a) Perforated Drainage Pipe

Shall be 100 mm diameter, perforated and corrugated as manufactured by the Big "O" Drain Tile Company or equivalent as approved by the Engineer. Pipe shall be enclosed in a fabric filter.

b) Granular Material

Shall conform to Specification 2210.

2170 - 3 CONSTRUCTION

The pipe shall be placed in a surround of sub-drainage sand in a 150 mm deep trench excavated prior to the placement of the subdrainage sand lift. All major tears and rips in the filter fabric shall be repaired. All couplings or fittings shall be enclosed in filter fabric. The drainage pipe shall be covered with subdrainage sand prior to the placement of sub-base. Where the drainage pipe is connected to catch basins the end of the pipe shall not extend more than 150 mm into the barrel of the catch basin and shall be securely mortared in place.

Capped clean-outs shall be provided where access to the perforated drainage pipe is not readily available in a catch basin or manhole.

2190 **SPECIFICATION FOR THE GRADING OF BOULEVARDS**

2190 - 1 GENERAL

The work shall consist of the backfilling and grading of boulevards to the grades and cross-sections shown on the plans or as directed by the Engineer. All work required on boulevards immediately adjacent to a walk, curb, curb and gutter, or pavement to be constructed shall be included in the work contracted for.

2190 - 2 MATERIALS

Sufficient clean and proper soil shall be stockpiled from the excavation or supplied to provide boulevards filled with soil and graded. If no suitable soil is available from the excavation for a particular location, sufficient clean and proper soil shall be stockpiled from the excavation of other locations.

2190 - 3 CONSTRUCTION

All backfilling and backsloping for sidewalk, curb and gutter, shall be at a slope of 5:1 unless otherwise specified, with the slope to start at the finished concrete surface. Backfilling and backsloping for lane crossings and private driveway crossings shall be at a slope of 10:1 unless otherwise specified with the slope to start at the finished concrete surface. In no case shall the Contractor backfill or backslope on private property without permission of the Engineer.

When fill is required for boulevards, the Contractor shall, upon receiving authorization from the Engineer, fill the boulevards to an elevation 100 mm below the top of curb, if landscaping is to be completed in the same construction year, otherwise the Contractor is to fill above the top of curb to ensure drainage from the boulevards. Backfill will be left high to ensure adequate drainage over the curb and to protect the curb from movement. No broken concrete, cinders, sand, gravel or other foreign matter shall be used for boulevard fill. All material of a similar nature encountered within 100 mm from the final boulevard grade shall be removed.

2200 **SPECIFICATION FOR ROADWAY GRAVEL**

2200 - 1 GENERAL

The work shall consist of the grading and gravelling of roads and lanes. The material shall consist of natural aggregate/reclaimed asphalt/granular material.

2200 - 2 MATERIALS

The gradation of the Roadway gravel shall be within the following limits:

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
14.0 mm	100%
5.0 mm	50 - 80%
2.0 mm	30 - 60%
400 μm	15 - 30%
80 μm	5 - 15%

The minimum percent of fractured faces retained on the 5.0 mm sieve shall be 25% by weight.

2200 - 3 CONSTRUCTION

Construction shall be completed and trimmed during each phase, so as to conform to the proper grades and lines with tolerances of ± 20 mm vertically and ± 100 mm horizontally. The average level of the finished grade shall neither be consistently high or low from design grade.

Following grading to the above mentioned specification the application of gravel shall be carried out to the specified width and shall be placed uniformly to a depth as specified or in accordance with Standard Drawing R-2D.

2210 **SPECIFICATION FOR SUB-DRAINAGE SAND**

2210 - 1 GENERAL

The work shall consist of the placement of sub-drainage sand for granular based structures. The uncompacted sub-drainage course shall be placed to the lines, grades and cross-sections shown on the plans or as directed by the Engineer.

2210 - 2 MATERIAL

The gradation of the sub-drainage sand shall be within the following limits.

Sieve Designation	Percent Passing By Weight
28 mm	100%
12.5 mm	90-100%
5.0 mm	75-100%
2.0 mm	55-100%
800 μm	35-75%
400 μm	20-50%
160 μm	0-15%
80 μm	0-5%

Minimum Permeability 1×10^{-4} cm/sec

Use gradation to determine suitability but that permeability specification will be used as guide for acceptance of the material.

2210 - 3 CONSTRUCTION

The placement of subdrainage sand will be carried out in a manner such that hauling and placing operations do not deform the subgrade or over compact the surface along defined routes, resulting in non uniform density. In general the hauling operation should be carried out in such a manner that traffic on the subgrade is limited to unloaded vehicles.

Ideally the placement would involve a dump and doze operation from a working pad of subdrainage sand and sub-base, with no equipment travelling across the prepared subgrade. The contractor shall place the sub-base in a manner such that rutting of the in place sub-drainage sand does not occur.

Construction shall be completed and trimmed to ± 20 mm vertically and ± 100 mm horizontally deviations shall be neither consistently high nor consistently low.

2220 **SPECIFICATION FOR SUBBASE COURSE**

2220 - 1 GENERAL

The work shall consist of the placement of sub-base course immediately following the placement of the sub-drainage sand and conforming to the lines, grades and cross-sections shown on the drawings. It shall consist of a layer of screened or crushed sand or gravel with or without binder added.

2220 - 2 MATERIALS

The sub-base aggregate is to be supplied by the Contractor. The method of processing and delivery must be satisfactory to the Engineer. The sub-base material shall be weighed at the Contractor's expense on scales provided by the Contractor. The sub-base aggregate shall be composed of fragments of durable rock, free from injurious quantities of soft or flaky particles, shale, loam and organic or other deleterious material.

The gradation of sub-base aggregate shall be within the following limits;

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
56 mm	100%
80 μm	5 - 15%
Plasticity Index	0 - 6

2220 - 3 CONSTRUCTION

If pneumatic tire rollers are used, the lift of sub-base course shall not exceed 120 mm in depth. The depth of lift may be increased if mechanical vibratory rollers, approved by the Engineer are used, provided that adequate compaction can be obtained.

Sub-base course shall be compacted until no further settlement is apparent and the particles are well-keyed into place. If the natural moisture content of the sub-base course is insufficient for proper compacting, water shall be added as directed by the Engineer.

Traffic over sub-base course will not be permitted except by permission of the Engineer. If hauling is permitted over subbase course the Contractor will, at his own expense, maintain and repair the subbase course as to cross-section and compaction. The Contractor shall provide at his own expense, all necessary protection of works and the safety of the public.

The placement of subbase course will be carried out in a manner such that hauling and placing operations do not deform the subgrade or over compact the surface along defined routes, resulting in non uniform density. In general the hauling operation should be carried out in such a manner that traffic on the subbase is limited to unloaded vehicles.

Ideally the placement would involve a dump and doze operation from a working pad of subbase, with no equipment travelling across the prepared subgrade. The Contractor shall place and protect the subbase in a manner such that rutting or mixing of the in place subdrainage sand does not occur.

Construction shall be completed and trimmed to ± 20 mm vertically and ± 100 mm horizontally.

Deviations shall be neither consistently high nor consistently low.

2230 **SPECIFICATION FOR GRANULAR BASE COURSE**

2230 - 1 GENERAL

The work shall consist of the placement of granular base course materials to the grade lines and cross-sections as shown on the Plans or as designated by the Engineer.

2230 - 2 MATERIALS

a) Gradation

When tested according to A.S.T.M. Designation C135, Method of Test for Sieve Analysis, the material shall meet one of the following gradation requirements as specified by the Engineer.

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT		
Size	Type 32	Type 33	Type 34
25 mm	100		
20 mm	93 - 100	100	100
12.5 mm	72 - 93	81 - 100	91 - 100
5 mm	45 - 77	50 - 80	70 - 85
2 mm	29 - 56	32 - 52	45 - 65
800 μm	17 - 38	18 - 33	27 - 42
400 μm	13 - 26	15 - 25	20 - 30
160 μm	7 - 14	11 - 19	11 - 16
80 μm	7 - 11	7 - 11	7 - 11
Plasticity Index	0 - 6	0 - 6	0 - 6

The percentage passing the designated sieve sizes for any representative sample, when plotted on a semi-log grading chart, shall show a free flowing concave curve without sharp breaks, within the limits specified above. The material passing through the 400 μm sieve shall have a Liquid Limit not greater than 25 and a Plasticity Index not greater than six (6).

b) Aggregate

The aggregate shall consist of hard, durable particles free from injurious quantities of soft or flaky particles, loam or organic matter, or other deleterious material. The gravel shall be crushed gravel passing a 25 mm sieve.

Granular material retained on the 5 mm sieve shall have a minimum average of forty-five percent (45%) of the aggregate with at least one fractured face. Average will be defined as the average all tests for each working shift.

c) Clay Binder

Shall consist essentially of fine particles of sand, silt and clay containing no particles larger than will pass a 25 mm square opening screen, and shall be free from injurious amounts of organic matter or other deleterious material. It shall have a plasticity index of not more than 15. The clay shall be broken down by a shredder or pulverizer before being added to the mixture if required by the Engineer.

d) Filler

Filler material shall be fine sand (minimum 100% passing 630 μm sieve) and free from rocks or any deleterious material.

e) Water

Water shall be reasonably clean and free from substances which might render it unfit for use.

2230 - 3 CONSTRUCTION

The base course shall consist of an intimate mixture of course aggregate, sand, clay, and water. These materials shall be combined, compacted and finished in a true workmanshiplike manner on the previously prepared sub-base or subgrade to a compacted thickness as shown on cross-sections and plans, and in these specifications.

All tools, machinery, plant and equipment used in handling material and executing any part of the work, shall be subject to the approval of the Engineer. All such equipment shall be maintained in efficient working order, and where any machinery, plant or equipment is found to be unsatisfactory, it shall be improved or replaced.

Granular base course is to be supplied, placed and delivered by the Contractor. The method of processing and delivery must be satisfactory to the Engineer.

The rolling and compacting shall begin at the gutter edges of the roadway and progress toward the centre parallel to the centre line with such overlapping of successive passes as may be required to produce the required density. A blade grader shall be used in conjunction with the compaction equipment to maintain an even and uniform compacted surface shaped to the required lines. Any irregularities or depressions in the final surface that develop under rolling, shall be corrected by loosening the material at these places and adding or removing material until the surface is smooth and uniform. The final surface of the granular base course shall be compacted in such a manner as to ensure the granular base course structure is stable and tightly knit throughout.

The surface of the granular base course shall be such that when tested with a 3 m straight edge placed on the surface of the roadway, the maximum deviation of the surface from the edge of the straight edge shall nowhere exceed 10 mm.

Each layer of base course shall be compacted to at least one hundred percent (100%) of the maximum Standard Proctor dry density for the material comprising the layer. While spreading or rolling, water shall be applied to the base course if required, and as instructed by the Engineer.

The final moisture content of the base course mixture in each layer just before compaction shall be not more than optimum moisture in order to obtain maximum density. The optimum moisture for the base course mixture and the maximum density of the compacted layers shall be determined by the Engineer.

Traffic over base course will not be permitted except by permission of the Engineer. If hauling is permitted over base course, the Contractor will, at his own expense, maintain and repair the base course as to cross-section and compaction. The Contractor shall provide at his own expense, all necessary protection of works and the safety of the public.

Construction shall be completed and trimmed to ± 10 mm vertically and ± 100 mm horizontally. Deviations shall be neither consistently high nor consistently low.

2235 **SPECIFICATION FOR IN-PLACE RECYCLED BASE COURSE**

2235 - 1 GENERAL

The work shall consist of the in-place recycling of an existing pavement by tilling and by furnishing and spreading new aggregate, if necessary, injecting emulsified asphalt and shaping and compacting the mixture.

2235 - 2 MATERIALS

a) Asphalt Emulsion

Asphalt emulsion shall be CSS-1, with the emulsion applied at a rate that will leave a residual asphalt content of 5.0% based on dry weight of aggregate or as determined by the laboratory.

2235 - 3 CONSTRUCTION

The aggregate surface shall be prepulverized to the full depth to be stabilized to avoid encountering any hard consolidated areas. Any necessary subgrade stabilization or removal/replacement is then to be carried out.

The pulverized mix is then relaid and the surface is shaped to the desired final cross-section prior to using the in-place mixer again. If new aggregates are to be blended with the existing materials to improve gradation, the proper amount of new material is placed on the shaped roadway surface prior to the first mixing pass. The mixer then mixes the aggregate and incorporates the other mix components, leaving the combined mix in the same basic position but loose or "fluffed".

When the surface is ready for emulsion, the moisture content of the aggregate should not exceed 3% unless laboratory tests indicates that a higher moisture content will not be harmful when the asphalt emulsion is added. On the other hand, if water is needed it will be metered or properly introduced by water distributor and thoroughly and uniformly mixed with the aggregate. The method to be used will be determined by the Engineer.

If any of the liquids tend to run ahead of the rotor assembly on steep grades, or for any other reason, the application rate should be split into two or more mixing operations. After the water, if needed, and emulsion have been introduced by mixing, the in-place mixer will make additional passes as necessary to assure complete homogeneous blend of the mix. The mixer shall "break track" with the proceeding mixing pathways overlapping the joint lines.

A typical or normal sequence of operations when water and emulsion are introduced, separately or as specified would be:

a) Prepulverize and shape the road surface. However, where unstable subgrade exists, windrow the mix aside and remove/replace the unstable subgrade as necessary prior to shaping the road surface.

b) First Pass - Add water through the mixer or any other approved method and mix. This step may not be needed if moisture content of aggregate is within mixing limits.

c) Second Pass - Add emulsified asphalt at a specified rate through the mixer and mix.

d) Third Pass - Overlap the joints of preceding passes and mix without adding materials.

e) Fourth Pass - Final remix if necessary. It must be noted that additional passes may be needed for aeration.

f) Reshape the road surface to prescribed control.

g) Rolling - Compaction should start when the mix has been allowed time to break or is at optimum moisture content. Initial rolling may be initiated with a pneumatic-tired roller. (optional)

If at any time during compaction, the asphalt mixture exhibits undue rutting or shoving, rolling should be stopped. Compaction should not be attempted until there is a reduction in water content, occurring either naturally or by mechanical aeration. Finished rolling should be done with a steel-wheeled roller.

When one machine is used the maximum that can be mixed in an eight-hour day will be 5.0 square metres. Lower production rates may be necessary until correct aggregate sizes are achieved and/or recycled base has been adequately mixed. The experience gained the first day will determine the allowable area that may be added to the production on following days.

Coating - Field mix coating shall be a minimum of 90% of laboratory coating design.

Density - Density in field shall be a minimum 95% of maximum laboratory density based on the dry weight of compacted mixture.

Moisture - Aggregate moisture content shall be a maximum of 3% or as determined by the laboratory.

After the mixture has been spread and when it will bear the weight of the roller without excess lateral movement, it shall be rolled longitudinally. Rolling shall start at the edges and progress toward the center, overlapping on successive trips by at least one-half width of the roller. The entire surface shall be rolled twice in this manner unless, in the opinion of the authorized representative, additional rolling is necessary.

2240 SPECIFICATION FOR CONCRETE BASE COURSE

2240 - 1 GENERAL

The work shall consist of constructing a concrete base to the lines, grades and cross-sections shown on the Plans or as designated by the Engineer.

2240 - 2 MATERIALS

a) Concrete

Shall conform to Specification 2500 and 2550

2240 - 3 CONSTRUCTION

a) Placing

Immediately prior to placing the concrete, the subgrade shall be brought to an even surface conforming to the specified cross-section. Concrete shall be placed on a moist, compacted gravel layer. If the gravel layer is dry, it shall be sprinkled with as much water as will be absorbed readily.

After mixing, the concrete shall be deposited rapidly upon the gravel layer to the required depth of the pavement in successive batches. The concrete shall be spread evenly and compacted by means of vibration until the water flushes to the surface. The finished surface of the concrete must conform at every point to the cross-section of the finished pavement with a maximum tolerance of ± 10 mm vertically. Immediately before the initial set of the concrete, the surface shall be roughened to provide a bond for the asphaltic concrete wearing surface. The roughening of the surface shall be accomplished in such a manner and with such tools as shall be approved by the Engineer.

The minimum depth of concrete base course is 200mm unless otherwise specified.

b) Slip-Form Paver

The use of a slip-form paver as an alternative construction method shall be allowed provided that prior to use, the specifications for the slip-form paver shall be submitted to the Engineer for written approval. Requirements contained in the specifications for concrete base course shall also apply to the slip-form method unless modified below.

The slip-form paver shall spread, consolidate, screed, and float finish the concrete in one pass. The machine shall be of ample strength to withstand severe use and shall be adjustable for loss of cross-section due to wear.

The forms shall extend the full depth of the pavement, and shall not have an inward slope or batter of more than 15 mm. The forms shall be of sufficient length that the concrete will remain stable and rigid at the edges by the time the forms have passed.

c) Construction Joints

Where it is practical, the concrete (base) extension must be placed in one continuous section. At cold joints between existing and new concrete base or when construction joints are allowed, 10M steel dowels, 600 mm long, shall be placed at 1.0 metre intervals unless otherwise designated by the Engineer.

Where width of concrete base is less than 300 mm in parking lanes, dowels may be left out.

d) Protection of Concrete Base

All classes of traffic and hauling shall be excluded from the concrete base by the erection of suitable and substantial barricades until, in the opinion of the Engineer, the concrete has hardened sufficiently to sustain it, and in no case until the last laid concrete has cured as follows:

Concrete Strength	Minimum Cure Time
15 Mpa	7 days
15 Mpa - HE	4 days
32 Mpa - HE	24 hours

The Contractor shall maintain on the job, sufficient canvas or other suitable covering to protect all freshly laid concrete from the action of the elements.

e) Curing

After the concrete has been finished to cross-section and as soon as the concrete has set sufficiently, the entire surface shall be sprayed with a concrete curing compound in a manner and in such quantity as will be directed by the Engineer. All concrete surfaces that are left exposed to the air after removal of forms shall be sprayed with curing compound in a similar manner. The curing compound shall be applied by means of Protex power sprayer or equal.

The compound shall adhere to damp concrete having a horizontal or vertical surface and form a continuous film when applied according to the manufacturer's instructions. When dried, the Compound shall not be tacky and must adhere to the concrete surface even under normal pedestrian traffic conditions. The film shall not render the concrete surface slippery. The compound shall be clear or translucent, resinous base, non-bituminous. It shall contain a fugitive dye, readily distinguishable upon the concrete for at least four hours after application. The colour shall become inconspicuous within seven days of application. The Compound shall equal or exceed the A.S.T.M. "Specification for Liquid Membrane-Forming Compounds for Curing Concrete," Designation C309. The water retention efficiency tests shall be carried out in accordance with A.S.T.M. Designation C156.

2245 **SPECIFICATION FOR CONCRETE EXTENSION**

2245 - 1 GENERAL

The work shall consist of excavating and placing a 200 mm lift of concrete base in areas where proper compaction of asphalt gutter patch can not be achieved or as directed by the Engineer.

2245 - 2 MATERIAL

a) Concrete

15 MPa concrete shall conform to Specification 2500 and 2550.

2245 - 3 CONSTRUCTION

The area in which the extension is to be placed shall be cleaned out to ensure that a 200 mm lift of concrete base can be placed. The concrete shall be placed to 50 mm to 75 mm below the lip of gutter or as shown on the plans or as designated by the Engineer. The concrete shall be surfaced raked to give a rough texture. The exposed gutter repair shall be properly barricaded for the protection of pedestrians and vehicular traffic until the asphalt patch of overlay is placed.

Where it is practical, the concrete (base) extension must be placed in one continuous section. At cold joints between existing and new concrete base or when construction joints are allowed, 10M steel dowels, 600 mm long, shall be placed at 1.0 metre intervals unless otherwise designated by the Engineer.

Where width of concrete base is less than 300 mm in parking lanes, dowels may be left out.

After the concrete has been finished to cross-section and as soon as the concrete has set sufficiently, the entire surface shall be sprayed with a concrete curing compound in a manner and in such quantity as will be directed by the Engineer. The curing compound shall be applied by means of Protex power sprayer or equal.

The Contractor shall maintain on the job, sufficient canvas or other suitable covering to protect all freshly laid concrete from the action of the elements.

2250 **SPECIFICATION FOR SOIL CEMENT BASE COURSE**

2250 - 1 GENERAL

The work shall consist of placing a mixture of an approved granular material, Portland Cement and water uniformly mixed, compacted, finished and cured, in accordance with these specifications and conforming to the lines, grades, thickness and typical cross-sections shown on the plans or as designated by the Engineer.

Subgrade shall be Lime Modified Subgrade as set out in Specification 2150.

2250 - 2 MATERIALS

A qualified testing laboratory engaged and paid by the Contractor shall be employed to prepare a short-cut design for the soil-cement aggregate on which the tender is based. The short-cut design, including percentage of cement content by weight and a sieve analysis shall accompany the tender submission. The percentage of cement content by weight shall be that amount necessary to produce a durable product with a minimum seven-day compressive strength of 3 MPa.

A qualified testing laboratory engaged and paid by the Contractor shall be employed to determine the optimum moisture content and density by the moisture-density test for soil-cement (A.S.T.M. D558) and the minimum required amount of cement by the wet-dry and freeze-thaw tests (A.S.T.M. D559 and D560). This design shall be provided to the Engineer prior to start of construction and shall be the basis for soil cement base constructed.

The maximum permissible soil cement losses of samples subjected to 12 cycles of the wet-dry test or freeze-thaw test shall not exceed 14%.

Field samples taken during construction shall also be required to meet the conditions of the test procedure.

a) Portland Cement

Shall conform to the latest specifications for Portland Cement (CSA Standard A5).

b) Water

Shall be free from substances deleterious to the hardening of soil cement.

c) Granular Material

Shall be subject to the approval of the Engineer. When unsuitable or unacceptable material is encountered, it shall be removed and replaced with select material as directed by the Engineer.

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
56 mm	100%
5 mm	55% - 100%
2 mm	40% - 100%
400 μm	20% - 50%
80 μm	6% - 17%
Plasticity Index	0 - 6

d) Mix Design

The mineral aggregate gradation shall be within the limits as set out above. The sieve analysis when plotted on a semi-log grading chart shall give a smooth flowing curve without sharp breaks. The maximum permissible variation from the job mix formula gradation shall be as follows:

5 mm Sieve	± 15%
800 μm Sieve	± 10%
80 μm Sieve	± 3%

e) Curing Seal

Shall consist of liquid asphalt varying from MC-70 to MC-250 and from RC-70 to RC-250 or SS-1 to suit the conditions of the soil-cement base and shall conform to A.S.T.M. Designation D597 or D598 for Cutback Asphalts. Where SS 1 is used, the dilution with water shall be 1:1.

2250 - 3 CONSTRUCTION

Soil-Cement base course may be constructed with any machine or combination of machines that will produce results that meet the requirements of the specifications with regard to pulverization, cement application, mixing, water application, incorporation of material, grading, compaction, finishing and curing.

The approved granular material, cement and water shall be mixed in a pugmill, either of the batch or continuous-flow type. The plant shall be equipped with feeding and metering devices which will add the granular material, cement and water into the mixer in the specified quantities. Soil and cement shall be mixed sufficiently to prevent cement balls from forming when water is added. Mixing shall continue until a uniform and intimate mixture of granular material, cement and water is obtained.

The mixture shall be hauled to the roadway in trucks equipped with protective covers. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader or spreaders. Not more than 30 minutes shall lapse between the placement of soil-cement in adjacent lanes at any location except at longitudinal construction joints. The layer of soil-cement shall be uniform in thickness and surface contour, and in such quantity that the completed base will conform to the required grade and cross-section. Dumping of the mixture in piles or windrows upon the subgrade will not be permitted.

No more than sixty (60) minutes shall elapse between the start of moist mixing and the start of compaction of soil-cement.

At the start of compaction, the percentage of moisture in the mixture based on oven-dry weights, shall not be below or more than two percentage points above the specified optimum moisture content, and shall be less than that quantity which will cause the soil-cement mixture to become unstable during compaction and finishing.

The specified optimum moisture content and density shall be determined in the field by the Engineer or his representative by the moisture density test A.S.T.M. Designation D558 on representative samples of soil-cement base mixture obtained from the area being processed.

Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. The loose mixture then shall be uniformly compacted to the specified density within two hours. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross-section.

If necessary, during shaping operations, the surface of the base shall be lightly scarified to remove any tire imprints on smooth surfaces left by equipment. The resulting surface shall then be compacted to the specified density. Rolling shall be supplemented by broom-dragging if required.

The moisture content of the surface material must be maintained at not less than its specified optimum moisture content during all the compaction operations.

The soil cement base shall be compacted to not less than ninety-seven percent(97%) of the maximum Standard Proctor density as determined by A.S.T.M. Designation D558.

Any portion of the soil cement base that has a density of ninety-five percent (95%) or less of the specified density, shall be corrected or replaced to meet these specifications. The specified density shall be the maximum density as determined on a representative field sample taken from the moist mix (A.S.T.M. D558).

Surface compaction and finishing shall be done in such a manner as to produce in not longer than two hours, a smooth, dense surface, free of compaction planes, cracks, ridges or loose material.

Full width construction shall be carried out on streets and lanes to eliminate longitudinal joints and to protect the subgrade from rain should this occur during the placing operation.

At the end of each construction day, or at any time where delays will put the completion of a roadway beyond the limit set for completion of the work, a construction joint shall be made by trimming the end or side of the compacted mixture to a straight line normal or parallel to the centre line of the road bed and with a vertical face in the thoroughly compacted material.

Soil cement for large areas shall be built in a series of parallel lanes of a convenient length and width that meets the approval of the Engineer. Straight longitudinal joints shall be formed at the edge(s) of each day's construction, by cutting back in the thoroughly compacted material to form a true vertical face with the road bed and shall be free from all shattered and loose material.

No cement shall be applied when the soil is frozen or when the air temperature is less than 5°C in the shade and decreasing. The Contractor shall cover or otherwise protect any soil-cement during the seven-day curing period when the air temperature falls below 0°C. Only such cement shall be applied as can be completely processed within six (6) hours.

The completed soil cement base shall be covered with a bituminous curing seal. Cure coats shall be applied at a rate between 0.8 and 1.4 litres per square metre of surface. Curing seal shall be applied as soon as possible after final rolling, but in no case, later than twenty-four (24) hours.

The wearing course shall not be applied for a period of at least seven days after the completion of the bituminous curing seal. In the meantime local light traffic shall be permitted to cross the area.

The surface must be cleaned and repaired at the Contractor's expense prior to the application of the wearing course.

The surface of the soil cement shall be such that when tested with a 3 m straight edge placed in any direction or on the surface of the roadway, the maximum deviation from the surface of the straight edge shall not exceed 10 mm. The finished surface shall conform to the required cross sections and grades within ± 10/mm, except that the average level of the finished surfaces shall neither be consistently high or low from the design levels of the surface of the base course.

Maintenance shall include immediate repairs of any defects that may occur. The work shall be done by the Contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Faulty work shall be replaced for the full depth of the treatment. Any low area shall be remedied by replacing the material for the full depth of the treatment rather than by adding a thin layer of soil cement to the completed work.

2250 - 4 ACCEPTANCE

The "Short-Cut" test procedure will not be acceptable for determination of cement contents, but may be used for confirmation of cement contents. The "Rapid Test" procedure will not be accepted.

The percentage of cement by weight as determined utilizing A.S.T.M. Test Designations D559 and D560 shall be that which is necessary to give a durable product with a minimum compressive strength of 3 MPa on a seven-day test. At least one field density and moisture test will be carried out by the Engineer or his representative per 150 linear metres of roadway construction to determine if the material is compacted to the minimum density specified. This test shall be paid for by the Owner.

At least one test for cement content of soil cement mixtures, as determined by A.S.T.M. Test Designation D806, shall be carried out by the Engineer or his representative per 150 linear metres of roadway construction. This test shall be paid for by the Owner.

The basis of acceptance or rejection of the placed soil cement shall be the seven-day compressive strength. Compressive strengths found to be between 2.0 and 3.0 MPa shall be accepted with the payment reduced in accordance with the following formula:

$$\text{Payment Reduction} = \frac{\text{Specified Strength - Actual Strength}}{\text{Specified Strength}} \times 1.7 \times \text{Unit Price Bid}$$

Seven-day compressive strengths below 2.0 MPa shall be rejected and the contractor shall remove and replace the understrength soil cement at his expense.

The area of understrength or rejected soil cement shall be that which is represented by the understrength seven-day compressive strength molds as determined by the Engineer, but in no case shall exceed 150 linear metres of roadway construction, represented by each understrength sample.

2260 SPECIFICATION FOR SAND ASPHALT BASE COURSE

2260 - 1 GENERAL

The work shall consist of an intimate mixture of mineral aggregate, filler and asphaltic binder, combined in accordance with these specifications, laid to a compacted thickness as specified by the Engineer, conforming to lines, grades and cross-section as shown on the plans.

Subgrade shall be Lime Modified Subgrade as set out in Specification 2150.

2260 - 2 MATERIALS

Materials shall be in accordance with the standard specifications of the Asphalt Institute, unless otherwise specified in this section.

a) Aggregates

Shall consist of hard durable, uniformly graded crushed gravel or steel slag. It shall be clean and free from adherent coatings and extraneous material such as wood, roots, et cetera. The minimum sand equivalent shall be 30%.

The gradation of mineral aggregate shall be within the following limits:

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
20 mm	100%
10 mm	85% - 100%
5 mm	65% - 93%
2 mm	45% - 80%
800 µm	30% - 55%
400 µm	15% - 37%
160 µm	4% - 20%
80 µm	2% - 6%

The percentage passing the designated sieve sizes for any representative sample shall, when plotted on a semi-log grading chart, show a smooth flowing curve without sharp breaks.

b) Percent Bitumen

The percent bitumen shall be sufficient to make the mix waterproof. Molds will be made with different asphalt contents and placed in a water bath to determine the amount of water absorbed. The maximum amount of water absorbed after submerging for twenty-four (24) hours shall be 1.5% by weight of the Marshall mold.

c) Mineral Filler

When the mineral aggregate is deficient in mineral filler the Contractor shall add in the weight hopper of the asphalt plant, mineral filler in such quantities as will be required to meet the gradation of mineral aggregate as specified above. Mineral filler shall consist of Portland Cement, Pozzoline, commercially ground stone dust, or other mineral dust approved by the Engineer. Mineral filler shall have a Plasticity Index of zero, and when tested by means of laboratory sieves, it shall meet the following requirements:

% passing 800 μm sieve - 100%
% passing 160 μm sieve - not less than 85%
% passing 80 μm sieve - not less than 65%

d) Asphaltic Binder

Shall have a penetration of Original Sample at 25 °C, 100 grams, 5 seconds of 150 – 200 (A).

The limits of the viscosity and penetration shall be as follows:

	LIMITS			
Viscosity	155	78	50	92
Penetration	150	150	200	200

e) Mix Design and Proportioning

The Contractor shall submit a job mix formula for the Engineer's approval prior to commencement of the work. This job mix formula shall be based on representative samples from the stockpile to be used for sand asphalt base construction. The Marshall Method of mix design shall be used. Minimum 50 blow Marshall Stability - 3200 newtons, Per Cent Air Voids - 3-6, Flow 0 - 5 mm.

The mineral aggregate gradation shall be within the limits as set out in above and the maximum permissible variation from the job mix formula gradation shall be as follows:

10 mm sieve	± 5%
2.5 mm sieve	± 12%
800 μm sieve	± 10%
80 μm sieve	± 5%

f) Plant Operation

Temperatures shall be controlled in accordance with the following limits:

		Degrees Celsius	
Penetration Asphalt	Maximum Temperature of Dry Aggregate	Asphalt Storage Temperature	Bituminous Mix at the Pugmill
150-200(A)	160 °C	120 - 150	125 - 135

The bituminous aggregate immediately before entering the pugmill shall not contain more than one-half percent moisture by weight.

2260 - 3 CONSTRUCTION

Where the area to be paved is a prepared aggregate base or sub-base, it shall be primed as directed by the Engineer, and in accordance with the specifications for "Prime Coat"

A "Tack Coat" shall be applied to bond successive layers of the sand asphalt base at a rate as specified in the specifications for "Tack Coat".

The Bituminous Mixture shall not be spread when the air temperature is below 2 °C. The mixture shall be laid at a temperature of the mix of not lower than 105 °C, nor more than 140°C. The mixture shall be spread by means of a mechanical self-powered paver except for those areas inaccessible to the mechanical paver. The complete operation of spreading and compaction shall be done in daylight hours. The mixture shall be compacted so that upon completion, the density of the asphalt base shall be not less than ninety-five (95%) percent of a standard fifty blow Marshall Compaction Test.

Transverse joints in succeeding courses shall be offset at least 600 mm. Longitudinal joints shall be offset at least 150 mm.

Any irregularities which vary more than 10 mm in 3 m shall be corrected. Irregularities which may develop before the completion of rolling shall be remedied by loosening the mix and removing or adding material as may be required. The finished grade shall be within ± 10 mm of design grade vertically and within ± 100 mm horizontally. The average level of the finished grade shall neither be consistently high or low from design grade.

The depth of each compacted lift of sand asphalt base shall not be greater than 80 mm unless written authorization is obtained from the Engineer.

No traffic shall be permitted on the completed sand asphalt base until it has cooled to 60 °C.

2300 **SPECIFICATION FOR ASPHALTIC PRIMER OR TACK COAT**

2300 - 1 GENERAL

The items or work covered by the section are those required for the supply and application of asphaltic material as a prime or tack coat for a compacted base course.

2300 - 2 MATERIALS

The bituminous material shall be MC70 to MC250, RC70 to RC250 or SS-1. Where SS-1 is used, the dilution with water shall be 1:1.

2300 - 3 CONSTRUCTION

a) Preparation

1. Asphalt Primer

Immediately prior to applying the asphalt primer, the surface of the base course shall be brought to uniform cross-section by patching all depressions and defective areas using an approved patching material and by removing all bumps and irregularities. All loose and foreign material shall be removed by light sweeping.

2. Tack Coat

The pavement shall be clean and dust free. When thoroughly set, the tack coat shall be covered immediately or protected from traffic until covered.

b) Application

Upon the prepared surface, the asphalt shall be applied uniformly, at a rate of 1.5 litres per square metre for asphalt primer, at a rate of 0.5 litres per square metre for tack coat, and a rate of 1.0 litres per square metre for cure coat as directed by the Engineer. The asphalt primer shall be applied only when the surface is dry or slightly damp unless otherwise allowed by the Engineer in writing, and only when the air temperature in the shade is above +2 °C. The application temperature of the asphalt primer shall be specified by the Manufacturer.

To ensure uniformity of application, a drip pan shall be inserted under the nozzles when the application is stopped, and building paper shall be spread over the treated surface to allow sufficient distance on restarting so that the nozzles are operating at full force when the untreated surface is reached. The building paper shall then be removed or destroyed. A narrow spout pouring pot or hand spray shall be used to apply primer material necessary to touch up any spots unavoidably missed by the distributor.

Concrete work adjacent to the roadway shall be completely protected from the application operation by a covering approved by the Engineer. Any unnecessary splashing of the concrete shall be cleaned at the Contractor's expense. The Contractor shall maintain the primed surface until the surface course has been placed. Maintenance shall include spreading any additional sand and patching any breaks in the primed surface with additional asphaltic material.

The pressure distributor used for applying asphaltic materials shall be equipped with pneumatic tires and shall be so designed and operated as to distribute the asphaltic material in a uniform spray without atomization, in the amount and between the limits of temperature specified. It shall be equipped with a fifth wheel speed tachometer registering metres per minute and so located as to be visible to the truck driver to enable him to maintain the constant speed required for application at the specified rate. The pump shall be operated by a separate power unit, or by the truck power unit. It shall be equipped with a tachometer registering litres per minute passing through the nozzles and readily visible to the operator.

Suitable means of accurately indicating at all times the temperature of the asphaltic material shall be provided. The thermometer well shall be so placed as not to be in contact with a heating tube. The distributor shall be so designed that the normal width of application shall not be less than 2 m, with provision for the application of lesser width when necessary.

If provided with heating attachments, the distributor shall be so equipped and operated that the asphaltic material shall be circulated or agitated throughout the entire heating process.

2325 **SPECIFICATION FOR THE SUPPLY OF ASPHALTIC CONCRETE**

2325 - 1 GENERAL

The Asphaltic Concrete shall consist of a homogeneous mixture of mineral aggregate, filler and asphaltic binder, combined in accordance with these Specifications.

Where a standard, specification or test method is referenced in this specification, the current version shall apply.

2325 - 2 MATERIALS

a) Aggregate

Shall consist of hard, durable, uniformly graded, crushed gravel or steel slag and shall not contain organic or soft materials nor materials that break up when alternately frozen and thawed or wetted and dried, nor other deleterious materials.

When tested according to ASTM Designation C136, Method of Test for Sieve Analysis, the material shall meet the following gradation requirements:

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT		
	12.5 mm Max. Aggregate	16 mm Max. Aggregate	20 mm Max. Aggregate
20 mm			100%
16 mm		100%	85% - 100%
12.5 mm	100%	90% - 100%	75% - 93%
10 mm	90% - 100%	79% - 92%	65% - 90%
5 mm	55% - 85%	50% - 72%	40% - 65%
2 mm	30% - 65%	32% - 51%	25% - 46%
800 μm	20% - 45%	20% - 35%	15% - 32%
400 μm	10% - 30%	15% - 27%	13% - 25%
160 μm	5% - 15%	7% - 15%	7% - 15%
80 μm	2% - 10%	4% - 11%	4% - 11%

The maximum aggregate size for type of roadway shall be in accordance with the following table:

TYPE OF ROAD	MAXIMUM AGGREGATE SIZE
Local/Residential	12.5 mm or 16.0 mm
Collector/Bus Route	16.0 mm
Arterial/Industrial	16.0 mm or 20.0 mm

If aggregate has insufficient material passing the 80 μm sieve, the Contractor shall supply mineral filler, approved by the

Engineer, in the proportions required.

The minimum sand equivalent value shall be 45 when tested in accordance with ASTM D2419, Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregates.

The coarse aggregate must conform to the requirements for gravel ASTM Designation D692.

The fine aggregate must conform to the requirements of the Standard Specifications for fine aggregate for Bituminous Concrete Pavements, ASTM Designation D1073.

b) Mineral Filler

When the mineral aggregate is deficient in mineral filler, the Contractor shall add in the weigh hopper of the asphalt plant, mineral filler in such quantities as will be required to meet the gradation of aggregate as specified above. Mineral filler shall consist of Portland Cement, Pozzolan, commercially ground stone dust, or other mineral dust approved by the Engineer. Mineral filler shall have a plasticity index of zero.

c) Asphaltic Binder

The asphaltic binder shall be uniform in character, free of water and shall not foam when heated to 175 ^{o}C. It shall meet the following specifications:

ASTM Characteristics	ASTM Test Method	Specifications 150-200(A)		300-400(A)	
		MIN	MAX	MIN	MAX
Penetration, @ 25 ^{o}C, 100 g, 5 sec.	D5	(see table below)		(see table below)	
Viscosity @ 60 ^{o}C, MPa's	D2171				
Flash Point (Cleveland Open Cup), ^{o}C	D92	205	-	175	-
Thin Film Oven Test Weight Loss, max %	D1754	-	1.0	-	2.0
Penetration @ 25 ^{o}C of residue, % of orig.	D5	50	-	-	-
Ductility: @ 25 ^{o}C	D113	100	-	-	-
Solubility in Trichloroethylene, min %	D2042	99.5	-	99.5	-

The limits of the viscosity and penetration shall be as follows:

		LIMITS			
150-200(A)	Viscosity / Penetration	$\frac{155}{150}$	$\frac{78}{150}$	$\frac{50}{200}$	$\frac{92}{200}$
300-400(A)	Viscosity / Penetration	$\frac{45}{300}$	$\frac{26.5}{300}$	$\frac{17}{400}$	$\frac{27}{400}$

d) Recycled Mixes

300-400(A) may be used for recycle applications upon approval of the engineer. The mixed binder from the recycle and the 300-400(A) shall fall within the conditions outlined above.

e) Mix Design Procedure

Prior to the commencement of any work, the contractor shall employ a testing laboratory to produce a laboratory mix design and make recommendations concerning blending of mineral aggregates.

The asphalt cement and mineral aggregates shall be uniformly combined in such proportions as to produce a suitable mixture that produces the properties called for in this specification.

The laboratory mix design is to comply with the requirements for Specification 2325, THE SUPPLY OF ASPHALTIC CONCRETE, 2 MATERIALS, a), b), c) and d) and follow the Marshall Method of mix design.

The Marshall Method of mix design shall be used in accordance with ASTM Designation D 1559 or AASHTO T245, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus. The mix, for Minimum 50 Blow Marshall Stability, shall conform to the following criteria:

Local Residential	5,700 Newtons
Collector/Bus Route	7,000 Newtons
Arterial/Industrial	10,000 Newtons
Minimum Retained Stability	70% of Initial Stability
% Voids of Total Mix	3-5
Minimum V.M.A.(Max. Agg.)	15% (12.5 mm)
	14.5% (16 mm)
	13.5% (20 mm)
Maximum Flow in mm	5
Minimum Flow in mm	2

The retained stability test is to ensure that the asphaltic mix has reasonably good durability. One of the Marshall specimens is soaked in a water bath at 60 °C for twenty-four hours. A Marshall stability performed on this specimen shall have retained a minimum of 70% of the initial stability.

Minimum Film Thickness	7.5 μm

Film thickness shall be determined in accordance with Saskatchewan Highways and Transportation Standard Test Procedure STP 204-19.

f) Job-Mix Formula

The job-mix formula is the target aggregate gradation and asphalt cement content for plant production.

The Contractor's quality control laboratory will test a trial batch of the proposed job-mix formula to verify the laboratory mix design. If the initial trial batch fails, the Contractor will submit results of further trial batch tests performed by its laboratory until successful results are obtained. The laboratory mix design and proposed job-mix formula will not be approved until successful results are obtained.

The approved job-mix formula shall comply with the requirements of Specification 2325, THE SUPPLY OF ASPHALTIC CONCRETE, 2 MATERIALS, a), b), c), d) and e).

The maximum permissible variation in the aggregate gradation of the actual hot mix produced from the job-mix formula shall be as follows:

20 mm sieve	± 5%
16 mm sieve	± 5%
12.5 mm sieve	± 5%
10 mm sieve	± 5%
5 mm sieve	± 5%
2 mm sieve	± 4%
800 μm sieve	± 3%
160 μm sieve	± 2%
80 μm sieve	± 1.5%

Hot mix asphalt shall not be supplied until the Engineer gives permission in writing to proceed with a specific job-mix formula. The job-mix formula shall remain in effect until changes are approved in writing by the Engineer.

The three point moving average of asphaltic binder in the mix shall not vary by more than zero point three percent (0.3%) from the job-mix formula design.

All of the above mentioned tests, laboratory mix designs and job mix formula confirmations shall be at the expense of the Contractor.

2325 - 3 CONSTRUCTION

a) Plant Operation

The asphalt paving plant shall be capable of turning out a uniform mix of previously designed proportions and to maintain this mix. The machine shall be equipped with screens and bins.

Proportioning may be done by weight or volume and must be accurate. The asphalt may be done by weight or volume and must be accurate. The asphalt storage tanks shall be protected from open flame and be equipped with an easily read thermometer.

Temperatures shall be controlled in accordance with the following limits:

Penetration Asphalt	Maximum Temperature of Dry Aggregate	Asphalt Storage Temperature	Bituminous Mix at the Pugmill
150-200(A)	160 ^{o}C	120-150 ^{o}C	115-150 ^{o}C

The bituminous aggregate, immediately before entering the pugmill, shall not contain more than one-half percent (1/2%) moisture by weight. In the case of recycled mix, the maximum temperature of the aggregate mix just prior to adding binder, shall be 160 ^{o}C.

The hot mix will be compared to the job-mix formula and the Marshall properties to determine the acceptance of the asphalt concrete product.

b) Quality Control

Before commencing hot mix production, the Contractor shall submit to the Engineer a quality control plan. This plan shall include by whom the tests will be performed and shall state which tests will be performed and at what frequency.

Contractor shall be responsible for the final product of asphaltic concrete production meeting the requirements of these specifications including the approved job mix formula.

The Contractor shall provide copies of all quality control testing to the Engineer.

end of section

2350 **SPECIFICATION FOR THE PLACEMENT OF ASPHALTIC CONCRETE SURFACE COURSE OR FULL DEPTH STRUCTURE**

2350 - 1 GENERAL

The work shall consist of placing asphaltic concrete to a compacted thickness conforming to the lines, grades, and cross-sections as shown on the Plan or as designated by the Engineer.

2350 - 2 MATERIALS

As specified in Specification 2325.

2350 - 3 CONSTRUCTION

The mixture shall be transported from the mixing plant to the work in vehicles with tight metal bottoms previously cleaned of all foreign materials. When directed by the Engineer, the vehicle shall be suitably insulated and each load shall be covered with canvas or other suitable material of sufficient size to protect it from weather conditions. The inside surface of all vehicles may be lightly lubricated with a thin oil or soap solution prior to loading, but excess lubricating will not be permitted.

The mixture shall be laid with a mechanical selfpowered spreader capable of spreading the mixture true to line, grade and crown as required. The paver shall be equipped with hopper and distributing screw of the reversing type to place the mixture evenly in front of adjustable screeds. The paver shall be equipped with an adjustable strike off screed of such design that drag marks will be eliminated and with built-in tamping bars for compaction during spreading.

The Bituminous Mixture shall not be spread when the air temperature is less than 2 °C. The asphaltic concrete mixture shall only be laid on a base which has been approved by the Engineer. The Contractor shall remove all loose and foreign material and water. The mixture shall be delivered at a minimum temperature of 110 °C and a maximum temperature of 150 °C.

The mixture shall be laid and rolled to the widths and thicknesses shown on the drawings or as directed by the Engineer. The finished surface shall have the minimum number of longitudinal joints practicable.

Where a pavement greater than 80 mm thick is specified, it shall be laid in two lifts. The second lift shall not be placed over the bottom layer until the temperature is 60 °C. Where a pavement which is 80 mm or less in thickness is specified, it may be laid in one lift and rolled to the required thickness. Before rolling is started, the surface shall be checked, inequalities in depth adjusted and fat spots or sandy accumulations replaced and irregularities in alignment or grade along the outside edge shall be corrected. The Contractor shall provide competent workmen to correct irregularities as outlined. The paver shall operate on a schedule approved by the Engineer, but in no lane for more than one day before the adjacent lane is placed.

A constant supply of hot asphalt must be supplied so that there is no delay in work. Otherwise, if the temperature of the uncompacted mat cools below 110 °C, the Contractor shall cut back the mat to the graded and compacted area.

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

Except when otherwise required to fill the complete concrete gutter section, remove asphalt entirely from the gutter section and round out the edge of the asphalt mat adjacent to the face of gutter before the mat is rolled or compacted.

A continuous well-sealed bond is required between old and new surfaces. The contact surface of all longitudinal joints shall be painted with a thin and uniform coat of hot asphalt primer before placing the new mix. Where the asphaltic concrete material is placed in two layers, longitudinal joints in the two layers shall be staggered by a minimum of 150 mm.

When matching a longitudinal joint to a previously laid mat, an overlap of not less than 25 mm nor more than 75 mm shall be made. The depth of the overlapping mat should be enough so that subsequent compaction after rolling will bring the new mat down only to the level of the adjacent mat.

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. Rollers shall be operated by competent and experienced personnel. Vibratory rollers shall not be used on soil cement base.

All rolling shall proceed as directed by the Engineer, but in general, shall be longitudinal. Alternate trips of the rollers shall be slightly different lengths.

The motion of the rollers shall be slow enough at all times to avoid displacement of the hot mixture. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause shall be corrected immediately by the use of lutes and fresh mixture when required.

Where new pavement structure abuts the existing pavement surface that is 100 mm thick or greater, the Contractor shall cold plane 50 mm of existing surface for a distance of a minimum two (2) metres to allow the top lift to be placed across the construction joint. The end of the milled joint shall be produce a straight line across the paved surface with a vertical face to pave to. For existing pavement surfaces less than 100 mm thick, sawcutting is acceptable. The finished surface across the joint shall be smooth, such that when a three (3) metre straight edge is placed across the joint, no gaps appear between the straight edge and the pavement edge.

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

The breakdown rolling shall take place as closely behind the laying machine as the temperature and condition of the mat will allow. If used, pneumatic tire rolling will be made with the tire pressure at a level such that only light rutting is evident. Maximum densities are attained when tire pressures are raised as rapidly as the mix stability will permit. Pneumatic rolling shall continue until two complete coverages have been made by the roller with the tire pressure at 850 kPa for collector, industrial and arterial roads and 600 kPa for residential roads. Pneumatic rolling is to be completed before the temperature of the placed mix falls below 95 °C.

Steel tire rolling - For final rolling, a steel tire roller shall be used. After final rolling of the surface course, the asphalt shall meet the gutter at an elevation of 10 mm above and along the entire lip of the gutter except on the high side of superelevation curve where it shall be flush with the lip of the gutter. Final rolling shall be carried on until all roller marks are eliminated and no further compaction is possible.

Sufficient rollers must be maintained on job site to insure full compaction of asphalt mix before temperature of mix falls below 95 °C.

The asphaltic finished surface shall be true to the required profile and cross-section, with a tolerance of ± 5 mm from the required elevations. The finished grade shall neither be consistently high or low from the design grade. The surface shall show no depressions or bumps exceeding 5 mm under a straight edge three 3 m (minimum) long, placed parallel to the road centre line.

Where water valve boxes or manholes are rebuilt, constructed, raised or lowered and/or adjusted in conjunction with surface construction or renewal, adjust the appurtenances such that the top surface of the appurtenance is flush with the finished grade of the pavement, sidewalk or boulevard.

After placing, rolling and compacting the asphalt, depressions or bumps measured centerline to the top of the appurtenances under a straight edge a minimum of 3m long placed parallel to the road are not to exceed:

Appurtenance	Depression	Bump
water valve boxes	10 mm	5 mm
floating manholes	5 mm	5 mm
solid manholes	10 mm	5 mm

Bumps exceeding 5 mm are not allowed.

Any uplifting or settlement of water valve boxes and/or manhole frames shall be corrected to conform to this specification.

The average asphalt concrete thickness must meet or exceed the required thickness and in no case shall any individual core thickness be thinner than 5 mm of the required thickness.

When deviations in excess of the above tolerances are found the pavement surface shall be corrected by methods satisfactory to the engineer.

The completed pavement shall have an average density of ninety-eight percent (98%) and in no case shall any individual density test be less than ninety-six percent (96%) of the laboratory compacted density as determined by ASTM Designation D1559 or AASHTO T245, Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus, using a compaction of fifty blows for each face. The intent is that a long term durable product be provided.

The field density shall be taken in accordance with ASTM D2950, Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.

No traffic shall be allowed on the finished surface until it has cooled to 60 °C or until permitted by the Engineer.

Quality Control

Before commencing hot mix production, the Contractor shall submit to the Engineer a quality control plan. This plan shall include by whom the tests will be performed and shall state which of the following components of the test will be performed and at what frequency.

Contractor shall be responsible for the placement of asphaltic concrete meeting the requirements of these specifications.

2390 **SPECIFICATION FOR CRACK SEALING**

2390 - 1 GENERAL

The work shall consist of preparing and sealing cracks an excess of 2 mm width of as determined by the Engineer. All decisions concerning the extent of sealing required are final.

An inspection shall be made in late spring of the year following completion of the pavement. Any cracks which warrant sealing at the time of inspection, plus any cracks which develop and warrant sealing until the time of sealing, shall determine the extent of the sealing required.

2390 - 2 MATERIALS

The crack sealant shall be a high quality asphalt - rubber sealant which meets requirements of ASTM D-3405 such as Crafco Asphalt Rubber Plus or approved equal capable of providing long life, healability, low service temperature flexibility and high service temperature resistance to flow.

2390 - 3 CONSTRUCTION

Cracks and joints shall be cleaned using appropriate routing, sawing, brushing, blowing, or other techniques to provide intact bonding faces which are free of moisture, dust, or other contaminants.

Cracks shall be widened using a router to form a sealant reservoir which is 10 mm wide and 20 mm deep. The routed cracks should then be cleaned with compressed air heated to 815 ^{0}C to remove all dust and free all moisture and then sealed in such a manner that the sealant is surface level upon cooling.

The sealant shall be applied using a melter-applicator unit. The melter-applicator unit shall be a self-contained double boiler device with the transmittal of heat through a liquid having a minimum flash point of 315 ^{o}C. It must be equipped with an on board automatic heat controlling device to permit the attainment of a pre-determined temperature, then, maintain that temperature as long as required. The unit shall also have a means to vigorously and continuously agitate the sealant. The sealant shall be applied to the pavement under pressure supplied by a positive displacement pump.

The cracks must be sufficiently dry to permit bonding of the sealant. The contractor shall ensure traffic is not permitted on the newly sealed surface for a period of one (1) hour from completion of the crack sealing.

2400 **SPECIFICATION FOR PORTLAND CEMENT CONCRETE PAVEMENT**

2400 - 1 GENERAL

This Specification shall cover the preparation of Portland Cement Concrete for, and all concreting operations relating to, the construction of Portland Cement Concrete pavements, curbs, gutters, private approaches, bullnoses, median slabs and other related concrete works.

The work to be done by the Contractor under this Specification shall include the supply of all materials, and the furnishing of all superintendence, overhead, labour, equipment, tools, supplies and all other things necessary for and incidental to the satisfactory performance and completion of all work as hereinafter specified.

Where a Standard is referenced in this Specification, the current version of that Standard shall apply.

2400 - 2 MATERIALS

a) General

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

b) Cement

All cement shall be either Type 10 Normal Portland Cement or Type 30 High Early Strength Portland Cement conforming to the requirements of CAN/CSA-A5.

Cement shall be kept in weatherproof storage that will protect it from moisture and contamination, and in such a manner as to permit inspection, sampling and identification, where required, of each lot.

Check tests of cement which has been previously approved by the Engineer, will be made from time to time by the Engineer and any cement which fails to comply with the requirements of CAN/CSA-A5 will be rejected, notwithstanding any certificate of acceptance that may have been previously given. Cement which has been rejected must be removed immediately by the Contractor.

c) Pozzolans

Pozzolanic materials such as Fly Ash shall conform to CAN/CSA-A23.5-M86, Supplementary Cementing Materials. The mass of the pozzolan shall not exceed 20% of the total mass of Cementitious Material. Its use shall be limited to concrete placed not earlier than May 1, nor later than September 15, of each work season.

d) Water

Water used for mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances. It shall be equal to potable water in physical and chemical properties.

e) Aggregates

The Contractor shall furnish in writing to the Engineer the location of the sources where aggregate will be obtained in order that same may be inspected and tentatively approved by the Engineer. Changes in the source of aggregate supply during the course of the contract will not be permitted without notification in writing to and the express approval of the Engineer.

1. Fine Aggregate

Fine aggregate shall conform to the requirement of CAN/CSA-A23.1-M90, Section 5, Aggregates.

2. Coarse Aggregate

Coarse Aggregate shall conform to the requirements of CAN/CSA-A23.1-M90, Section 5, Aggregates.

The grading of coarse aggregates shall conform to the requirements of Table 2, Group 1 Aggregate, CAN/CSA-A23.1-M90.

f) Admixtures

No admixture, other than Air-Entraining Agent and Type WN Water-Reducing Agent, shall be used without the written authorization of the Engineer, unless otherwise specified in the Special Provisions.

The air entraining agent shall conform to the requirements of CAN3-A266.1-M78. The water-reducing agent shall be Type WN and shall conform to the requirements of CAN3-A266.2-M78.

g) Storage of Material

All materials shall be handled in a careful and workmanlike manner, to the satisfaction of the Engineer. Storage of materials shall be in accordance with the requirements of CAN/CSA3-A23.1-M90, Section 9, Storage of Materials, except as otherwise specified herein.

h) Incidental Materials

1. Joint Sealer

The joint sealer shall be a hot-poured elastic type and shall conform to the requirements of ASTM Standard D 3405, Specification for Joint Sealants, Hot-poured, for Concrete and Asphalt Pavements.

2. <u>Fibre Joint Filler</u>

Fibre joint filler shall be rot-proof and of the preformed, non-extruding, resilient type made with a bituminous fibre and shall conform to the requirements of ASTM Standard D 1751, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

3. <u>Reinforcing Steel</u>

All reinforcing steel shall be supplied according to the type and dimensions as shown on the Drawings.

All reinforcing steel shall conform to the requirements of CSA Standard G30.12-M, Billet-Steel Bars for Concrete Reinforcement. If, in the opinion of the Engineer, any reinforcing steel provided for the concrete works exhibits flaws in manufacture or fabrication, such material shall be immediately removed from the site and replaced with acceptable reinforcing steel.

The reinforcing steel shall be supplied in accordance with the following requirements:

-Tie Bars shall be Grade 40 deformed bars.
-Dowel Bars shall be Grade 40 plain bars.
-Bar Accessories shall be of a type approved by the Engineer.

All reinforcing steel shall be straight and free from paint, oil, mill scale and injurious defects. Rust, surface seams, or surface irregularities will not be cause for rejection provided that the minimum dimensions, cross-sectional area and tensile properties of a hand wire-brushed specimen are not less than the requirements of CSA Standard G30.12M.

Epoxy Coating material shall be Scotchcote 213, fusion bonded epoxy coating as manufactured by the 3M Company or approved alternate.

The coating shall meet the following general requirements:

i. ASTM G14-72 Impact Resistance of Pipeline Coatings - Falling Weight Test.

ii. FHWA - NEEP No. 16

iii. ASTM C-1044-73 Resistance of Transparent Plastics to Surface Abrasion.

iv. ASTM G17-72 Penetration Resistance of Pipeline Coatings.

v. ASTM G8-72 Cathodic Disbonding of Pipeline Coating.

Coating thickness shall be 175 $\pm$ 50 Micrometres.

Continuity of Coating:

-The coating shall be checked visually after cure for continuity. It shall be free from holes, voids, contamination, cracks, and damaged areas.

-The coating shall not have more than two holidays (pinholes not visible to the naked eye) in any linear foot of the coating bars. Holiday checks shall be made with a 67-1/2-volt holiday detector in accordance with the manufacturer's instructions.

-In the event that construction methods and techniques result in damage to the continuity of the epoxy coating on reinforcement steel, such as might occur through field bending of longitudinal tie bars, such damage shall be repaired using the same type of epoxy coating material as was used in the original coating operation.

4. <u>Liquid Membrane-Forming Curing Compound</u>

Curing compound shall be white-pigmented liquid membrane-forming curing compound conforming to the requirements of CGSB Standard 90-GP-la.

5. <u>Polyethylene Film</u>

Polyethylene film shall be clear or white opaque and conform to the requirements of ASTM Standard C171.

6. <u>Form Coating</u>

Form coating shall be of a type approved by the Engineer.

7. <u>Miscellaneous Materials</u>

Miscellaneous materials shall be of the type specified on the Drawings or approved by the Engineer.

i) <u>Design Requirements</u>

1. <u>Mix Design Statement</u>

For each type of concrete to be used, the Contractor shall provide the Engineer with a Mix Design Statement certifying the constituent materials and mix proportions that will be used in the Portland Cement Concrete. The Contractor shall also supply evidence to the Engineer that the mix proportions selected will produce concrete of the specified strength, workability and yield.

A water-reducing agent as approved by the Engineer and not exceeding the manufacturer's recommended quantity may be used. Where additional dosage of admixture is required, written approval shall be obtained from the Engineer.

This Mix Design Statement shall be submitted to the Engineer at least one (1) week prior to the delivery of any concrete to the job site. Once approved by the Engineer, all concrete shall be supplied in accordance with this Statement, which shall be called the Job Mix Formula.

No changes in the Job Mix Formula will be permitted without following the above procedure.

2. Concrete Strength and Workability

Proportioning of fine aggregate, coarse aggregate, cement, water, air-entraining agent and water-reducing admixture shall be such as to yield concrete having the required strength and workability, as follows:

Concrete for Pavements, Commercial Approaches, Curb and Gutter Sections, Curbs and Bullnoses

Specified Compressive Strength @ 28 days of 32 MPa

Minimum Cementitious Materials content = 320 kg/m^3
Type 10 or Type 30, portland cement, including no more than 20% by mass of approved pozzolan.

Maximum Water/Cement Ratio = 0.45

Maximum Slump = 80 mm

Aggregate Size: Maximum 28 mm nominal
Air Content: 6.5% $\pm$ 1%

3. Concrete for Early Opening of Pavements

It shall be the responsibility of the Contractor to modify the mix design, as required, in order to ensure that the minimum compressive strength of the concrete pavement is 20 MPa and is achieved within the early opening requirements of the Contract.

The mix design statement for this concrete shall be submitted to the Engineer in accordance with 2400-2-i Design Requirements of this Specification. Either Type 10 or Type 30 Portland Cement may be used in attaining this higher earlier strength. Other conditions of 2400-2-i, Design Requirements, shall apply.

The concrete cylinders used to test the compressive strength of the concrete pavement for the purpose of determining the early opening requirements shall be placed in a curing box and shall remain on site near the location in which the concrete pavement was placed until the cylinders are to be tested. Samples for quality control shall continue to be lab cured and tested.

j) Supply of Materials

1. Concrete Supply

Unless otherwise specified in the Special Provisions of the Contract, the use of a ready-mixed concrete plant only will be permitted. Concrete shall be proportioned, mixed and delivered in accordance with the requirements of CAN/CSA-A23.1-M90, Section 18, Production of Concrete, except that the transporting of ready-mixed concrete in non-agitating equipment is not permitted without the written permission of the Engineer.

The discharge of ready-mixed concrete from the transit mixer shall be completed within 1 1/2 hours after the introduction of the mixing water to the cement and aggregates, unless an extension of time is authorized by the Engineer.

All delivery tickets shall indicate the time of batching.

The Contractor shall maintain all equipment used for handling and transporting the concrete in a clean condition and proper working order.

2400 - 3 CONSTRUCTION

a) Equipment

All equipment shall be of a type approved by the Engineer. The equipment shall be in good working order, kept free from hardened concrete or foreign materials, and shall be cleaned at frequent intervals.

The Contractor shall at all times have sufficient standby equipment available on short notice.

b) Sub-grade, Sub-base and Base Course Construction

No concrete work shall commence until the construction of sub-grade, sub-base course and granular base course has been completed and has been approved by the Engineer.

Granular base course shall be specified by the Engineer.

c) Forms

Forms for concrete shall be constructed of steel or wood and shall be sufficiently rigid to prevent lateral or vertical distortion from the loading environment to which the forms will be subjected. All forms shall be set to the design grades, lines and radii as shown on the Drawings. Forms shall be adequately anchored and firmly set in continuous contact with the compacted sub-base to prevent displacements during concrete placement. All formwork in place shall be subject to inspection and correction of grade and alignment prior to, and at any time during, concrete placement.

The surfaces of all formwork to come in contact with the concrete shall be thoroughly cleaned and treated with form coating before concrete placement. The form coating shall be applied by brush or spray so as to give the forms an even coating without excess or drip, and shall not be allowed to get on any reinforcing steel. The form coating shall not cause a softening or permanent staining of the concrete surface and, further, it shall not impede the proper functioning of the curing compound.

Forms shall not be removed for a period of at least twenty-four (24) hours after the concrete placement has been completed. Removal of forms shall be done in a careful and workmanlike manner in order to avoid damage to, or spalling of, the concrete.

Placement of Portland cement concrete pavement by formed methods shall be permitted only at locations designated on the Drawings and areas too small to permit slip form paving.

Forms shall be of suitable cross section and strength and adequately secured 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 of shaped steel sections and shall be of a depth at least equal to the edge thickness of the work prescribed and shall have a base equalling 80 percent of the height of the form with a minimum base width of 150 mm. The forms shall be free from warps, bends or kinks. Approved flexible forms shall be used for construction where the radius is 60 metres or less.

d) Placing Reinforcing Steel

All reinforcing steel shall be positioned as shown on the Drawings and shall be held in place by positive and satisfactory means so that the correct position of the reinforcing steel will be maintained after the concrete has been placed, vibrated and finished. If reinforcing steel is displaced during concrete placing operations, concrete placement shall cease and shall not resume until the displaced reinforcing steel has been reset to its true design position.

Once all reinforcing steel is in position, it shall be inspected and approved by the Engineer before any concrete is placed. Otherwise the concrete will be rejected by the Engineer and shall be removed by the Contractor at his own expense.

Where the Drawings call for a new slab to be tied to an existing slab, the Contractor shall install tie-bars into the existing slab in the following manner.

Holes 16 mm in diameter and a minimum of 230 mm deep shall be drilled into the existing pavement at the spacings shown on the Drawings. Particular care shall be taken to ensure that no damage to the pavement results from such drilling operation. Any damage shall be repaired at the Contractor's expense to the satisfaction of the Engineer.

Holes shall be thoroughly cleaned and dried prior to installation of epoxy. Epoxy, as approved by the Engineer, shall be mixed in accordance with manufacturer's instructions.

Using a method approved by the Engineer, the hole shall be thoroughly coated with epoxy. A 15 M tie-bar shall then be driven into the prepared hole.

e) Joints

Contraction, isolation and construction joints shall be constructed, where required, in accordance with details shown on the Drawings or as directed by the Engineer. All joints in pavement slabs shall be vertical and continuous through the curbs.

Isolation joints shall be constructed only where directed by the Engineer. A 15 mm thick fibre joint filler shall be installed in isolation joints. The fibre joint fill shall extend from the base of the concrete slab up to 10 mm below the concrete surface. All isolation joints shall be edged with an approved tool to assure no concrete bridges across the joint filler.

Where concrete is to be placed against an existing pavement structure, the joint shall be constructed as shown on the Drawings, or as directed by the Engineer.

Contraction joints shall be saw cut by approved methods to the dimensions shown on the Drawings as soon as the concrete is sufficiently hard so that it will not be ravelled or damaged by the Blade. The time at which all such saw cutting is to be undertaken shall be determined by the Contractor, normally within 6 to 24 hours after placement. The Contractor shall be wholly responsible for all concrete defects arising from this operation and shall further correct or replace all such defective concrete as may be required in the opinion of the Engineer. The costs of all corrective measures shall be borne entirely by the Contractor and rejected concrete shall be removed by and at the expense of the Contractor clear of the site of the work.

Immediately after the sawing of each joint, the joint and the pavement surface shall be cleaned of all residue left by the sawing operation. When the joint is wet cut, the cleaning shall be done by water jet having sufficient volume and pressure to remove the residue. Alternative methods of cleaning joints which have been wet cut must be approved by the Engineer. When the joint is dry cut, the cleaning shall be done by air jet having sufficient volume and pressure to remove the residue.

Longitudinal joints shall be either formed or saw-cut. When longitudinal joint is saw-cut, the Contractor shall ensure that any residue cleaned from the longitudinal joint does not go into the previously cleaned contraction joints.

f) Concrete Placement

No concrete shall be placed until the Engineer has examined and approved the layout of the forms, dowels, tie bars and joints, and the condition and grade of the compacted base course. Concrete placement may not proceed when ambient air temperatures are below 5 °C.

The placing of concrete on a base course which is too wet or too dry, or which is frozen, will not be permitted. The prepared grade shall be sufficiently moist to prevent absorption of water from the freshly placed concrete, but must be free from mire or water pondage. The temperature of the fresh concrete shall not be less than 10 °C nor greater than 30 °C, as measured at time of placing.

Concrete delivery vehicles will not be permitted to travel on the prepared base if, in the opinion of the Engineer, damage to the base is observed to occur.

Concrete shall be placed within 90 minutes of batching and before it has taken its initial set. Retempering will be permitted only under the conditions specified in Section 18.4.3, Control of Slump and Air Content, of CAN/CSA-A23.1-M90.

Concrete shall be deposited in the forms as nearly as practicable to its final position in a rapid and continuous operation in such a manner as to require as little rehandling as possible and to avoid segregation and separation of the materials.

The deposited concrete shall be spread by means of a mechanical spreader or by an approved hand method. The surface of the concrete shall then be struck off by mechanical means in a manner such that when the concrete is vibrated and screeded the finished concrete will conform to the cross-section and elevation shown on the Drawings.

In areas inaccessible to mechanical equipment, after the concrete has been vibrated, the surface of the concrete shall be struck-off manually with appropriate tools and in an approved manner so that the concrete will conform to the cross-section and elevation shown on the Drawings. Neat cement or mortar shall not be used to facilitate the finishing surfaces.

Mechanical vibrators only shall be used to consolidate the concrete. Spading, hand tamping, using puddling rods, or using other similar methods will not be permitted in place of vibration.

Concrete shall be worked thoroughly around any reinforcement, and around embedded fixtures and into the angles and corners of the forms. During placement, concrete shall be sufficiently vibrated with suitable equipment to secure close bond with the reinforcement, to eliminate entrapped air voids, and to ensure a homogeneous structure and adequate consolidation. Particular care shall be given to placing and vibrating the concrete along the faces of the forms to ensure a dense, smooth surface devoid of imperfections.

Once the placing and vibrating of the concrete has been completed, the forms, shall not be jarred, and any projected reinforcing steel shall not be disturbed, for a period of at least twenty-four (24) hours.

If a slip form paving machine is used for concrete placement, it shall be of a size and type adequate to handle the width and thickness of the concrete pavement to be constructed. The slip form paver shall distribute the fresh concrete evenly to the required grade without segregation and without disturbing the reinforcing steel. The concrete shall be thoroughly consolidated by means of vibrators, struck off to exact grade, and given a float finish, all automatically and continuously by the machine. The machine shall be equipped with automatic controls capable of controlling both the elevation and direction of the machine within a tolerance of 5 mm from the specified grade and alignment.

The Machine Placed Portland Cement Concrete shall be placed by slip form pavers. The paver and related equipment, shall place the pavement to the full depth, width, crown, and grade shown on the Drawings.

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 250 mm wide and 6.5 metres 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. 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. Where it is necessary to operate the paver on adjacent pavement, the propelling mechanism must be rubber tired or the pads of the paver protected to prevent damage to the pavement.

The paver shall be equipped with:

1. A mechanically operated primary strike-off which conveys 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 VPM.

3. An extrusion plate not less than 1 metre in width (measured longitudinally with the pavement); set with its leading bullnosed edge higher than the trailing edge so that the concrete is extruded under compression.

4. A rubber belt no less than 600 mm wide, set behind the oscillating extrusion plate and operated with a lateral movement of 100 mm to 200 mm.

5. A suitable mechanism to provide automatic control of line and grade while sensing a grade line.

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 which will 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 15 vertical to 1 horizontal. The forms shall be of sufficient length that the concrete will remain 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 written approval by the Engineer prior to their use.

g) Edge slump

Edge slump shall be controlled to less than 15 mm except where abutting pavement is to be placed adjacent to that edge. In such cases, edge slump shall be restricted to less than 8 mm.

h) Concrete Finishing

Before initial set has begun, the sequence of operations shall be the strike off and consolidation floating if necessary, straight-edging, and final surface texturing.

After the pavement has been consolidated and struck off, it shall be scraped with a 3 metre long straight-edge equipped with a handle to permit operation from the edge of the pavement. The straight edge shall be operated parallel to centre line of the pavement and shall be moved forward one-half to length after each pass across the slab width. Irregularities shall be corrected by adding or removing concrete. All disturbed areas shall be again straight-edged. The use of long handled bull-floats shall be confined to a minimum; they may be used in areas not accessible to finishing equipment or in emergency situations.

Following straight-edging, the edges of all concrete placed shall be carefully finished with an appropriate edging tool. The entire surface shall be textured by a steel or fibre broom or a type approved by the Engineer drawn across the plastic concrete surface at right angles to the direction of traffic. Surface depressions introduced by brooming operations shall not be more than 3 mm deep.

i) Concrete Curing

Immediately following concrete finishing, the surface of the concrete shall be treated with a liquid membrane-forming curing compound. The rate of application shall not be less than that recommended by the manufacturer. The Contractor shall be responsible for assuring complete coverage of all exposed concrete surfaces.

As soon as the side forms are stripped, the edges of all concrete slabs shall be sprayed. In the case of slip form paving, the edges shall be treated at the same time as the pavement surface. Care should be taken not to apply curing compound to exposed reinforcing steel.

Liquid membrane-forming curing compound shall not be used when the pavement is otherwise protected from cold weather by polyethylene film.

j) Joint Sealing

The joints shall be thoroughly cleaned of all dirt, loose mortar particles and other foreign material lodged in the joints.

After this cleaning and immediately before applying the joint sealer, the joint shall be blown out with an air jet having sufficient volume and pressure to remove dust and loose material remaining after the cleaning operation.

The joint shall then be filled with joint sealer to the depth shown on the Drawings. Overfilling of joints shall be avoided.

The joint must be surface dry at the time of filling, and the ambient temperature must be at least 4 °C and rising.

k) Climatic Conditions

The Contractor shall be responsible for taking all necessary measures to protect freshly laid concrete from climatic conditions including hot weather, wind, rain, sleet, snow and cold weather, to the satisfaction of the Engineer.

Concrete shall be adequately protected from freezing for a minimum of seven (7) days after completion of placing operations, or longer as required to ensure that the pavement opening requirements of this Specification are met. Protection shall be provided such that the surface of the concrete is maintained a minimum temperature of 10 °C for the period specified.

Concrete damaged as a result of inadequate protection against climatic conditions shall be removed and replaced by the Contractor at his own expense.

l) Opening to Traffic

In no case shall traffic or construction equipment be allowed on the pavement until the concrete has reached a minimum compressive strength of 20 MPa as determined by field cured cylinders.

If an early opening requirement is included in the Contract, a compressive strength of 20 MPa shall be attained within the specified opening time.

Also, before the pavement may be opened to traffic and/or before the Contractor may commence boulevard grading operations, the pavement joints shall be filled with joint sealer in accordance with 2400-3-J Joint Sealing of this Specification.

The Engineer's decision as to when the pavement will be opened to traffic or construction equipment shall be final.

2400 - 4 ACCEPTANCE

a) Inspection, Testing and Approval

All workmanship and all materials furnished and supplied under this Specification are subject to close and systematic inspection and testing by the Engineer or by the Testing Laboratory designated by the En0gineer including all operations from the selection and production of materials through to final acceptance of the specified work. The Contractor shall be wholly responsible for the control of all operations incidental thereto notwithstanding any inspection or approval that may have been previously given. The Engineer reserves the right to reject any materials or works which are not in accordance with the requirements of this Specification.

There shall be no charge to the Owner for any materials taken by the Engineer for testing purposes.

Testing, frequency and interpretation of tests on all materials shall conform to CAN/CSA-A23.1-M90 or as superceded in this Specification.

All materials shall be approved by the Engineer at least ten (10) days before any construction is undertaken. If, in the opinion of the Engineer, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such materials shall be rejected by the Engineer and replaced by the Contractor at his own expense.

b) Access

The Engineer shall be afforded full access for the inspection and control testing of concrete and constituent materials, both at the site of work and at any plant used for the production of concrete, to determine whether the concrete is being supplied in accordance with this Specification.

c) Materials

All materials shall conform to CAN/CSA-A23.1-M90.

d) Concrete Quality

Quality control tests will be used to determine the acceptability of the concrete supplied by the Contractor.

The Engineer shall obtain samples of concrete and of the constituent materials required for quality control tests.

The frequency and number of concrete quality control tests shall be determined by the Engineer but not less than stated in the requirements of CAN/CSA-A23.1-M90.

An outline of the quality control tests is as follows:

Samples of concrete for all slump, air and strength tests shall be taken in accordance with CAN/CSA-A23.1-M90 (CSA Test Method A23.2-1C, Sampling Plastic Concrete).

Slump tests shall be made in accordance with CSA Test Method A23.2-5C, Slump of Concrete. If the measured slump falls outside the limits specified in 2400-2-i, Design Requirements, of this Specification, a second test shall be made. In the event of a second failure, the Engineer reserves the right to refuse the use of the batch of concrete represented. A slump test will be made with every strength test.

Air content determinations shall be made in accordance with CSA

Test Method A23.2-4C, Air Content of Plastic Concrete by the Pressure Method. If the measured air content falls outside the specified limits, a second test shall be may at any time within the specified discharge time limit for the mix. In the event of a second failure, the Engineer reserves the right to reject the batch of concrete represented. An air determination shall be made with every strength test.

Test specimens shall be made and cured in accordance with CSA Test Method A23.2-3C, Making and Curing Concrete Compression and Flexure Test Specimens.

Compressive strength tests of laboratory cured cylinders at twenty-eight (28) days shall be the basis for acceptance of all concrete supplied by the Contractor. For each twenty-eight (28) days strength test, the strength of two companion standard-cured test specimens shall be determined in accordance with CSA Test Method A23.2-9C, Compressive Strength of Cylindrical Concrete Specimens, and the test result shall be the average of the strengths of the two specimens. Reduced payment for understrength concrete shall be made in accordance with Specification 2500.

Compressive strength tests on specimens cured under the same conditions as the concrete works shall be made to check the strength of the concrete so as to determine if the pavement may be opened to traffic; and also to check the adequacy of curing and/or cold weather protection. For each field-cured strength test, the strength of two field-cured test specimens shall be determined in accordance with CSA Test Method A23.2-9C, Compressive Strength of Cylindrical Concrete Specimens, and the test result shall be the average of the strengths of the two specimens.

e) Addition of Water

For low-slump concrete used in slip formed paving only, water may be added to the transit mixer only under the supervision of the supplier's testing laboratory, provided the requirements for concrete quality are maintained. Once water is added the mixer drum shall be rotated 30 times at mixing speed and the slump and air tested before discharge.

f) Corrective Action

Acceptance criteria for compressive strengths of laboratory cured cylinders shall conform with Sections 17.5 and 17.6 of CAN/CSA-A23.1-M90. The Contractor shall, at his own expense, correct such work or replace such materials found to be defective under this Specification in an approved manner to the satisfaction of the Engineer.

2500 **SPECIFICATION FOR THE SUPPLY OF PORTLAND CEMENT CONCRETE**

2500 - 1 GENERAL

These specifications cover the requirements for the supply of Portland Cement to be used for all concrete work unless otherwise specified. The constituent materials - cement, aggregates, water and admixtures shall conform to the requirements of this specification. Where a Standard is referenced in this Specification, the current version of that Standard shall apply.

2500 - 2 MATERIALS

a) Cements and Supplementary Cementing Materials

1) Portland Cement

All cement shall be either Type 10 Normal Portland Cement or Type 30 High Early Strength Portland Cement or Type 50 Sulphate Resistant Portland Cement conforming to the requirements of CSA Standard A5.

2) Supplementary Cementing Materials

Use of Type C Flyash, conforming to the requirements of CSA Standard A23.5, is permitted as follows:

.1) Not more than 20% of the mass of the total cement material content may be replaced with flyash.

.2) Submit together with the mix design, test results on concrete with flyash.

.3) After September 15, no portion of the total cement material content may be replaced with flyash.

b) Aggregates

1) Fine and coarse aggregates shall conform to the requirements of CSA Standard A23.1, Section 5.

2) The nominal size of coarse aggregates shall be 20 mm as per Section 5.4.2, Table 2.

3) The maximum aggregate size for Low Shrink Material shall be 6mm.

4) The maximum allowable shale content in the aggregate shall not exceed one half of one percent.

Representative samples of all aggregates proposed for use shall be submitted, when requested, to the Engineer sufficiently in advance of the commencement of operations to permit carrying out the required test.

c) Water

Shall be clear and free from injurious amounts of oil, acid, alkali, soluble chlorides, organic matter, sediment or any other deleterious substances.

d) Admixtures

These admixtures shall conform to the latest requirements of CSA Standard A23.1. Other admixtures shall not be used, unless specified herein, without the written approval of the Engineer. The manufacturer shall ensure that any additives used are compatible with the cement and with each other.

1) Air-entraining: Shall conform to the requirement of ASTM Standard C260.

2) Chemical: Shall conform to the requirement of ASTM Standard C494.

e) Storage of Materials

Materials are to be stored and handled in accordance with CSA Standard A23.1 Section 9.

f) Strengths and Proportions

The proportions of materials shall be such as to produce a concrete mix which will work readily into the corners and angles of the forms and around the reinforcement.

The Manufacturer is to assume responsibility for the design and production of the concrete mixture in accordance with alternate Number 1, Table 11, CSA Standard A23.1. Section 7.5.7 Compressive Strength Requirements and Section 17.5.8 Failure of Tests to Meet Requirements of CSA Standard A23.1 are superceded by the Strength Tests and Understrength Concrete requirements of Specification 2500 for the Supply of Portland Cement Concrete.

The concrete mixes shall, in addition to any other provisions of these specifications, conform to the following table:

Mix No.	Name and Type of Cement	Minimum Specified 28-day Compressive Strength	Air Content	Maximum Water/ Cementing Materials Ratio By Weight	Specified Slump
	Handformed Concrete				
1	Normal - 10	32 MPa	6.5% ± 1%	0.45	70 mm ± 20 mm
1FH	Flyash - 10	32 MPa	6.5% ± 1%	0.45	70 mm ± 20 mm
1HE	High Early Strength	32 MPa	6.5% ± 1%	0.45	70 mm ± 20 mm
1EA	Exposed Aggregate	32 MPa	6.5% ± 1%	0.45	70 mm ± 20 mm
2	Sulphate-Resistant - 50	30 MPa	6.5% ± 1%	0.50	70 mm ± 20 mm
	Extruded Concrete				
3	Normal - 10	32 MPa	6.5% ± 1%	0.45	30 mm ± 10 mm
3FE	Flyash - 10	32 MPa	6.5% ± 1%	0.45	30 mm ± 10 mm
	Concrete Base				
4	Normal - 10	15 MPa	6% ± 1%	-	100 mm ± 30 mm
4HE	High Early Strength	15 MPa	6% ± 1%	-	100 mm ± 30 mm
4HEES	HE Extra Strength	32 MPa	6% ± 1%	-	100 mm ± 30 mm
	Low Shrink Material				
5	Normal - 10	0.25 - 0.75 MPa	-	-	175 mm ± 30 mm

No concrete shall be placed until the Engineer has received copies of the mix design and has given written approval of its use.

2500-3 CONSTRUCTION

a) Batch Plants

Concrete is to be produced in accordance with CSA Standard A23.1 (Section 18).

b) Delivery and Mixing

Concrete shall be delivered in truck mixers.

The concrete shall be delivered to the site of the work and discharge shall be completed within one and one-half hours after the introduction of mixing water to the cement and aggregates, or the introduction of the cement to aggregates. The allowable concrete temperature at delivery shall be 10 °C to 35 °C.

2500 - 4 ACCEPTANCE

a) Inspection

The Engineer or his representative shall be afforded proper access to inspect ingredients and processes used in the manufacture and delivery of the concrete and for securing samples to determine whether the concrete is being furnished in accordance with these specifications. All tests and inspections shall be conducted so as not to interfere unnecessarily with the manufacture and delivery of the concrete.

Sampling of concrete shall be obtained in accordance with CSA Standard A23.1 (Test Method A23.2-1C).

b) Testing

1) Strength Tests

For standard and accelerated strength tests either 100 mm × 200 mm or 150 mm × 300 mm cylinders shall be used. The size of the cylinder used shall, however, meet the aggregate size limitations as specified in clause 4.2 of CSA Test Method A23.2-3C.

Test cylinders will be used as the basis of acceptance of the concrete compressive strength. Cylinders for strength tests shall be made in accordance to CSA Test Method A23.2-3C. No field cured cylinders will be used as a basis of acceptance. A strength test for any class of concrete shall consist of two standard cylinders made from a sample secured from a single load of concrete in accordance with CSA Test Method A23.2-1C. A total of three test cylinders are to be cast with one cylinder tested at seven days and two tested at twenty-eight (28) days. The test result shall be the average of two (2) specimens at twenty-eight (28) days except that if one specimen in a test shows a manifest evidence of improper sampling, molding or testing, it shall be disregarded. Contrary to Section 17.5.3.1 of CSA Standard A23.1, frequent testing will be conducted as directed by the Engineer.

The Contractor shall apprise himself of the testing procedures used by the Engineer. In the case of discrepancy between the test results of the Contractor and the Engineer, the Engineer's results shall be final.

Coring and testing of defective concrete shall not be considered to be representative of twenty-eight day lab cured cylinder results.

2) Air Content

Air content tests shall be determined in accordance with the most recent edition of CSA Standard A23.1 (Test Method A23.2-7C or A23.2-4C).

The following criteria apply to all mixes numbered 1, 2 and 3. The concrete load shall be rejected if the air content measured is less than 4.4%. If air content is measured between 4.4% and 5.4% the supplier will be allowed to add air to bring it within specification. In this latter event, however, if the initial air content measured in three consecutive loads of concrete delivered falls below 5.4%, the third load shall be rejected and all subsequent loads shall be rejected until initial air content measured is again over 5.4%.

If measured air content exceeds the limit of the specification the supplier may elect to spin the load. If this action brings the load within the specification before the time limit for age of concrete expires, the concrete may be accepted at the discretion of the Engineer.

3) Slump Test

Concrete delivered to the site which exceeds the maximum specified slump shall be rejected. When concrete delivered to the site is less than the specified range of slump additional water may only be injected into the mixture at the discretion of the Engineer. The drum or blades shall be turned an additional thirty (30) revolutions or more if necessary at mixing speed, until the uniformity of the concrete is within the allowable limits.

c) Understrength Concrete

These requirements shall not apply to field-cured specimens.

The strength level of each class of concrete shall be considered satisfactory if the averages of all sets of three consecutive strength tests for that class at one age equal or exceed the specified strength, and no individual strength test is more than 3.5 MPa below the specified strength.

The following remedies shall be applied only when the above criteria are not met. Notwithstanding the options of the Owner set forth in section 17.5.8, Failure of Tests to Meet Requirements of CSA Standard A23.1, the Owner reserves the right, in the Owner's sole discretion, to accept such concrete installed at the place of Work, with or without conditions, and to reduce payment on individual strength tests not meeting the minimum strength within the set of three consecutive strength tests for that class at one age, in accordance with the following:

1) For Mixes No. 1, No. 1FH, No. 1HE, No. 1EA, No. 3, No. 3FE and 4HEES, concrete represented by concrete cylinder tests between 24 MPa and 32 MPa will be subject to payment reduction per cubic metre and concrete represented by concrete cylinder tests below 24 MPa shall be rejected and replaced at the expense of the contractor.

2) For Mix No. 2, concrete represented by concrete cylinder tests between 22.5 MPa and 30 MPa will be subject to payment reduction per cubic metre, and concrete represented by concrete cylinder tests below 22.5 MPa shall be rejected and replaced at the expense of the contractor.

3) For Mixes No. 4 and 4HE, concrete represented by concrete cylinder tests between 12 MPa and 15 MPa will be subject to payment reduction per cubic metre, and concrete represented by concrete cylinder tests below 12 MPa shall be rejected and replaced at the expense of the contractor.

4) Reduction in payment described in (1), (2) and (3) above shall be calculated as follows:

Reduction in Payment

$$= \frac{\text{Specified Strength - Actual Strength}}{\text{Specified Strength}} \times 4.0$$

$$\times \text{ price per cubic metre specified in the contract.}$$

Costs of replacement of rejected concrete shall include removal of the rejected concrete and replacement thereof and all labour, equipment and material costs, including applicable overhead, associated therewith.

No bonus shall be paid for supply of concrete that exceeds the minimum specified strength.

Payment reductions will only apply to those batches that were tested and did not meet the minimum specified strength. Payment reduction will be assessed on the total quantity of the batch. If the delivered quantity is not known, the payment reduction will be calculated on the basis of five cubic metres (5 cum) per batch.

end of section

2550 SPECIFICATION FOR CONCRETE SIDEWALK, CROSSINGS, CURB AND GUTTER

2550 - 1 GENERAL

Concrete sidewalk, sidewalk crossing, curb and gutter, rolled curb and gutter, monolithic walk, curb and gutter, and structural sidewalk shall be constructed in accordance with the following specification and the standard drawings. The type of construction to be used will be shown on the construction plans or as directed by the Engineer and shall be in accordance with the provisions of this section.

The Contractor will be given the option of constructing hand formed sidewalk, curb and gutter at the unit rate bid in the schedule, provided that tie bars are used to tie the walk to the curb and gutter when poured separately. Extruded concrete shall meet the requirements of these specifications.

2550 - 2 MATERIALS

a) Concrete

Concrete shall conform to Specification 2500.

b) Granular Material

Granular Material shall conform to:

Sieve Designation	Percent Passing by Weight
20 mm	100%
12.5 mm	75 - 100%
5 mm	50 - 100%
400 μm	10 - 45%
80 μm	0 - 10%
Plasticity Index	0 - 6

c) Curing Compound

The Compound shall equal or exceed the A.S.T.M. "Specification for Liquid Membrane-Forming Compounds for Curing Concrete", Designation C-309. The water retention efficiency tests shall be carried out in accordance with A.S.T.M. Designation C-156.

The Compound shall adhere to damp concrete having a horizontal or vertical surface and form a continuous film when applied according to the manufacturer's instructions. When dried, the Compound shall not be tacky and must adhere to the concrete surface even under normal pedestrian traffic conditions. The film shall not render the concrete surface slippery. The Compound shall be clear or translucent, resinous base, non-bituminous. It shall contain a fugitive dye, readily distinguishable upon the concrete for at least four hours after application. The colour shall become inconspicuous within seven (7) days of application.

2550 - 3 CONSTRUCTION

a) Excavation and Base

The subgrade shall be excavated in accordance with Specification 2110, Specification 2120, Specification 2130, and/or Specification 2140.

A 50 mm layer of clean gravel or sand bedding shall be used as a levelling material under concrete sidewalks, curb and gutters unless the curb is to be constructed on granular base course. If necessary, granular base course or native earth material (in accordance with their respective specifications) shall be used to raise the subgrade to allow for the 150 mm layer of clean gravel or bedding sand. The requirement for a 150 mm layer of levelling material may be waived if automatic fine-grading equipment is approved in writing by the Engineer or if the levelling course is greater than 150 mm then a granular base course can be used. Automatic grade and line control will be required for the fine-grading equipment.

The base on which the concrete will rest shall be tamped and thoroughly wetted immediately prior to placing the concrete and must not be frozen.

b) Forms

Forms shall be of steel or wood of sufficient strength to resist the pressure of wet concrete, and the supply shall be sufficient to permit their remaining in place not less than twelve (12) hours after concrete has been placed, or longer if the Engineer considers it necessary, unless the surface of the concrete is to be finished. The use of bent, twisted, battered or worn-out forms will not be permitted. Forms may be checked for alignment and elevation by the Engineer before concrete is poured, and shall be cleaned and oiled before each use. Where required, reinforcement shall be secured in the location shown on the drawings and shall be free from scale, grease and rust immediately prior to placing concrete. Forms shall be held securely by approved methods to prevent movement and bulging when the concrete is being placed. Forms must be approved by the Engineer or his representative before concrete is poured. Flexible forms will be required for all curves with a radius of less than 50 m.

c) Depositing of Concrete

All concrete placing methods shall be subject to the approval of the Engineer. Concrete placing shall not be started until the Engineer has inspected and approved all preparations including forms, bedding, reinforcing steel, construction joints, and all mixing conveying, spreading, compacting, finishing, curing and protection equipment. Concrete shall be conveyed from the mixer to the point of deposit as practicable, using means and equipment which will prevent separation or loss of materials.

Concrete shall be deposited in the forms as close as practicable to its final position, and in no case more than 1 m from the point of final deposit in the horizontal or vertical direction.
Special care shall be taken to place the concrete against the forms, particularly in corners, in order to prevent voids, pockets, rough areas and honeycombing. The concrete shall be tamped in such a manner as to work the coarse aggregate away from the forms and exposed surfaces. Vibrators or vibrator speeds used in placing concrete shall be a minimum of 5,000 cycles per minute. Concrete shall be placed continuously until a complete section between expansion joints has been poured.

The concrete shall be thoroughly consolidated against and along the faces of the forms. Hand spreading shall be done with shovels, not with rakes, in order that the concrete will not be separated. Precautions should be taken to prevent overworking of the concrete.

d) Finishing

The surface shall be levelled with a vibrator mounted levelling beam. Special care shall be taken not to over-vibrate the concrete and in no case shall an excess of water be brought to the surface/or added to the surface. The surface shall then be marked in the specified manner and left until the concrete has set sufficiently to permit the finishing operations without causing bleeding. At this time the surface shall be brought to a true surface with a wood-float and a uniform brush finish shall be applied. Final marking of the blocks shall then be carried out leaving blocks with edges rounded or levelled to a radius of not less than 10 mm. The edges of the walk and the lines dividing the walk into sections shall be rigidly straight, joints with ragged edges will not be permitted.

The Contractor shall mark each City block or portion of block with a suitable tool showing the name of the Contractor and the year constructed.

The Contractor shall supply the marking tool and shall mark the sidewalk with the letters "WCB" at each water curb box location. The mark is to be placed 150 mm from the back of the sidewalk.

e) Joints

1. Expansion Joints

Expansion joints are required where specified. This joint shall be 10 mm wide and truly perpendicular. The expansion joint material shall be supplied by the Contractor and approved by the Engineer and shall meet the requirements of A.S.T.M. Designation D1751 or D1752.

No expansion joints shall be placed within 3 m of a service connection lead, catch basin or fire hydrants.

A strip of expansion joint material 10 mm thick and to the full depth of the sidewalk shall be placed around the base of all poles and other isolated places as specified.

2. Contraction Joints

Contraction joints shall be at every 1.5 m by means of a marking tool or other approved method, whose depth shall not be less than 40 mm and width shall not be less than 3 mm. The edge of the joint shall be rounded off with an edger having an arc of a circle having 10 mm as a radius. These joints shall be perpendicular to the longitudinal axis of the sidewalk, curb and gutter and shall extend through the full width of the sidewalk, curb and gutter.

3. Surface Joints

After trowelling, a joint not less than 10 mm deep shall be marked in the surface of the walk as shown on the drawings. The edge of the joint shall be rounded off with an edger having an arc of a circle of a 10 mm radius.

4. Sawed Joints

If required, saw joints shall be made with a special concrete saw capable of producing a true straight joint of constant depth in accordance with Specification 2010.

5. Cold Joints

Cold joints are required at the end of each day's placement of concrete at a contraction joint location. This joint shall be perpendicular to the surface and curb line. Dowels are to be inserted, as shown on the standard drawings, in order to provide a tie to the next pour of concrete.

f) Reinforcing

All curb radii shall be reinforced with two, 10 M reinforcing rods with at least 600 mm of the rod extending, beyond the cold joint, into existing or new curb (to follow). In residential areas, reinforcing in the curb radius may be omitted if the walk, curb and gutter are cast and placed in a monolithic operation. Use reinforcing rod, to bond new to older work at cold joints, in accordance with the pattern shown in Standard Roadway Drawing R-7B - Dowel Detail for Expansion Joints.

All separate rolled curb and gutter constructed adjacent to Commercial or Industrial Zoned Areas shall be reinforced with two 10 M reinforcing rods.

All walk poured as a separate operation behind curb/gutter shall be held in place by 600 mm 10 M bars inserted into the curb and gutter, at 1.5 m on centre (centre line of walk panels).

g) Curing and Protection

After the concrete has been finished to cross-section and as soon as the concrete has set sufficiently, the entire surface shall be sprayed with a concrete curing compound in a manner and in such quantity as will be directed by the Engineer. All concrete surfaces that are left exposed to the air after removal of forms shall be cured in the same manner as described in the immediately above after removal of forms.

No vehicular traffic shall be allowed to cross the crossings for a period of seven days after construction and substantial barricades shall be erected and maintained for this purpose. All freshly laid concrete shall be barricaded with suitable barricades for a period of one day and any damage to the finish of the walks or crossings shall be corrected.

No heavy construction equipment shall be allowed to operate adjacent to the freshly laid concrete for a period of seven (7) days for normal concrete and three (3) days for high early concrete or as approved by the Engineer.

If these corrections are not carried out before the concrete is hardened, repairs shall be made by the Contractor by replacing all damaged walk or curb and gutter. Patching will not be permitted. The forms shall be removed with care, as not to damage the walk or curb. In the event of any defect in construction or finish, the entire sections must be removed on the order of the Engineer.

The Contractor shall maintain on the job sufficient canvas or other suitable covering to protect all freshly laid concrete from the action of the elements.

h) Cold Weather Requirements

When the atmosphere has a temperature lower than 5 °C, all reinforcing materials, forms, and ground with which the concrete is to come in contact shall be defrosted and in no case shall concrete be deposited on or against any surface which is at a temperature of less than 2 °C.

No concrete shall be placed on frozen subgrade (native or granular). If the subgrade is frozen it shall be thawed prior to concrete placement.

Concrete placement and protection shall be limited by the following table. Concrete temperature shall not drop below 10 °C during the curing period. Rapid cooling of the concrete at the end of the heating period is to be avoided.

Outside Minimum Ambient Air temperature	Protective Measures
5 °C to 25 °C	Normal curing - no temperature protection required.
Below 5 °C	Adequate insulation for 7 days to achieve strength specified in CAN/CSA3-A23.1M90 with suitable enclosure or supplementary heat.

The Contractor may request the use of high early strength concrete at his own expense.

All concrete showing evidence of freezing shall be removed from the job and replaced at the Contractor's expense.

j) Hot Weather Requirements

Hot weather is defined for the purpose of this specification as a combination of low relative humidity, windy conditions and high temperatures. The Contractor is advised that the placing of concrete when the evaporation rate exceeds 0.5 $kg/m^2/hr$. (determined from Standard Drawing R-18) results in a substandard product that shall not be accepted. The removal and replacement of such if required would be at the Contractor's expense.
The Contractor shall limit the amount of concrete poured during hot weather to enable the work to be finished to the satisfaction of the Engineer. Surface wetting to facilitate finishing is not permitted. Protective measures to prevent fast setting of the concrete are to be implemented.

k) Inspection

The finished surfaces of all concrete work shall be true to the required cross-section with a tolerance of ± 10 mm from the required elevation and dimensions. Surfaces of curbs, gutters or sidewalks shall not show any depressions or bumps exceeding 5 mm under a straight edge 3 m long, placed parallel to the curb or sidewalk. Concrete not meeting the requirements specified shall be removed to the nearest joint and replaced at the Contractor's expense.

l) Walk Transition

At those corners where the sidewalk width is reduced from 1.5 m to 1.2 m the reduction should be tapered uniformly throughout the entire curve.

m) Driveway Crossings

The depth of the walk shall be increased from 130 mm to 180 mm for any crossings in or adjacent to commercial and/or industrial zone properties. Reinforcing for Commercial and Industrial crossings shall be in accordance with Roadway Standard Drawing R-7A. The payment for the extra 50 mm of concrete required for such crossings shall be included in the tender price for concrete crossing. Reinforcing bar may be required in certain crossings as designated on the plans, Standard Drawings, or by the Engineer.

	Depth
Residential	130 mm
Alley	180 mm
Commercial	180 mm (see R-7A for reinforcing)
Industrial	180 mm (see R-7A for reinforcing)

n) Pedestrian Ramps

Pedestrian ramps shall be installed in all radii according to details set out in City of Regina Standard Drawing R9-A or as approved by the Engineer. Tactile Markings shall be produced by a tool similar in detail to that set out in City of Regina Standard Drawing R-9B.

2600 **SPECIFICATION FOR CONCRETE MEDIAN, BOULEVARD AND ISLAND PAVING**

2600 - 1 GENERAL

The work shall consist of paving the centre median area between the concrete boulevard curbs with 150 mm of selected granular material and 100 mm of Portland Cement concrete.

2600 - 2 MATERIALS

a) Concrete

Concrete shall conform to Specification 2500 and Specification 2550.

b) Granular Material

Granular material shall conform to

Sieve Designation	Percent Passing by Weight
20 mm	100%
12.5 mm	75 - 100%
5 mm	50 - 100%
400 µm	10 - 45%
80 µm	0 - 10%
Plasticity Index	0 - 6

2600 - 3 CONSTRUCTION

The granular material shall be spread and compacted upon the subgrade or finished pavement as shown on the plan for median strip paving. The Portland Cement concrete median paving shall be constructed in accordance with the plan for median strip paving.

2620 **SPECIFICATION FOR THE INSTALLATION OF INTERLOCKING PAVING STONES**

2620 - 1 GENERAL

The work shall consist of preparation of the subgrade, a layer of compacted granular material, a layer of uncompacted bedding sand and the installation of the interlocking paving stones.

2620 - 2 MATERIALS

a) Granular Material

Granular material shall conform to Specification 2600. The base type to be used shall be designated by the Engineer.

b) Bedding Sand

The bedding sand shall consist of a screened or crushed washed sharp sand. The bedding sand shall be free from injurious quantities of soft or flaky particles, shale, loam and organic matter or other deleterious material. Uncompacted thickness of this layer shall be 50 mm or as designated on the plans.

When tested according to ASTM Designation C135, Method for Sieve Analysis, the material shall meet the following gradation requirement.

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
10 mm	100%
5 mm	85 - 100%
160 μm	10 - 30%
80 μm	0 - 3%
Plasticity Index	0 - 6

c) Interlocking Paving Stone

Interlocking paving stones shall be uniform in material, colour, size and from one manufacturer. Paving stones and edging units shall be as designated on the plans or in the Special Provisions of the contract documents.

Interlocking paving stones shall conform to the specification designation ASTM C936.

Compressive Strength	Minimum 55 MPa
Water Absorption	Less than 5%
Freeze/Thaw Testing	Maximum Weight Loss less than 1%
Minimum Thickness	60 mm
Colour	Brown

2620 - 3 CONSTRUCTION

The subgrade shall be prepared and compacted to 95% $\pm$ 2% of the maximum Standard Proctor dry density to within the limits of optimum and three (3%) percent above optimum moisture content to a depth of 150 mm. A 150 mm layer of granular material shall be placed on the subgrade and be compacted to 97% of the maximum Standard Proctor dry density and levelled. A 50 mm layer of uncompacted bedding sand is to be spread over the granular material.

The granular material shall be as set out in Specification 2550.

The paving stones shall be installed on the bedding sand in the specified pattern such that the space or joint between bricks does not exceed 3 mm.

The paving stones shall be tamped down and levelled by means of a mechanical vibrator until they are uniformly level, true to grade and free of any movement. All voids in the joints shall then be filled in by sweeping in dry sharp sand.

If necessary, cutting of paving stones shall be done with a mechanical cutter to obtain a true, even and undamaged edge.

2640 SPECIFICATION FOR LAWN REPAIRS

2640 - 1 GENERAL

Following the completion of all related construction activities, backfilling and seeding of areas as directed by the Engineer or his representative shall be completed.

2640 - 2 MATERIALS

a) Grass Seed Mixtures

Use a grass seed mixture equivalent to the one growing on site or a mixture of:

50% Canada Certified No. 1 Kentucky Bluegrass ('Baron', 'Touchdown', 'Fylking', 'Banff', 'Nugget')

20% Canada Certified No. 1 Creeping Red Fescue ('Boreal', 'Jasper', 'Dawson')

15% Canada Certified No. 1 Chewings Fescue ('Jamestown', 'Victory')

10% Canada Certified No. 1 Hard Fescue ('Aurora', 'Spartan', 'Serra')

5% Common No. 1 Perennial Rye Grass

NOTE: Acceptable cultivars include, but are not limited to, those listed in parentheses. Substitutions for any of the above must be approved by the Engineer.

An alternate mixture may be substituted with the permission of the Engineer, in areas where regular maintenance is doubtful. The mixture will contain:

40% Canada Certified No. 1 Canada Bluegrass ('Reubens')

20% Canada Certified No. 1 Hard Fescue ('Aurora', 'Spartan', 'Serra')

15% Canada Certified No. 1 Chewings Fescue ('Jamestown', 'Victory')

15% Canada Certified No. 1 Creeping Red Fescue ('Boreal', 'Jasper', 'Dawson')

10% Common No. 1 Perennial Rye Grass

NOTE: Acceptable cultivars include, but are not limited to, those listed in parentheses. Substitutions for any of the above must be approved by the Engineer.

All seed specified as Canada Certified No. 1 Grade or Common No. 1 Grade shall be as per Government of Canada Seeds Act Grade Standards.

All seed must be obtained from a recognized seed house or supplier.

b) Planting Soil

Planting soil (for seeded or sodded areas): mix 3 parts topsoil with 1 part peat moss, manure, or compost and 1 part sand.

c) Topsoil

Topsoil: friable, neither heavy clay nor very light sandy nature consisting of:

Name of Separate	Diameter, mm	Percentage in Soil
Sand	0.050 – 2.000	20% - 45%
Clay	0.000 – 0.002	27% - 40%
Organic matter	N/A	4% - 6%

.1 Soil pH to range from 6.5 – 8.0 inclusive.
.2 Salinity level as measured by conductivity of extract should be less than 2 mS/cm.
.3 Soil shall be free of any roots, living vegetation and weed seeds and couch grass.
.4 Soil shall be free of any clay lumps, coarse sand and gravel 2 mm and larger, and of any other foreign matter.

d) Peat Moss

.1 Derived from partially decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses.
.2 Elastic and homogeneous, brown in colour.
.3 Free of wood and deleterious material which could prohibit growth.
.4 Shredded particle maximum size: 5 mm.

d) Manure

Manure shall be well decomposed cattle excrement, rich in organic matter and humus containing balanced proportions of nitrogen, phosphorus and potash. It shall be reasonably free of living vegetation, weed seeds, and couch grass or bromegrass rhizomes. It shall be in a pulverized, friable condition and shall not contain any fresh, or "green", manure, clay, silt, gravel or other foreign material.

f) Sand

Sand shall be course and sharp with grains measuring from 0.5 mm to 1.5 mm.

g) Fertilizer

Fertilizer shall be 16-32-6 controlled release, sulphur coated urea (SCU) or ammonia sulphate fertilizer.

h) Miscellaneous Materials

Various materials such as gravel, crushed rock, sprinkler heads and landscaping timbers may be required. These shall be supplied as directed by the Engineer at an extra cost agreed upon on between the Engineer and the Contractor.

i) Delivery and Storage

All materials are to be delivered to the site and stored in an appropriate manner.

All grass seed shall be stored in a dry weatherproof place and shall be protected from damage by heat, moisture, rodents or other causes until time of seeding. Deliver grass seed in original containers taking care that all labels and identification remain legible and intact.

Topsoil, soil mixes or manure shall not be spread or otherwise handled while in a frozen or muddy condition.

All fertilizers shall be stored in a dry, weatherproof place to prevent a loss of effectiveness. Deliver fertilizer in original containers taking care that all labels and identification remain legible and intact.

2640 - 3 CONSTRUCTION

Determining the priority of specific job sites will be the responsibility of Engineer or his representative and shall be made in consultation with the Contractor with respect to logistical concerns and cost effectiveness.

Defining the area to be seeded will be the responsibility of the Engineer or his representative.

a) Preparation

Protect from damage sidewalks, trees, utilities, underground sprinklers, fences, cars and all public and private property.

Loosen and fine grade subgrade, eliminating uneven and low areas by rotovating and raking or other suitable means.

Remove from property all foreign materials, undesirable plants and their roots, stones and debris. Do not bury foreign material beneath the area to be landscaped.

A minimum of 100 mm of planting soil is to be placed on the graded subgrade.

The finished grade shall be smooth, loose textured and free of stones, roots, branches or other foreign materials, and flush with the curb or back of walk and blend into the contours of the existing lawn in an aesthetically pleasing manner. Positive drainage toward the street must be achieved.

In some locations special landscaping work may be required such as the removal and replacement of existing turf. This work shall be carried out as directed by the Engineer at an extra cost, agreed upon between the Engineer and the Contractor.

All soil and debris shall be cleaned up daily and sidewalks should be cleaned immediately and left "broom clean" daily.

b) <u>Seeding</u>

Seeding shall be done manually or mechanically, if feasible, at a specified rate of 2.5 kg per 100 m^2.

Incorporate the seed immediately by raking or other suitable means and roll the seeded areas immediately afterwards with a light turf roller.

Seeding shall be done from May 1st to August 30th on irrigated sites and from May 1st until weather conditions prohibit on non-irrigated sites.

Seeding shall be done during calm weather, on ground which is free of frost, snow and water.

The homeowner/occupant shall be notified in writing upon completion of seeding.

The area shall be given a final cleaning removing all soil and debris and leaving sidewalks free of soil or other materials.

The proper germination of all specified grass species is the responsibility of the Contractor.

c) <u>Fertilizer</u>

Fertilizer shall be spread at a rate of 2.5 kg per 100 m^2 or as recommended by soils test.

d) <u>Maintenance</u>

The Contractor shall ensure that the seeded areas are properly maintained until such time as the turf is properly established as specified.

After acceptance by the Engineer the maintenance shall be the responsibility of the homeowner/occupant.

2640 - 4 ACCEPTANCE

a) Primary Inspection

Shall occur within 48 hours of completion of work and will be concerned with workmanship and grades.

b) Final Inspection and Acceptance

Areas will be deemed acceptable provided that seeded areas are properly established and turf is free of eroded, bare or dead spots, couch grass and relatively free of weeds.

end of section

2645 **SPECIFICATION FOR COARSE GRASS SEEDING**

2645-1 GENERAL

The work shall consist of levelling and preparing the seed bed, seeding, fertilizing and cleaning up areas to be seeded in coarse grass as shown on the Plan on as designated by the Engineer.

2645-2 MATERIALS

a) Grass Seed Mixtures

Use a grass seed mixture equivalent to the one growing on site or a mixture of:

40% Canada Certified No. 1 Canada Bluegrass ('Reubens')

20% Canada Certified No. 1 Hard Fescue ('Aurora', 'Serra', 'Spartan')

15% Canada Certified No. 1 Chewings Fescue ('Jamestown', 'Victory')

15% Canada Certified No. 1 Creeping Red Fescue ('Boreal', 'Jasper', 'Dawson')

10% Common No. 1 Perennial Rye Grass

NOTE: Acceptable cultivars include, but are not limited to, those listed in parentheses. Substitutions for any of the above must be approved by the Engineer.

An alternate mixture may be substituted, with the permission of the Engineer, in areas where regular maintenance is doubtful. The mixture will contain:

25% Smooth Brome ('Carlton')

25% Streambank Wheatgrass ('Sodar')

25% Russian Wild Rye ('Swift')

25% Alfalfa ('Heinrichs')

NOTE: Acceptable cultivars include, but are not limited to, those listed in parentheses. Substitutions for any of the above must be approved by the Engineer.

All seed specified as Canada Certified No. 1 Grade or Common No. 1 Grade shall be as per Government of Canada Seeds Act Grade Standards.

All seed must be obtained from a recognized seed house or supplier.

b) Fertilizer

Fertilizer shall be 16-32-6 controlled release, sulphur coated urea SCU) or ammonia sulphate ferilizer.

c) Fill Soil

Shall be clean material free of sands, gravels, concrete, asphaltic concrete and other debris.

2645-3 CONSTRUCTION

Where designated on plans, ground surface shall be worked by equipment in order to fill in low spots and reduce high spots in such a manner as to promote drainage.

Unsuitable and excavated material shall be disposed of by the Contractor at a site designated by the Engineer. Landfill costs shall be the responsibility of the Contractor.

Landfill costs shall be the responsibility of the Contractor.

Where specified on plans or designated by the Engineer, the Contractor shall distribute and level fill soil to a depth of seventy-five millimetres (75 mm).

Ground surface shall be disced to a minimum depth of seventy-five millimetres (75 mm) to prepare seedbed.

Discing shall be followed by harrowing to level out the ground surface.

Should the seeding be done with a large brillion or other applicable type of seeder the work would be acceptable.

Seeding shall follow harrowing, the seed (mixture as specified) to be spread on ground surface at a rate of 2.5 kg per 100 m^2.

Fertilizer shall be spread at a rate of 2.5 kg per 100 m^2 or as recommended by soils test.

After seed and fertilizer have been applied, ground surface shall be harrowed a second time to cover the mixture.

Clean up immediately, soil or other debris spilled onto pavement and dispose of deleterious materials.

2650 SPECIFICATION FOR THE INSTALLATION OF CULVERTS

2650 - 1 GENERAL

The work will consist of installing corrugated steel pipe culverts at locations and in conformity with lines, grades and cross-sections shown on the plans or designated by the Engineer.

2650 - 2 MATERIALS

a) CSP Pipe

Shall be galvanized with bituminous exterior and interior protective coating. Thickness and size shall be as shown on the plans or as designated by the Engineer.

b) Granular Material

Shall be clean sand free from injurious amounts of deleterious substances. Ninety-five (95%) percent shall pass a 10 mm sieve and no more than five percent (5%) shall pass a 160 um sieve.

c) Rip Rap

Shall be hard, dense, durable field stone, boulders, quarry rock or broken concrete well graded in size between 150 and 250 mm with a minimum of 50% by weight exceeding 200 mm in diameter.

2650 - 3 CONSTRUCTION

The excavation for the culvert and the culvert bed, including sub-cut if required, shall be in accordance with Specification 2110 and 2130. If the foundation is unsuitable, the bottom of the bed shall be sub-cut to the dimensions staked by the Engineer. The sub-cut shall be backfilled in accordance with the requirements for embankments as designated by the Engineer. The bedding line shall be shaped to fit the culvert.

Corrugated steel pipe culverts shall be placed with the inside circumferential laps pointing downgrade and with the longitudinal laps at the sides or quarter points. The sections of the culvert shall be firmly joined with coupling bands. Joints shall be as tight as possible.

Granular backfill under the haunches of culverts shall be compacted with mechanical impact tampers. If a density for embankments has not been specified, mechanical impact tampers shall be used for compacting the earth material against the culvert.

After the earth backfill and granular backfill has been placed and compacted around the culvert, the remainder of the embankment shall be constructed in accordance with the requirements for Embankments. The earth material above the bedding line shall be placed, simultaneously and uniformly, in lifts on each side of the culvert. In sub-cut the lift shall extend to the limits of the sub-cut; otherwise, the lifts shall extend not less than 15 m from each side of the culvert.

No objectionable material shall be used within that portion of the embankment above or below the bedding line on culverts through the roadbed. The embankment, within three (3) diameters or three (3) spans of the culvert barrel, shall be free from rocks having a dimension of 75 mm or greater when measured in any direction.

Rip rap quantities and placement for erosion control a culverts shall conform to Saskatchewan Highways and Transportation Specification HM 1602-7. The material referred to as rip rap shall consist of hard, dense, durable field stone, boulders, quarry rock or broken concrete, well graded in size between 150mm and 200mm with a minimum of 50% by weight exceeding 200mm in diameter.

The Contractor shall repair or replace, at no direct expense to the City of Regina, any culvert damaged by his operation.

2660 **SPECIFICATION FOR THE INSTALLATION OF CHAIN LINK FENCE**

2660 - 1 GENERAL

The work shall consist of supply and installing chain link fence, including braces and gates constructed in accordance with the plans and specifications and at locations designated by the Engineer.

All fence construction shall take place from the road right-of-way side of the property line. The Contractor may enter private property only after obtaining written permission from the property owner.

2660 - 2 MATERIALS

a) Quality

All fencing materials including concrete, shall be new and supplied by the Contractor. All fencing material shall be Frost Fence, chain link fence, or equal.

b) Fence Fabric

The chain link fence fabric shall be 50 mm mesh by 9 gauge, zinc coated after weaving. Minimum zinc coating to be 490 grams per square metre of surface area. The fabric height shall be 1,830 mm, except where 1,200 mm fence is specified.

c) Line Posts

The Line Posts shall be 60 mm O.D. with minimum weight of 5.43 kg per metre, Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre. The minimum length of line posts shall be 2,670 mm, except where 1,200 mm fence is specified.

d) Terminal Posts and Straining Post

The Terminal Posts and Straining Posts shall be 90 mm O.D. with minimum weight of 11.24 kg per metre, Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre. The minimum length of terminal posts and straining posts shall be 2,900 mm.

e) Top Rails and Pipe Braces

The Top Rails and Pipe Braces shall be 43 mm O.D., Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre. TOP RAILS ARE NOT TO BE USED IN TRAFFIC AREAS. A 6 gauge top cable shall be used in its place.

f) Top and Bottom Wire

Wire shall be Number 6 Gauge, single strand 57 grams electro-galvanized and be stretched taut along the top and bottom of the fabric fastened at 460 mm intervals.

g) Gate Frames

Gate Frames are to be made of 43 mm O.D., Schedule 40 pipe, zinc coated with minimum coating of 490 grams per square metre. All joints to be electrically welded. Gates are to be supplied complete with zinc coated malleable iron hinges, latch and latch catch. Double gates to have centre rest with drop bolt for closed position and chain hold open. Gate latches are to be suitable for padlock which can be attached and operated from either side of gate. Hinges are to permit gate to swing back 180 degrees against fence. Gate braces shall be 33 mm O.D. zinc coated steel pipe with minimum coating of 490 grams per square metre.

h) Other Appurtenances

All other appurtenances such as tension bars, bands, rail ends, terminal post tops, line post tops, top rail sleeves, wire ties, nuts, bolts, washers, et cetera, shall be made of zinc coated steel with a minimum coating of 490 grams per square metre.

i) Concrete

The concrete used for the base of all posts shall conform to Specification 2500.

2660 - 3 CONSTRUCTION

Line posts shall be embedded into the centre of a concrete filled hole which measures 300 mm diameter and 1,070 mm deep. The line posts shall be placed at intervals of 3 m centre to centre and shall be set plumb and in accordance with the alignment staked.

Terminal posts and straining posts shall be embedded 1,080 mm into the centre of a concrete filled hole which measures 300 mm in diameter and 1,220 mm deep. The terminal posts and straining posts shall be set plumb and in accordance with the alignment staked.

Straining posts shall be installed as per the manufacturer's instructions or as designated by the Engineer. The maximum spacing of straining posts shall be 150 m or as designated by the Engineer.

Terminal sections, straining sections and corner sections shall be braced with a pipe brace as per the manufacturer's instructions and as shown in the detailed plans and specifications.

The fence fabric, wire ties, top rail, pipe braces, tension bar and fittings shall be attached to the posts and assembled according to the manufacturer's instructions and as specified on the plans as designated by the Engineer.

The chain link fence shall be attached to the side of the posts facing the private side of the property line. All gates to open inward towards the roadway.

The Contractor shall repair or replace, at no direct expense to the Owner, any fence material damaged by the Contractor's operations.

2680 **SPECIFICATION FOR THE INSTALLATION OF STEEL HANDRAIL**

2680 - 1 GENERAL

The work shall consist of the fabrication and erection of steel handrail to the lines grades and cross-sections shown on the plans or as designated by the Engineer.

2680 - 2 MATERIALS

a) General

1. Shop Drawings

Before fabrication or before any miscellaneous metal is delivered to the job site, submit Shop Drawings to the Engineer for review.

Show all locations, markings quantities, materials, sizes, and shapes and indicate all methods of connecting, anchoring, fastening, bracing, and attaching to the work of other trades.

2. Quality Assurance

Qualifications of Welders

Use only certified welders and the shielded arc process for all welding performed in connection with the work of this Section.

Codes and Standards

In addition to complying with all pertinent codes and regulations, comply with:

(1) CSA CAN3-S16.1-M78 and S136.

(2) CSA W59-1977 and CSA W47.1 for welding, fabrication and erection.

(3) Canadian Institute of Steel Construction (CISC) - Code of Practice for Building.

Conflicting Requirements

In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the more stringent provisions shall govern.

3. Product Handling

Protection

Use all means necessary to protect miscellaneous metal before, during, and after installation and to protect the installed work and materials of all other trades.

Replacements

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

b) Metal Products

1. Steel Shapes and Plates: G40.21-M1978, Type 300W
2. Hollow Structural Sections: G40.21-M1978, Type 350W
3. Mild Steel Pipe for Railings, Posts or Sleeves: A.S.T.M. A53
4. Bolts, Nuts: A.S.T.M. A325
5. Concrete Fasteners: Stainless Steel Hilti

c) Primer Paint

Shop coat primer shall conform to CGSB 1-GP-40d, unless otherwise indicated.

All primer paint for miscellaneous steel shall be compatible with the finish coatings.

d) Finish Paint

Finish coatings shall be applied to the primed surface. Colour to be approved by the Engineer.

Finish coatings shall consist of:

Intermediate - Alkyd Metal Enamel (1.0 mils)
Finish - Alkyd Metal Enamel (1.0 mils)

e) Galvanizing

Galvanizing shall conform to CSA G164 hot dip galvanizing to zinc coating designation Z600 (600 g/m^2).

Coatings for repair of damaged galvanized surfaces shall be zinc rich, "Galvafroid" by W.R. Meadows of Canada or "Devcon\Z" by Devcon Corp.

All other materials, not specifically described but required for a complete and proper installation of Miscellaneous Metal, shall be new, free from rust, first quality of their respective kinds, and subject to the approval of the Engineer.

2680 - 3 CONSTRUCTION

a) General

Inspection

Prior to all Work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where fabrication and installations of the Work of this Section may properly commence.

Make all required measurements in the field to ensure proper and adequate fit of miscellaneous metal items.

Verify that miscellaneous metal may be fabricated and installed in strict accordance with the original design and the reviewed Shop Drawings.

Discrepancies

In the event of discrepancy, immediately notify the Engineer.

Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies have been fully resolved.

b) Fabrication

Fabrication shall be done in accordance with CSA S16 and S136

All surfaces shall be prepared prior to welding by commercial blast cleaning to SSPC-SP6 removing all galvanizing in the area of the weld.

Completed fabrications shall be shop primed to CSA S16 all steel members excepting surfaces in contact with cast-in-place concrete and areas to receive welding work.

c) General Erection

All miscellaneous steel shall be erected in strict accordance with the Drawings, the reviewed Shop Drawings, and all pertinent regulations and standards in accordance with CSA S16 and S136.

Provide during erection all temporary bracing required for induced loads and stresses. Include such information on shop drawings.

Obtain Engineer's permission prior to field cutting or altering of steel members.

Touch up blemished or unprotected surfaces with primer.

Erection error not to exceed that which is specified in CSA S16.

Fabricate and install all handrail posts of 75 mm, diameter, Schedule 80 galvanized steel pipe and railings of 75 mm diameter, Schedule 40 galvanized steel pipe to the sizes and locations as shown on the Drawings.

Set posts in steel sleeves cast into concrete and grout with a non-shrink grout.

Pipe handrails shall have all corners rounded and intersections of hand, intermediate rails and stanchions shall be mitred and welded with continuous welds. All welds shall be ground smooth with no visible joints.

2780 SPECIFICATION FOR MUDJACKING/SLABJACKING

1.0 GENERAL

1.1 Provide all labour, materials, equipment, etc. to carry out the work in accordance with the specification as such but not limited to the following:
- removal of asphalt patches
- sawcutting private walks and driveways
- drilling grout holes
- pressure grouting
- patching grout holes
- clean up

1.2 This contract is for the mudjacking of concrete sidewalks, curb and gutter and slabs. Mudjacking is performed to bring the settled concrete up to an elevation matching adjacent sidewalks and/or slabs, or to bring the concrete structure up to pre-determined elevations as provided.

2.0 PRODUCTS

2.1 Furnish all equipment, tools, and other apparatus necessary for the proper construction and acceptable completion of the work specified under this contract.

2.2 Grout
Grout shall be a mixture of water, Portland cement, sand and additives and have a minimum seven (7) day compressive strength of 3 MPa. The mixture shall be a homogeneous paste with sufficient slump to ensure that all voids are filled to prevent undue stress on the structure.

2.3 Mineral Aggregate
Aggregates used for mudjacking may consist of natural sand, manufactured sand, or a combination of natural and manufactured sand and limestone dust. Maximum particle size shall be 5 mm.

2.4 Cement
Type 10 normal Portland cement.

2.5 Water
Water shall be clean and free from injurious amounts of oil, acid, salt, alkali, and organic or other deleterious matter. Water from hydrants may be accepted for use without being tested. If water is of questionable quality, it shall be tested at the expense of the Contractor.

2.6 Additives
Add bentonite, or other additives, as required to promote lubrication to ensure complete void filling and to compensate for shrinkage during curing.

2.7 The grout plant shall consist of a positive displacement grout injection pump capable of applying variable pressures up to 1750 kPa (250 psi), and capable of delivering this grout in a uniform and consistent manner. The mixer shall be a high speed colloidal mixing machine, or equivalent, capable of producing a consistent and homogeneous mixture.

2.8 Drilling equipment shall be an electrical drill, coring machine or other devices capable of drilling grout injection holes through concrete, pavement and base material.

2.9 Provide a quick-saw for cutting private walks and driveways. It must be available and on site during the mudjacking operation.

3.0 EXECUTION

3.1 Prior to any mudjacking, the site shall be inspected by the Contractor and the Engineer. The existing condition of the concrete structure or slab shall be noted and agreed upon. Should the Contractor deem the site or portion of the site unsuitable for mudjacking, the Contractor will advise the Engineer.

3.2 Failure to achieve the required standard at any mudjacking site which necessitates replacement of the sidewalk, curb and gutter or slab will result in non payment for the mudjacking carried out on the section requiring replacement.

3.3 The mudjacking standard will generally be equivalent to the concrete walk, curb and gutter, slab or driveway adjacent to the site, with respect to drainage, elevation, and profile and cross slope.

3.4 Sawcut pavement and/or sidewalk and/or curb and gutter.

3.5 Remove and dispose of all asphalt and/or grouting from previous repairs.

3.6 Grout injection holes shall be drilled vertically, having a maximum diameter of 50 mm. Drill holes in such a manner so as to prevent excessive breakout at the bottom of the slab.

3.7 Pump grout into the holes in a pattern and in an amount required to raise the structure to within 5 mm of the desired elevation.

3.8 Permanently seal grout holes flush with the surrounding surface with an approved rapid set concrete or other approved patch material. The patch material shall have a minimum thickness of 75 mm.

3.9 Prior to acceptance, clean up the site consistent with the surrounding area. Water under pressure will be required for site clean up. Clean site up immediately following the mudjacking operation.

3.10 Replace any concrete structures and/or asphalt slabs damage due to unnecessary or excessive force.

3.11 Restore asphalt and boulevard surfaces after lifting and leveling concrete sidewalk, curb and gutter.

3.12 Payment will be made under the appropriate pay items in the Form of Tender.

2999 LISTING OF ROADWAY STANDARD DRAWINGS

2999 LISTING OF ROADWAY STANDARD DRAWINGS

R-7G	Typical Sidewalk Enhancement	Jan/03
R-8	Edging and Joint Detail	Jan/03
R-9A	Typical Pedestrian Ramp at Radius	Dec/04
R-9B	Tactile Marking Tool	Jan/03
R-9C	Typical Pathway Ramp at Mid-Block Crossing	Dec/04
R-10	Combined Concrete Walk, Curb and Gutter Crossing	Dec/04
R-10A	Curb and Gutter Crossing with Boulevard	Jan/03
R-10B	Concrete Curb and Gutter Crossing	Dec/04
R-10C	Curb and Gutter Residential Crossing with Boulevard	Dec/04
R-11	Catch Basin Box-Out (Rolled Curb)	Jan/03
R-11A	Catch Basin Box-Out (Barrier Curb and Gutter)	Jan/03
R-11B	Box-out for Side Inlet Catch Basins (Barrier Curb)	Jan/05
R-11C	Box-out for Side Inlet Catch Basins (Rolled Curb)	Jan/03
R-11D	Concrete Pavement Manhole Isolation Detail	Jan/03
R-11E	Concrete Pavement Catch Basin Isolation Detail	Jan/03
R-12	Concrete Pavement Barrier Curb (Integral)	Jan/03
R-12A	Concrete Pavement Lip Curb (Integral)	Jan/03
R-13	Concrete Pavement Curb and Gutter Tie to Pavement	Jan/03
R-13A	Concrete Pavement Barrier Curb Tie to Pavement	Jan/03
R-13B	Concrete Pavement Barrier Curb (Separate)	Jan/03
R-14	Concrete Pavement Typical Joint Arrangement	Jan/03
R-14A	Concrete Pavement Longitudinal Joints	Jan/03
R-14B	Concrete Pavement Transverse Joints	Jan/03
R-14C	Concrete Pavement Joint Detail	Jan/03
R-15	Precast Concrete Curb	Jan/03
R-15A	Hydraulically Pressed Concrete Curb	Jan/03
R-16	Chain Link Fence Type "A"	Jan/03

2999 LISTING OF ROADWAY STANDARD DRAWINGS

R-16A	Chain Link Fence Type "A" - Banding Details	Jan/03
R-17A	Chain Link Fence Type "B"	Jan/03
R-17B	Gate Detail Type "B"	Jan/03
R-18	Rate of Evaporation Nomograph	Jan/03
R-19	Hoarding for Walkway	Jan/03
R-20	W-Beam Elements and End Sections	Jan/03

PAVEMENT DESIGN

CLASS OF STREET	* FULL DEPTH ASPHALT	* SOIL CEMENT BASE	* SAND/ASPHALT BASE	GRANULAR BASE	PORTLAND CEMENT CONCRETE PAVEMENT
1) LOCAL	150 A.C.	50 A.C. 140 BASE	50 A.C. 140 BASE	50 A.C. 150 BASE 150 SUB BASE 150 DRAINAGE SAND	150 P.C.C.(6”) 50 BASE
2) COLLECTOR	210 A.C.	80 A.C. 160 BASE	80 A.C. 185 BASE	70 A.C. 150 BASE 200 SUB BASE 150 DRAINAGE SAND	150 P.C.C.(6”) 50 BASE
3) BUS ROUTE (RESIDENTIAL)	225 A.C.	85 A.C. 175 BASE	85 A.C. 200 BASE	85 A.C. 170 BASE 200 SUB BASE 150 DRAINAGE SAND	165 P.C.C.(6.5”) 50 BASE
4) BUS ROUTE (CORE)	240 A.C.	95 A.C. 175 BASE	95 A.C. 205 BASE	95 A.C. 170 BASE 230 SUB BASE 150 DRAINAGE SAND	175 P.C.C.(7”) 75 BASE
5) INDUSTRIAL	240 A.C.	95 A.C. 175 BASE	95 A.C. 205 BASE	95 A.C. 170 BASE 230 SUB BASE 150 DRAINAGE SAND	190 P.C.C.(7.5”) 75 BASE
6) ARTERIAL 5% COMMERCIAL	250 A.C.	100 A.C. 185 BASE	100 A.C. 220 BASE	100 A.C. 180 BASE 230 SUB BASE 150 DRAINAGE SAND	200 P.C.C.(8”) 75 BASE
7) ARTERIAL 10% COMMERCIAL	265 A.C.	115 A.C. 190 BASE	115 A.C. 220 BASE	115 A.C. 180 BASE 250 SUB BASE 150 DRAINAGE SAND	225 P.C.C.(9”) 75 BASE

* PAVEMENT STRUCTURES – CONSISTING OF FULL DEPTH ASPHALT, SOIL CEMENT BASE OR SAND/ASPHALT BASE SHALL BE PLACED ON A LIME MODIFIED SUBGRADE 450 THICK.

NOTES

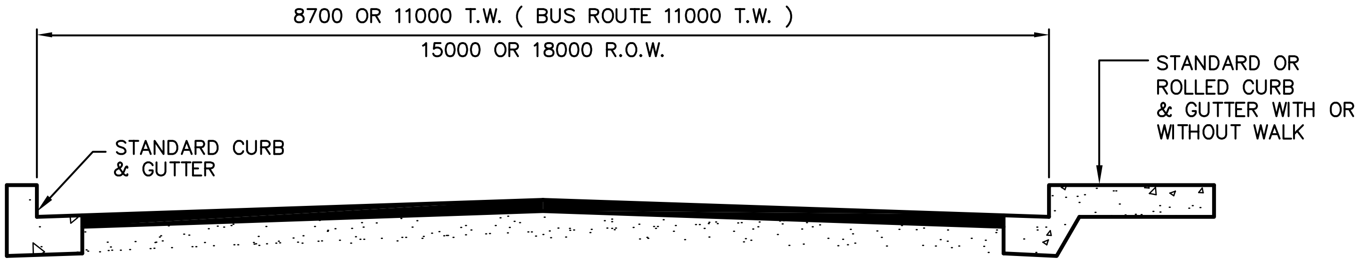
1. THE DESIGN THICKNESS INDICATED ABOVE REPRESENTS THE MINIMUM STRUCTURE REQUIRED.
2. A PAVEMENT DESIGN SHALL BE UNDERTAKEN WHERE WARRANTED.
3. CONCRETE PAVEMENT THICKNESS ARE INTENDED TO BE CONVENIENT INCREMENTS AVAILABLE IN THE INDUSTRY. IMPERIAL EQUIVALENTS ARE SHOWN IN PARENTHESES
4. PERFORATED DRAINAGE PIPE, AS SHOWN ON DRAWING No. R–2A, IS REQUIRED WITH GRANULAR BASE STRUCTURES
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.

Date	Revisions	By
Jan/01	CEMENT DESIGNATION	J.H.
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

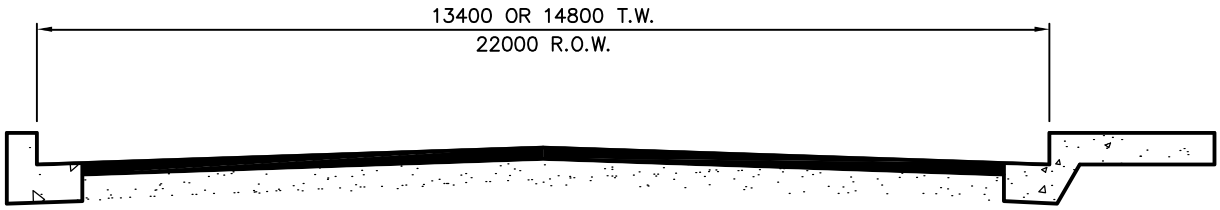
Description: **Alternate Pavement Structures**

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-1.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-1



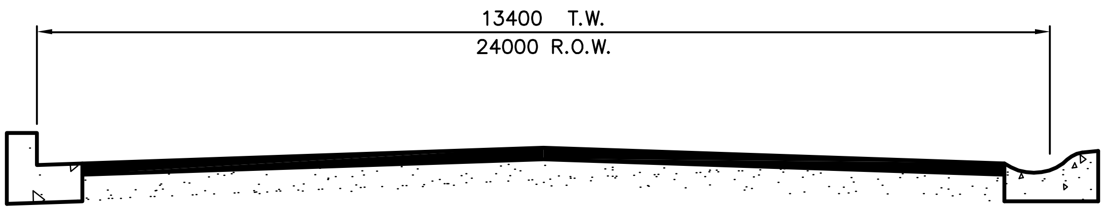
GRADE LIMITS 0.6% – 6.0%

CROSS SECTION FOR LOCAL STREET



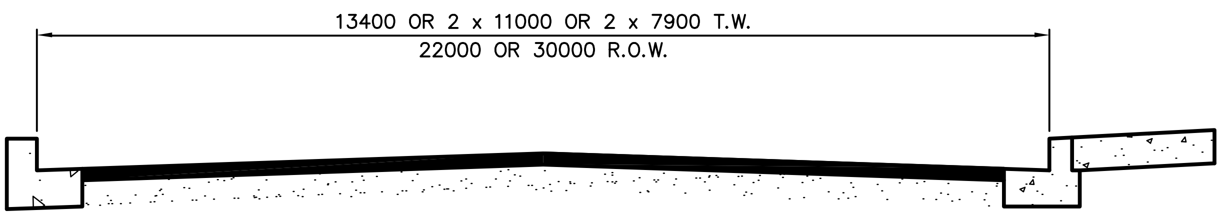
GRADE LIMITS 0.6% – 5.0%

CROSS SECTION FOR COLLECTOR STREET



GRADE LIMITS 0.6% – 4.0%

CROSS SECTION FOR INDUSTRIAL STREET



GRADE LIMITS 0.6% – 4.0%

CROSS SECTION FOR ARTERIAL STREET

NOTES:

1. ASPHALT SHALL BE PLACED TO HEIGHT OF 10 ABOVE THE LIP OF THE GUTTER, EXCEPT ON THE THE HIGH SIDE OF SUPER ELEVATED CURVE WHERE IT SHALL BE FLUSH WITH THE LIP OF THE GUTTER
2. ALTERNATE PAVEMENT STRUCTURES ARE AS DETAILED ON DWG. NO R–1
3. MINIMUM CROSS SLOPE 2.5%
4. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE NOTED

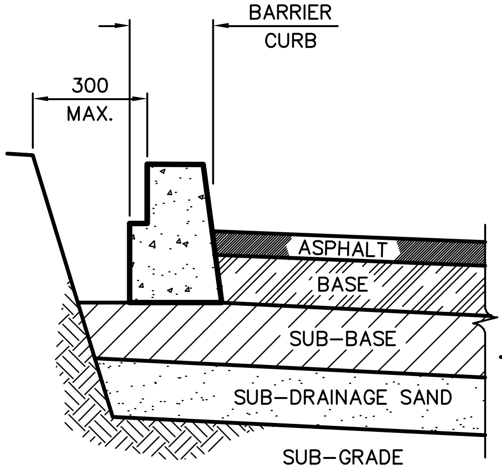
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

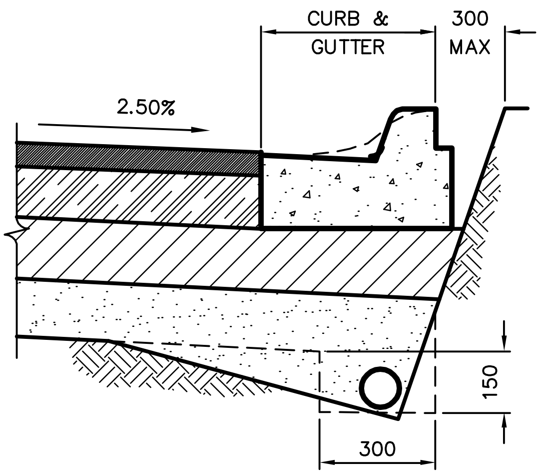
Description:

Typical Cross Sections for Asphaltic Concrete Pavements

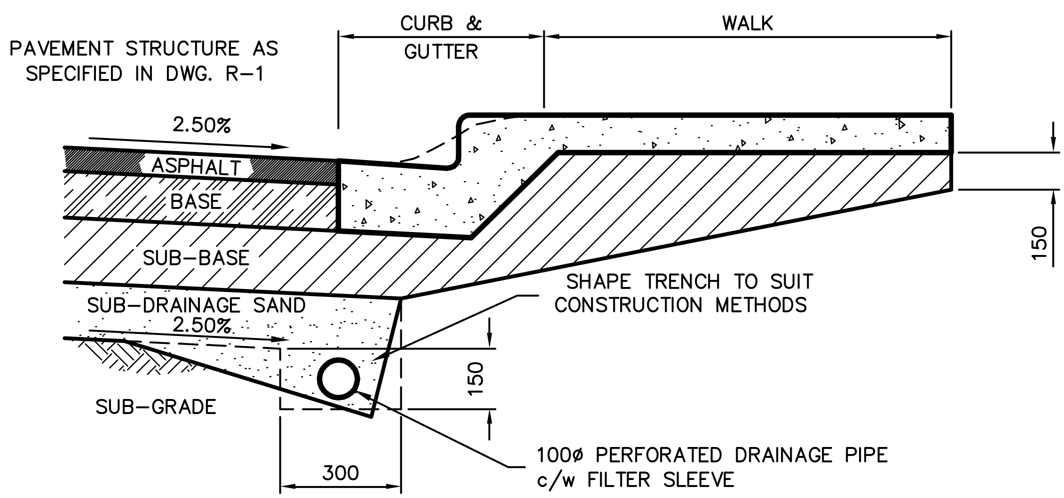
Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-2.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2



MEDIAN CURB



CURB & GUTTER



MONOLITHIC WALK CURB & GUTTER

NOTE:

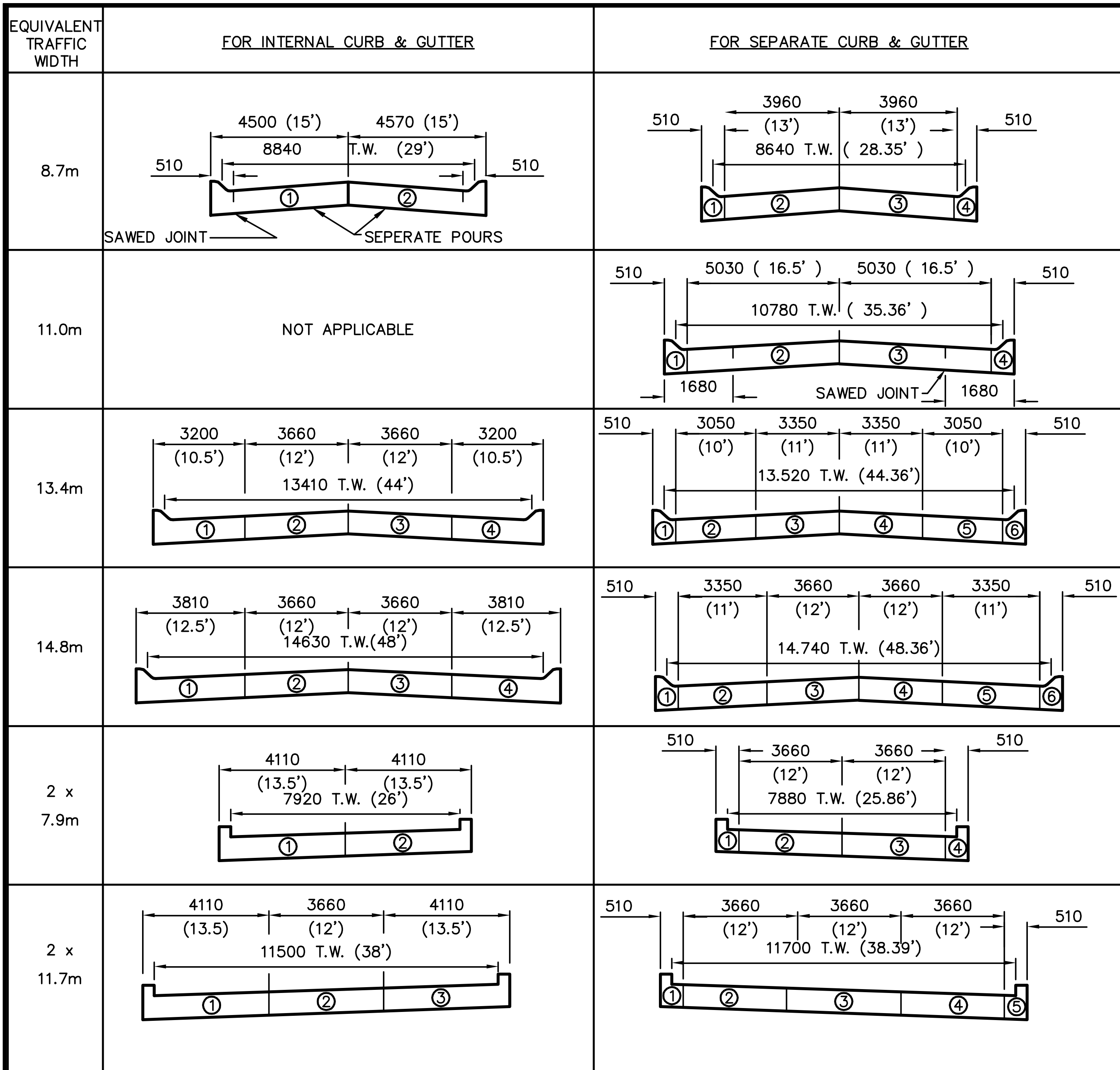
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	GRANULAR DEPTH @ B.O.W.	JH
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:
Typical Cross Sections for Granular Base Pavement Structures

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-2A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2A



CROSS SECTIONS

NOTES:

1. CROSS SECTIONS GIVEN ABOVE ARE BASED ON ESTABLISHED CONSTRUCTION PRACTICES. VARIATIONS IN THE WIDTHS OF POURS THAT ACHIEVE THE DESIRED TRAFFIC WIDTHS ARE SUBJECT TO THE APPROVAL OF THE DIRECTOR OF MUNICIPAL ENGINEERING.

2. MINIMUM CROSS SLOPE 2.5%

3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED. DIMENSIONS IN PARENTHESIS ARE IN IMPERIAL UNITS.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

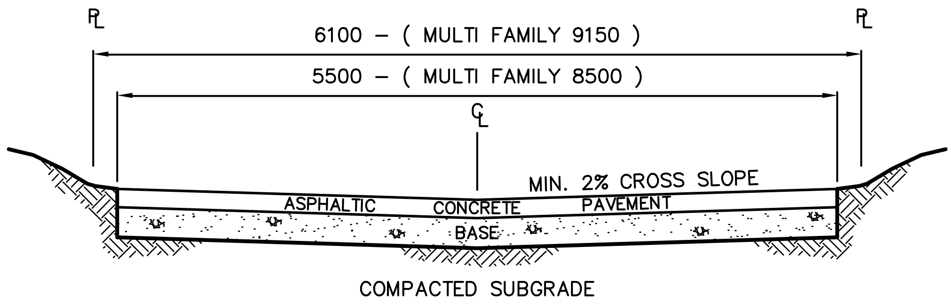
CITY OF REGINA

Engineering and Works

Description:

Typical Cross Sections for Portland Cement Concrete Pavements

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-2B.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2B



PAVEMENT STRUCTURES

50 ASPHALTIC CONCRETE PAVEMENT
90 SAND ASPHALT BASE

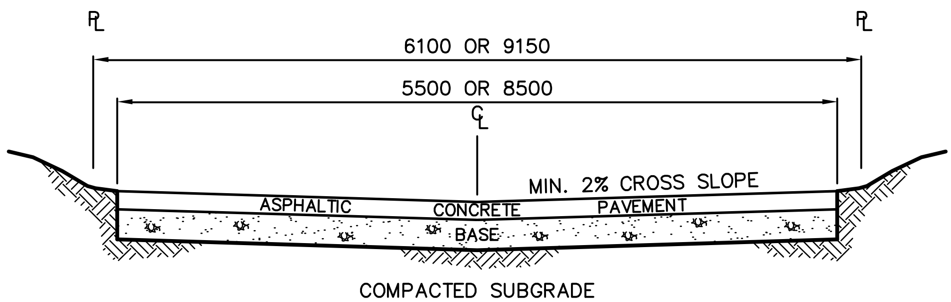
OR

50 ASPHALTIC CONCRETE PAVEMENT
250 GRANULAR BASE COURSE

OR

110 FULL DEPTH ASPHALT

RESIDENTIAL ZONE



PAVEMENT STRUCTURES

50 ASPHALTIC CONCRETE PAVEMENT
130 SAND ASPHALT BASE

OR

40 ASPHALTIC CONCRETE PAVEMENT
140 SOIL CEMENT BASE

OR

50 ASPHALTIC CONCRETE PAVEMENT
350 GRANULAR BASE COURSE

OR

140 FULL DEPTH ASPHALT

BUSINESS OR INDUSTRIAL ZONE

NOTES:

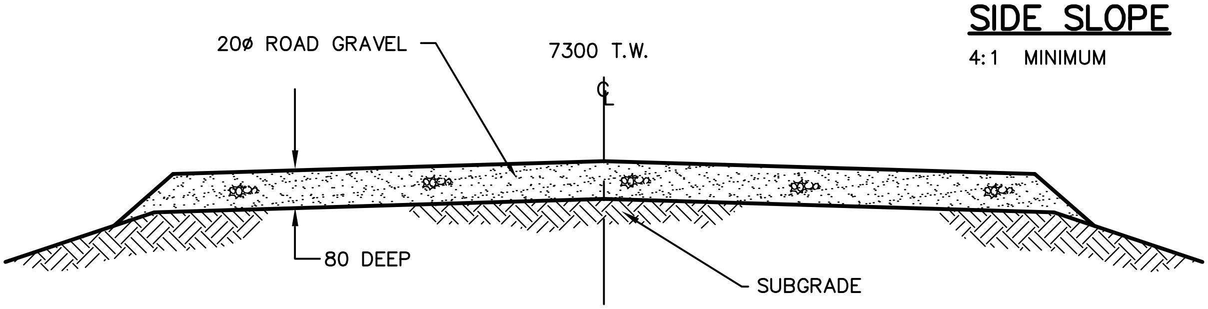
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. IF PAVED PARKING LOT ABUTTS ALLEY THEN EXTEND ALLEY PAVEMENT TO PROPERTY LINE .
3. GRADE LIMITS 0.6% – 6.0%

Date	Revisions	By
2002–01	GRANULAR BASE COURSE	JH
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:
Alley Pavement Structures

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-2C.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2C



CROWN

3% CROSS SLOPE

SIDE SLOPE

4:1 MINIMUM

TYPICAL CROSS SECTION

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	SIDE SLOPE; TITLE BLOCK	JH

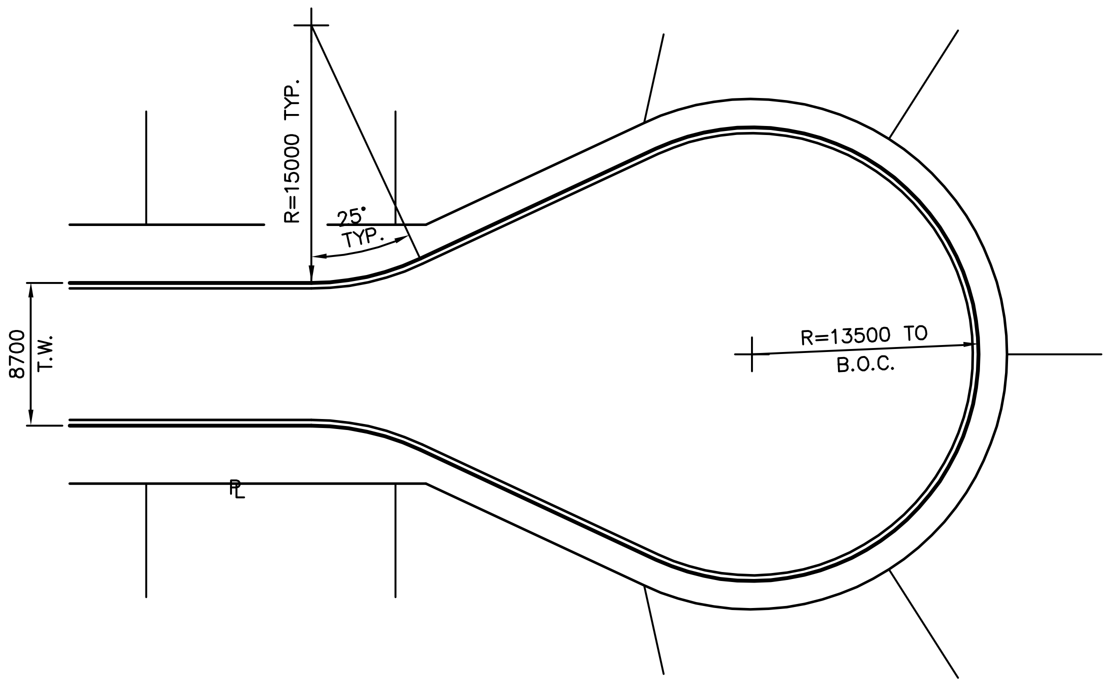
CITY OF REGINA

Engineering and Works

Description:

Graded and Gravelled Road Rural Area

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-2D.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2D



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

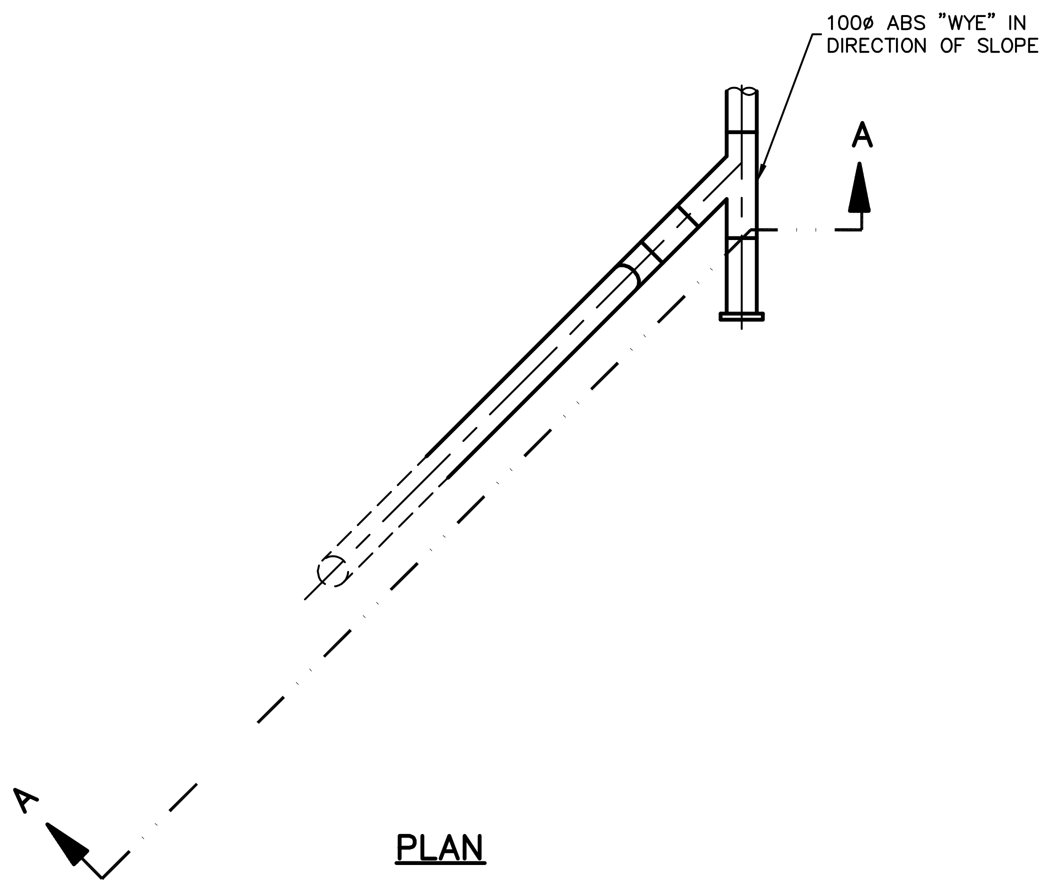
CITY OF REGINA

Engineering and Works

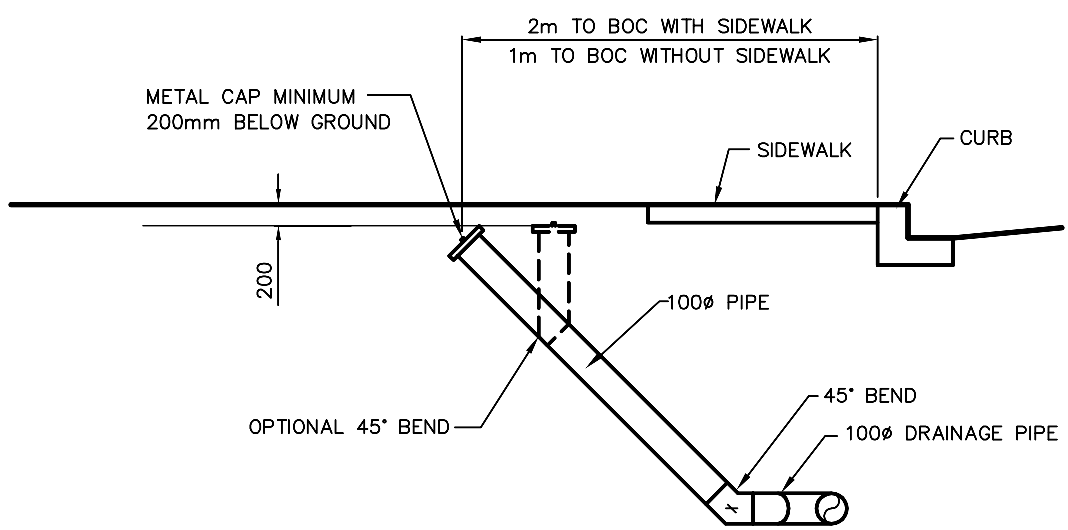
Description:

Typical Cul-De-Sac

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-2E.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2E



PLAN



SECTION A–A

NOTE:

1. ALL DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED.
2. NOTE LOCATION OF CLEAN–OUT ON AS–BUILT.

Date	Revisions	By
Jan/03	CAP LOCATION; TITLE BLOCK	JH

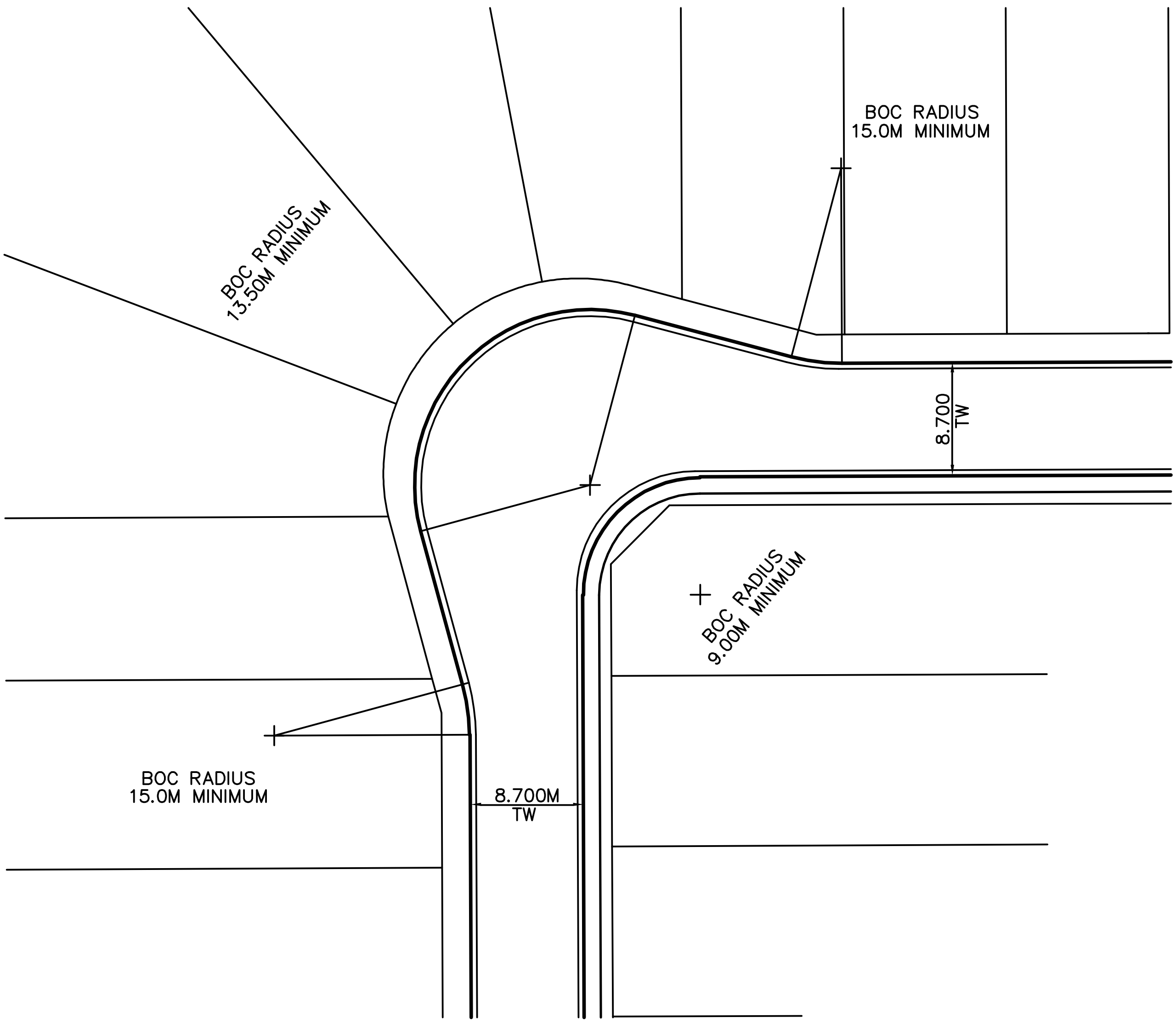
CITY OF REGINA

Engineering and Works

Description:

Drainage Pipe Clean-out Detail

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-2F.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2F



Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

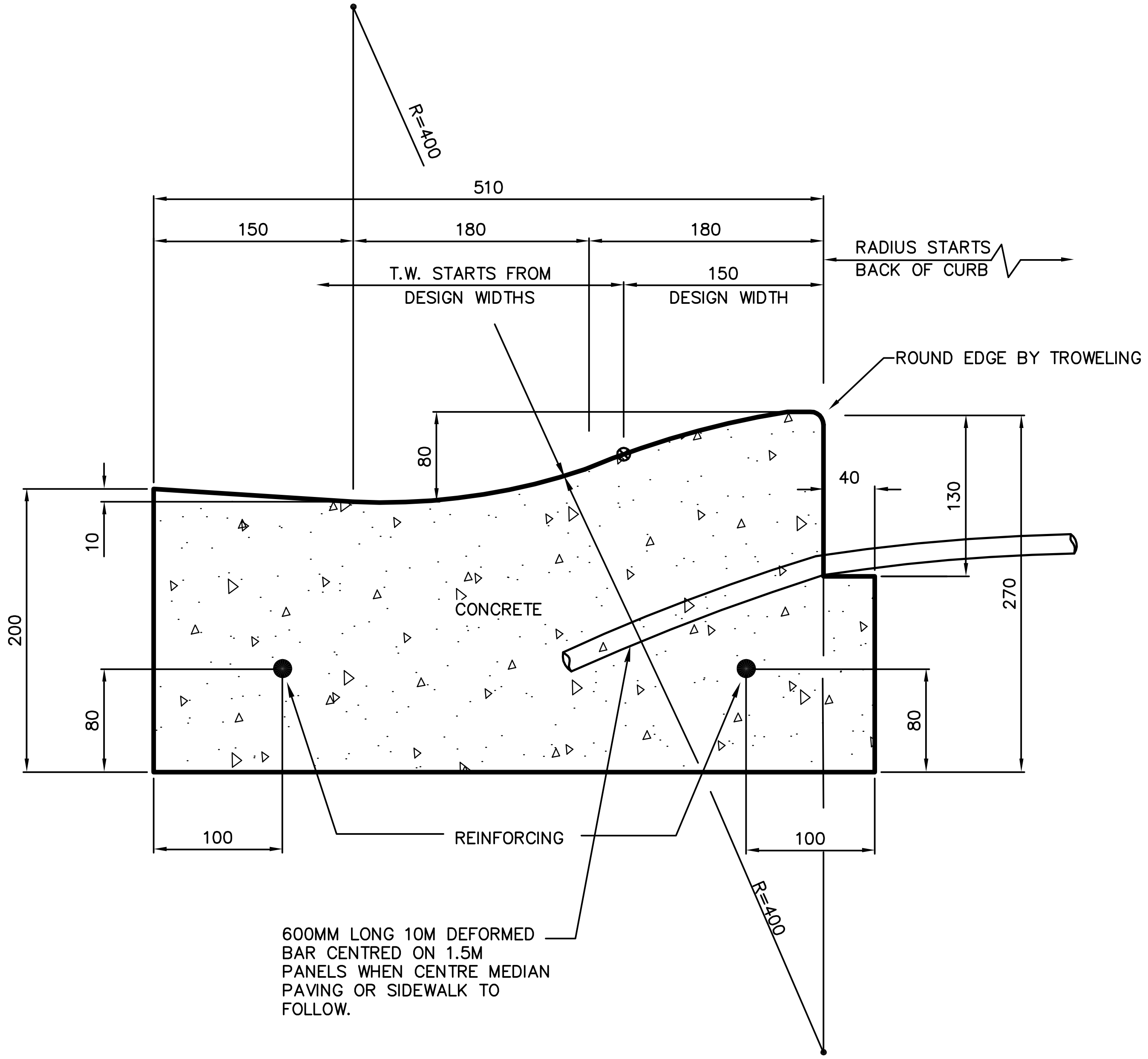
CITY OF REGINA

Engineering and Works

Description:

Typical Crescent Corner

Manager	Date	Digital File:
HARLAN RITCHIE	January/02	STDR-2G.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-2G



NOTES:

1. ALL DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED.

2. 10 M REINFORCING REQUIRED:
   - INDUSTRIAL AREAS
   - AT INTERSECTIONS ON RADII

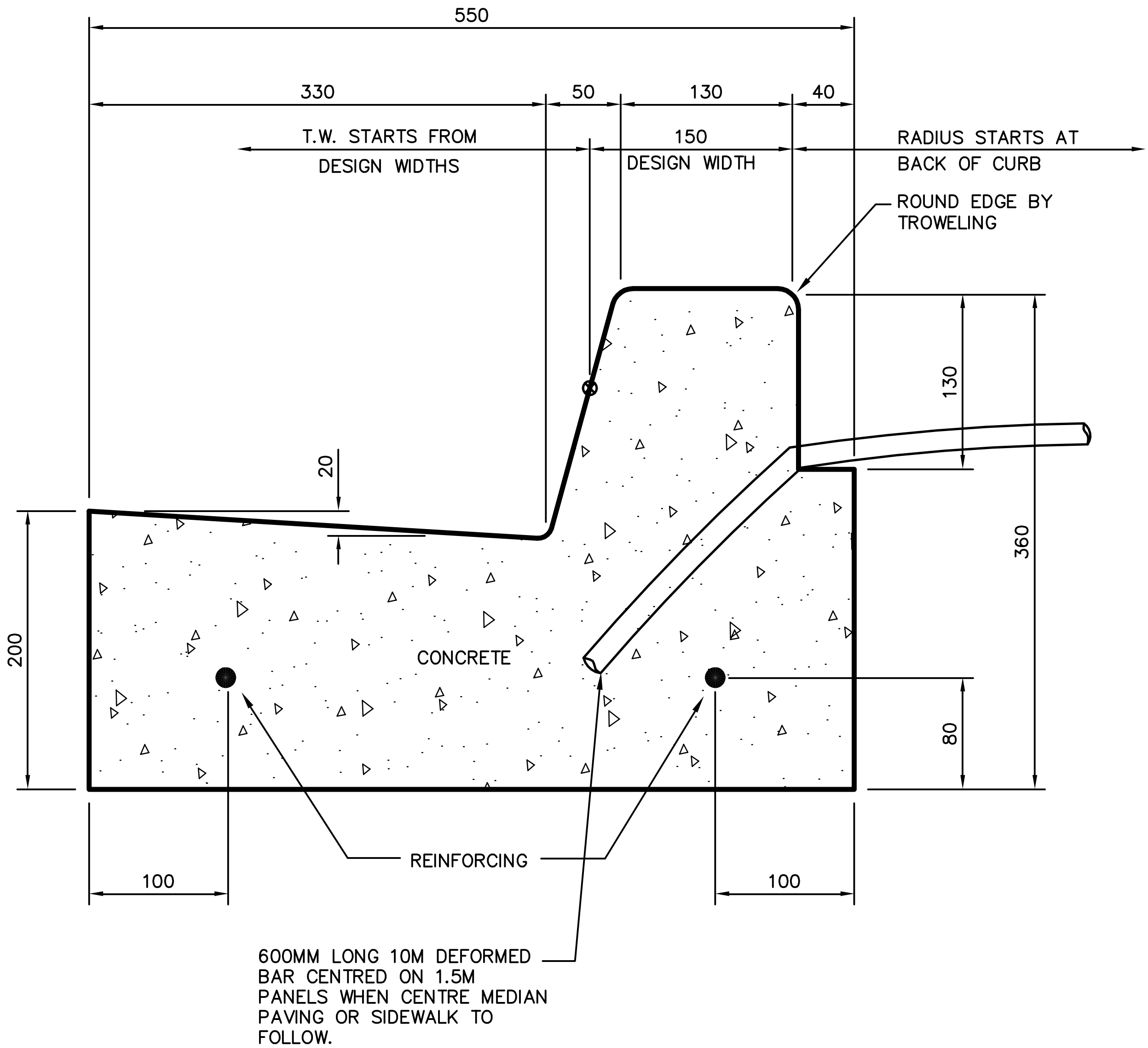
Date	Revisions	By
Jan/03	DEFORMED BAR; NOTE 2	JH
Jan/03	TITLE BLOCK	MLG

CITY OF REGINA
Engineering and Works

Description:

Rolled Curb and Gutter

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-3.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-3



NOTES:

1. ALL DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED.
2. 10 M REINFORCING REQUIRED:
   - AT INTERSECTIONS ON RADII

Date	Revisions	By
Jan/03	DEFORMED BAR; NOTE 2	JH
Jan/03	TITLE BLOCK	MLG

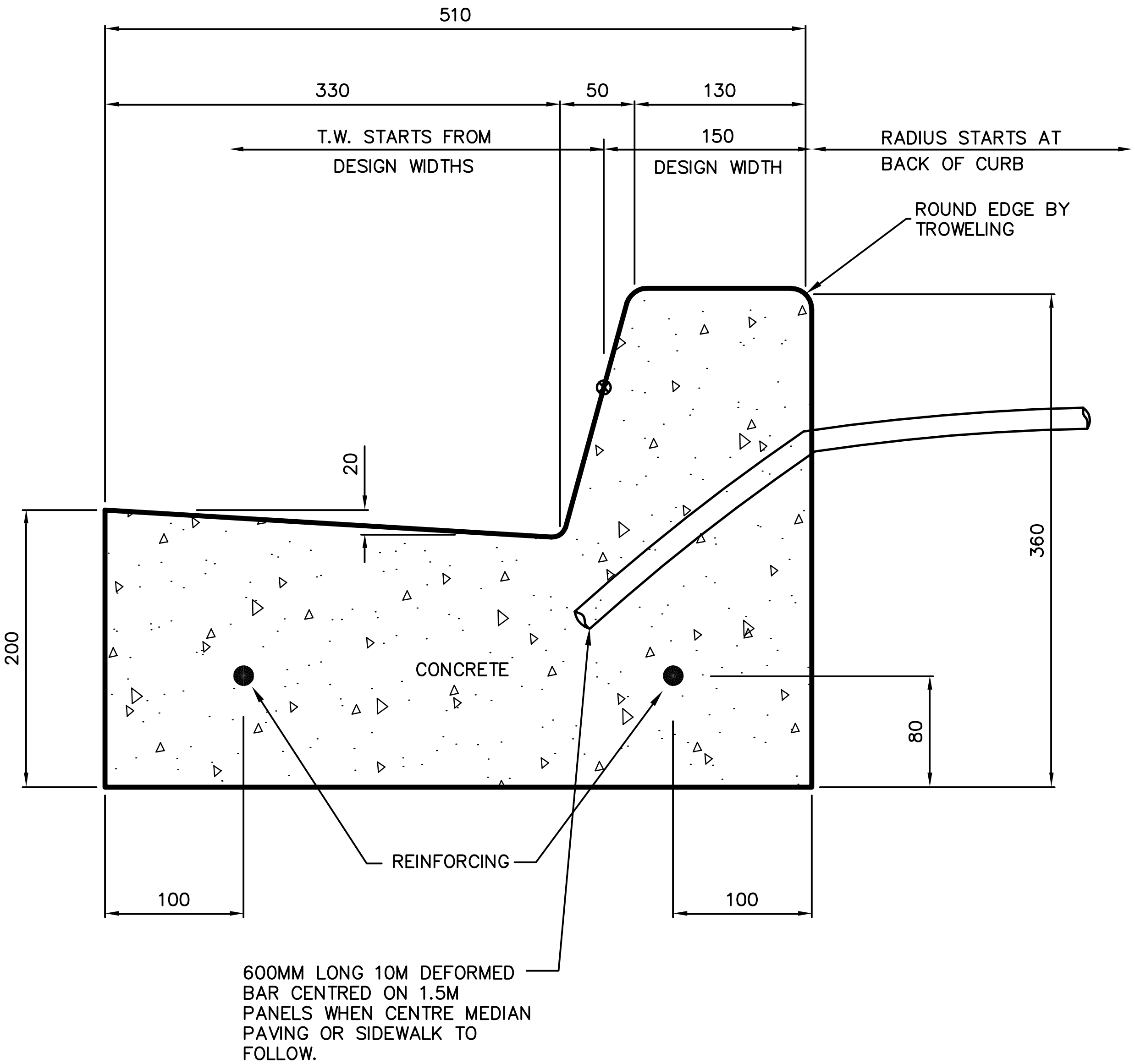
Regina CITY OF REGINA

Engineering and Works

Description:

Curb and Gutter Section With Walk Lip

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-4.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-4



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

2. 10 M REINFORCING REQUIRED:
   – AT INTERSECTIONS ON RADII

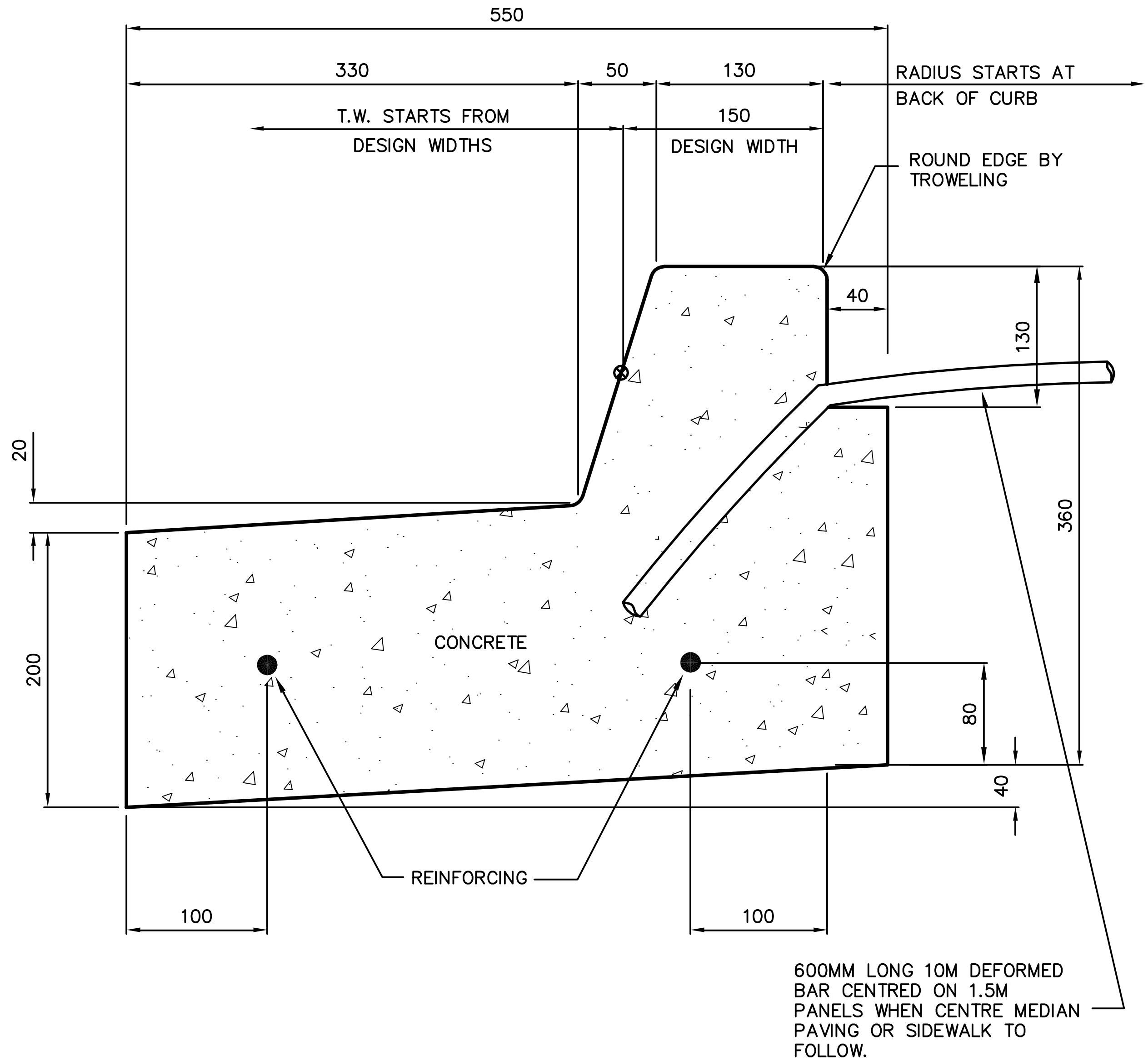
Date	Revisions	By
Jan/03	DEFORMED BAR; NOTE 2	JH
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:

Curb and Gutter Section Without Walk Lip

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-4A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-4A



NOTES:

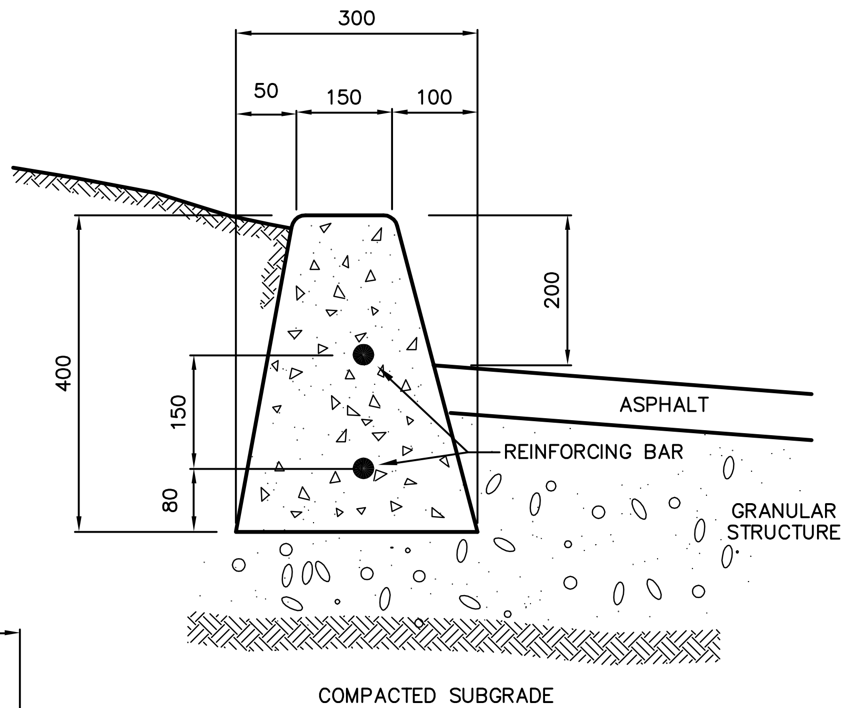
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. 10 M REINFORCING REQUIRED:
   —AT INTERSECTIONS ON RADII

Date	Revisions	By
2002–01	LIP AT BOC; TIE BAR	JH
Jan/03	NOTE 2; TITLE BLOCK	JH

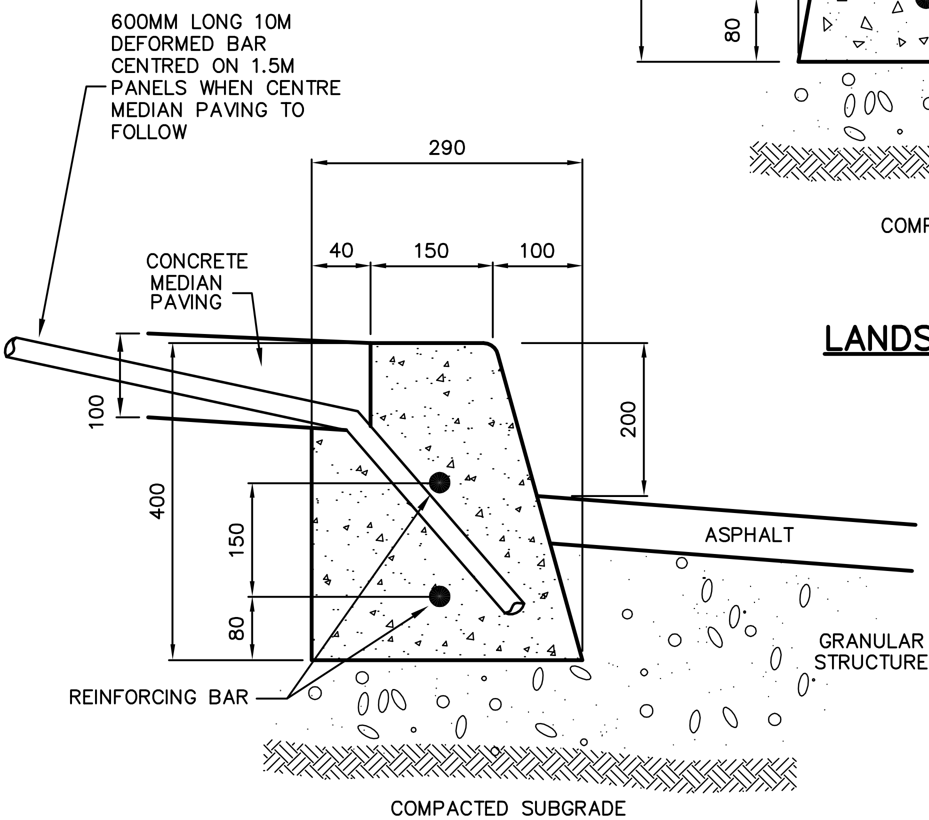
Regina
CITY OF REGINA
Engineering and Works

Description:
Reverse Curb and Gutter Section

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-4B.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-4B



LANDSCAPED MEDIAN



HARD SURFACE MEDIAN

NOTES:

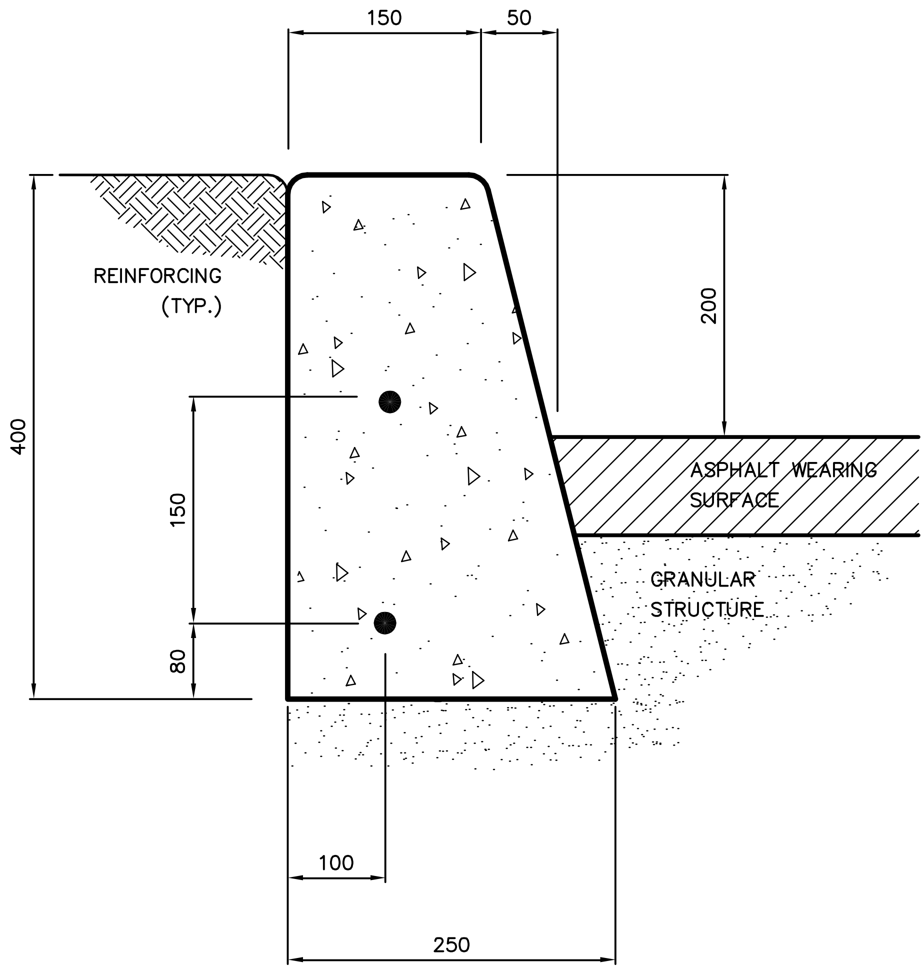
1. 10M REINFORCED BARS TO BE USED ON CURVED SECTIONS.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
2002-01	DIMENSIONS : TIE BAR	JH
Jan/03	TITLE DESCRIPTION; TITLE BLOCK	JH

CITY OF REGINA
Engineering and Works

Description:
Centre Median Curb Standard

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-5.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-5



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. 10M REINFORCING BARS TO BE USED ON BULL NOSES.
3. ON RADII OF LESS THAN 3 METERS, THE FRONT FACE MAY BE VERTICAL.

Date	Revisions	By
Jan/03	NOTE 2; TITLE BLOCK	JH

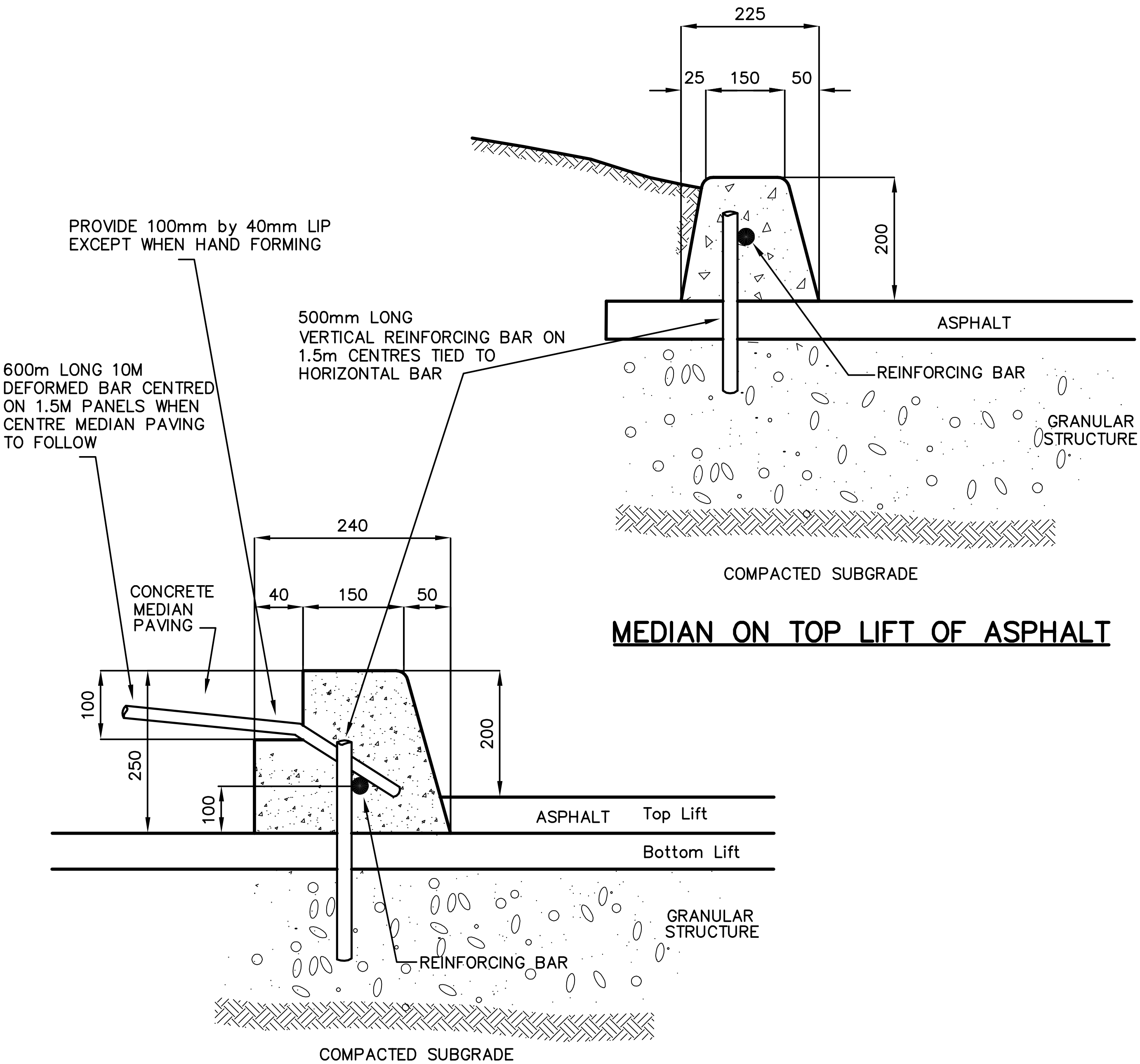
CITY OF REGINA

Engineering and Works

Description:

Hand Formed Centre Median Curb

Manager: HARLAN RITCHIE	Date: January/98	Digital File: STDR-5A.DWG
Approved: DAVID CALAM	Scale: NTS	Dwg: R-5A



MEDIAN ON TOP LIFT OF ASPHALT

MEDIAN ON BOTTOM LIFT OF ASPHALT

NOTES:

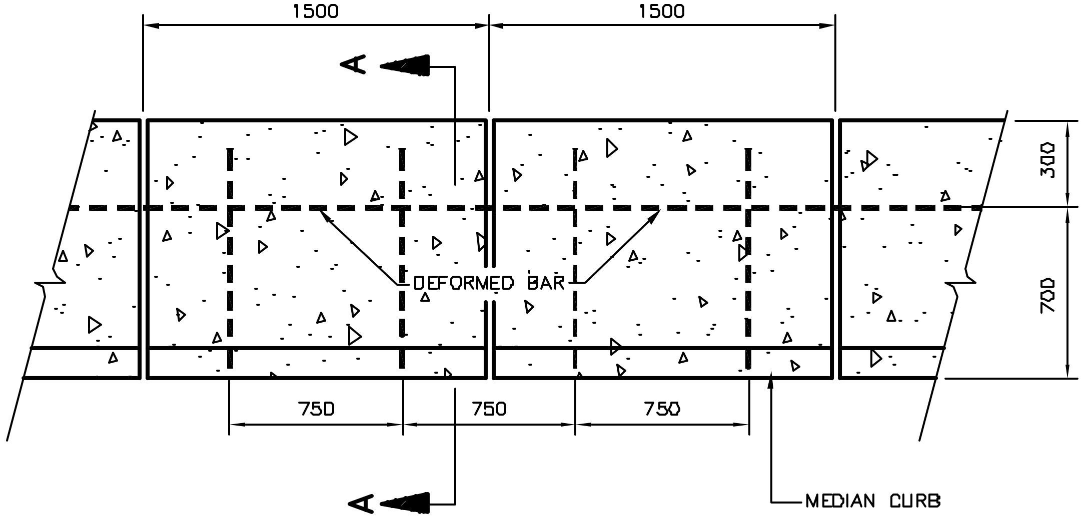
1. 10M REINFORCED BARS TO BE USED VERTICALLY AND HORIZONTALLY ON ALL SECTIONS
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

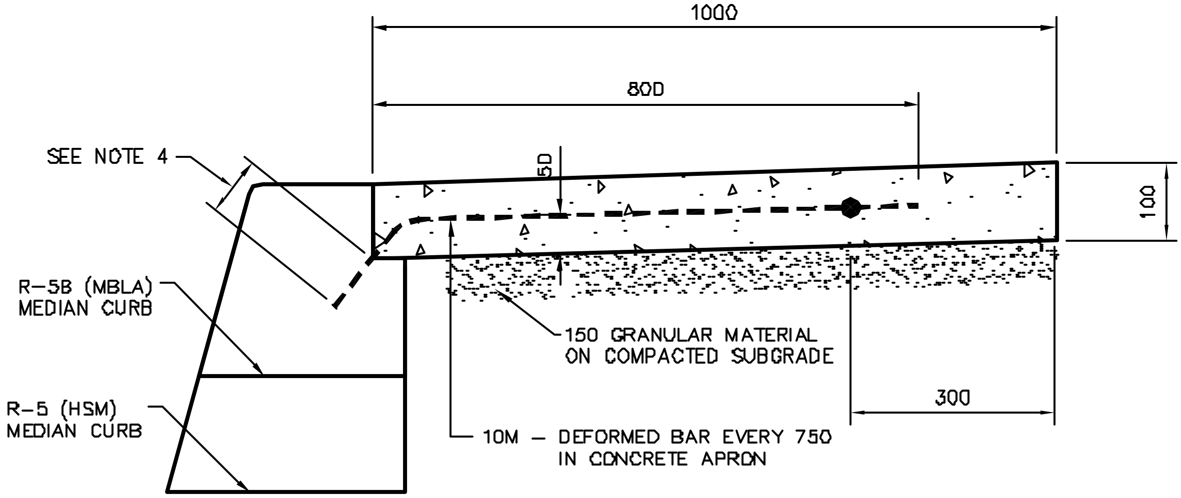
Regina
CITY OF REGINA
Engineering and Works

Description:
Centre Median Curb Cast on Asphalt Pavement

Manager	Date	Digital File:
HARLAN RITCHIE	January/02	STDR-5B.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-5B



PLAN



SECTION A–A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. CONTRACTION JOINTS EVERY 1500
3. TIE ALL DEFORMED BARS.
4. MINIMUM 100mm LONG FOR R–5B; 150mm TO 200mm LONG FOR R–5

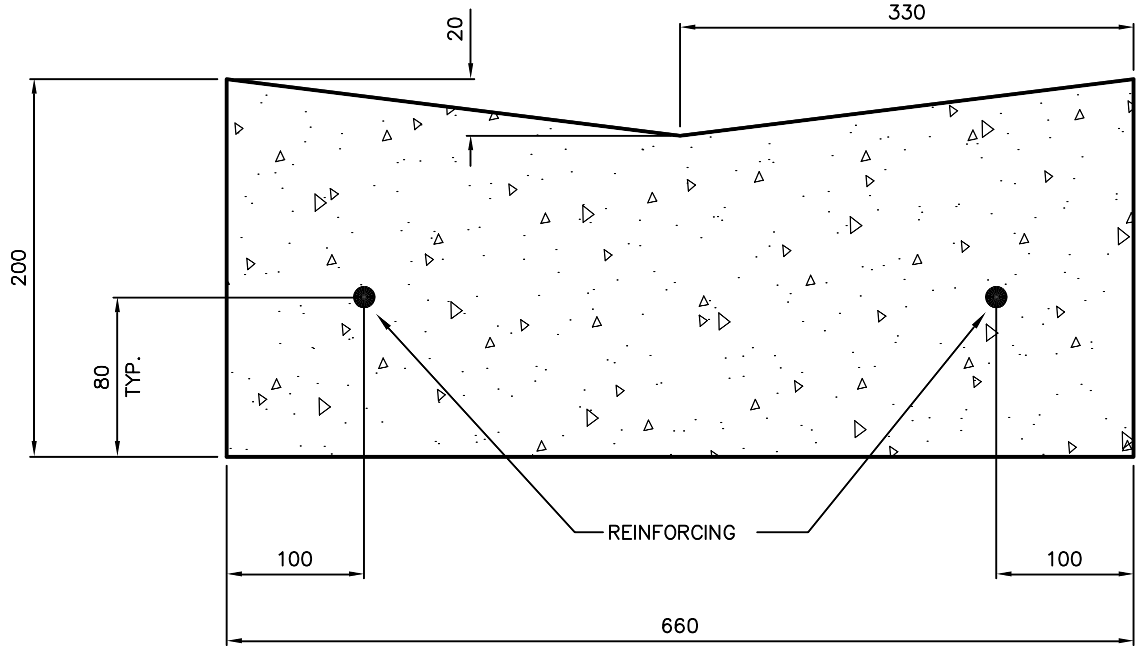
Date	Revisions	By

Regina
CITY OF REGINA
Engineering and Works

Description:

Centre Median Apron

Manager	Date	Digital File:
HARLAN RITCHIE	Feb. 10, 2004	STDR-5C.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-5C



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. REINFORCE COMMERCIAL AND INDUSTRIAL CROSSINGS.
3. REFER TO R–10A FOR TYPICAL APPLICATION

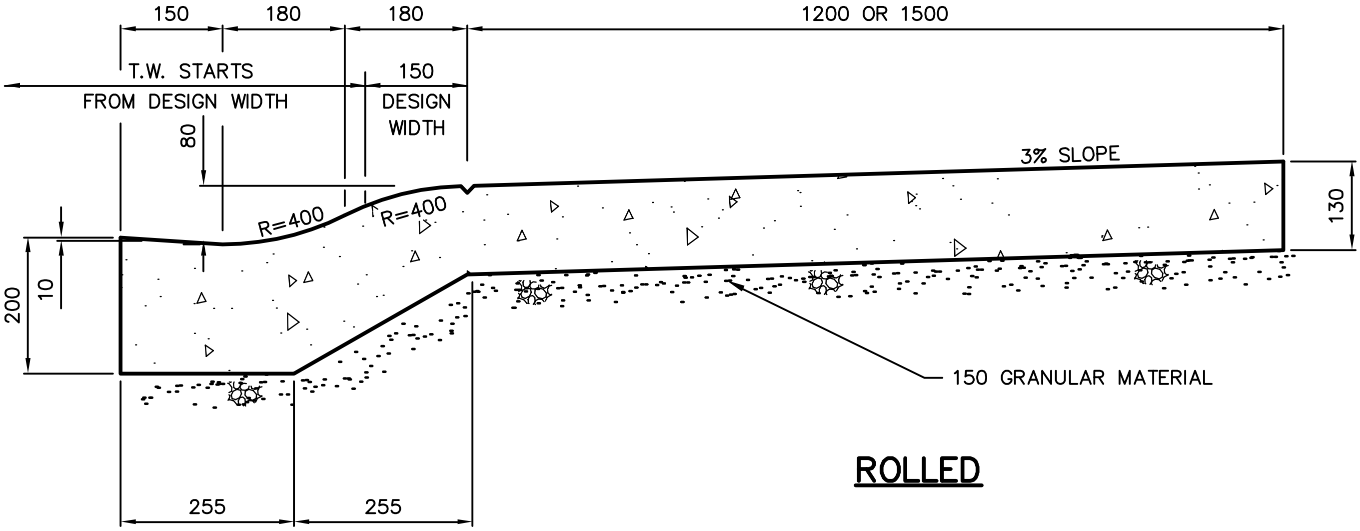
Date	Revisions	By
2001–01	REINFORCING COVER	
2002–01	NOTE 3 ADDED	JH
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

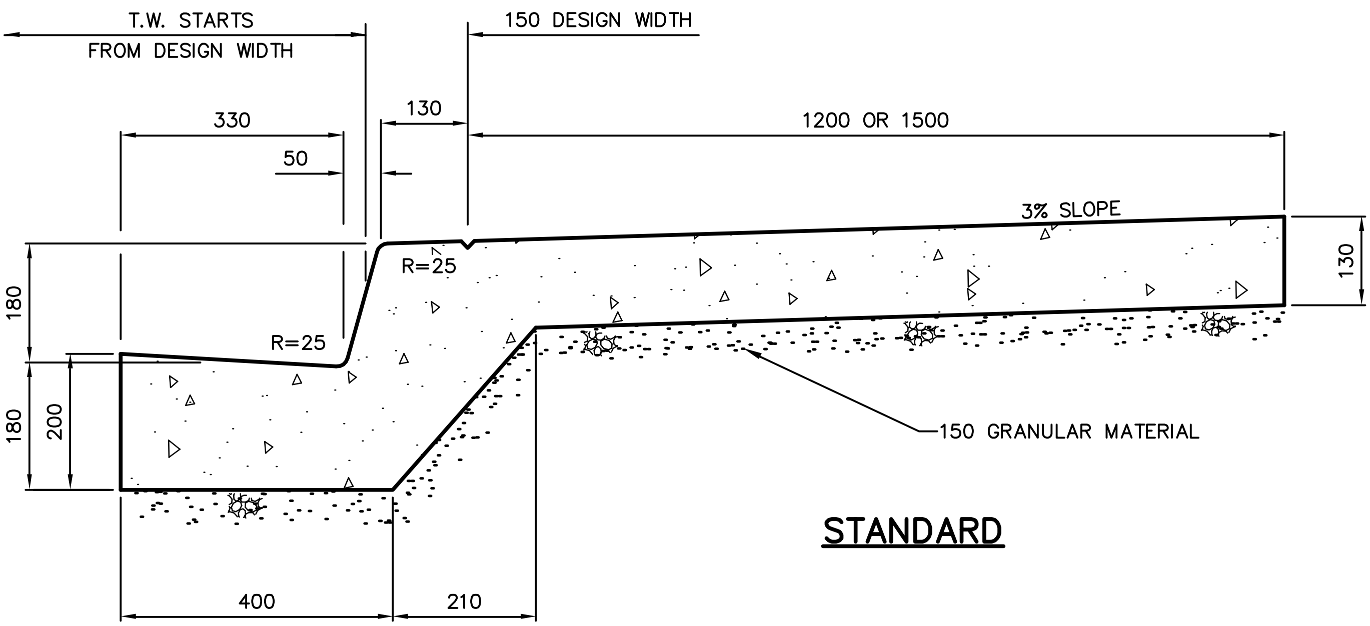
Description:

Concrete Swale Section

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-6.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-6



ROLLED



STANDARD

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. FOR ALLEY CROSSINGS, INCREASE WALK THICKNESS TO 180.

Date	Revisions	By
Jan/03	GRANULAR MATERIAL DEPTH	JH
Jan/03	TITLE BLOCK	MLG

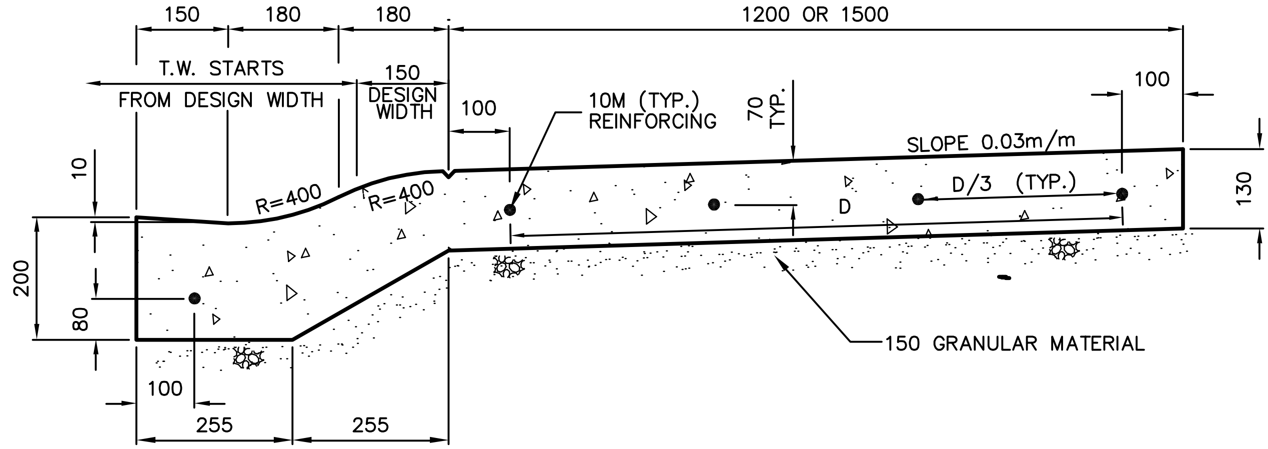
CITY OF REGINA

Engineering and Works

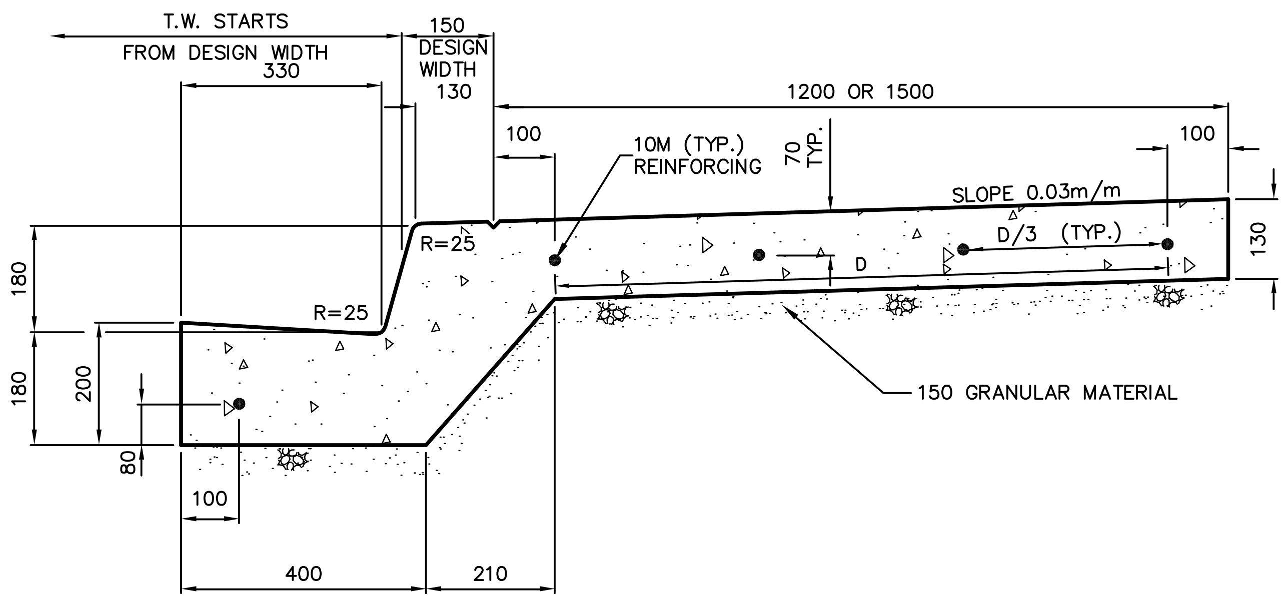
Description:

Monolithic Walk, Curb and Gutter

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7



ROLLED CURB



STANDARD CURB

NOTES:

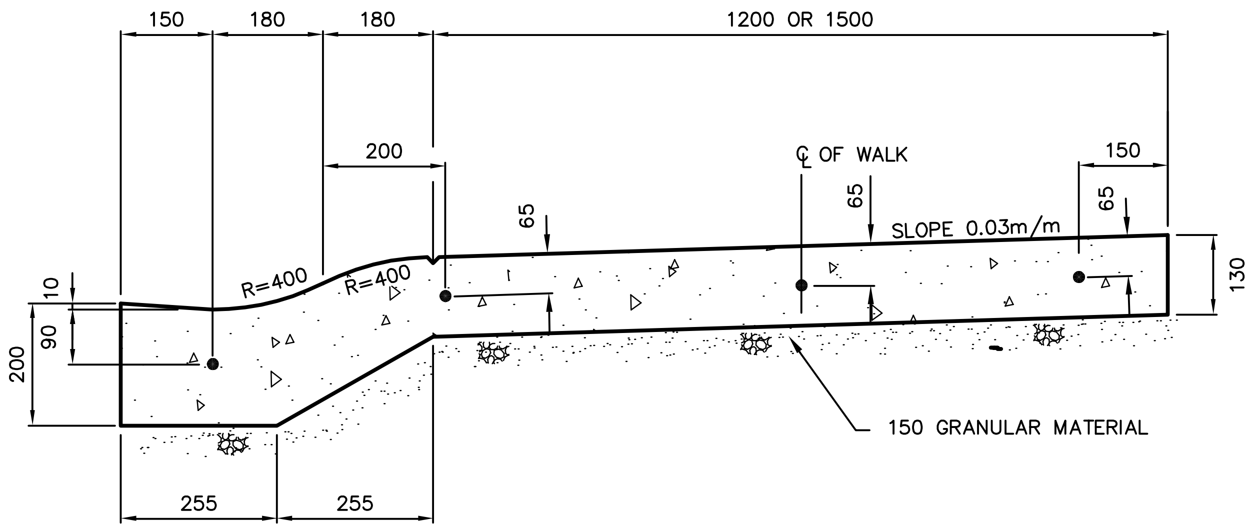
1. ALL DIMENSIONS ARE IN MIILIMETRES UNLESS OTHERWISE NOTED.
2. LONGITUDINAL 10M BARS TO EXTEND 300mm BEYOND THE TOP OF FLARE AND TO BE TIED TO TRANSVERSE 10M BARS AT 600 O.C.

Date	Revisions	By
Jan/03	GRANULAR MAT'L DEPTH; NOTE 2	JH
Jan/03	TITLE BLOCK	MLG

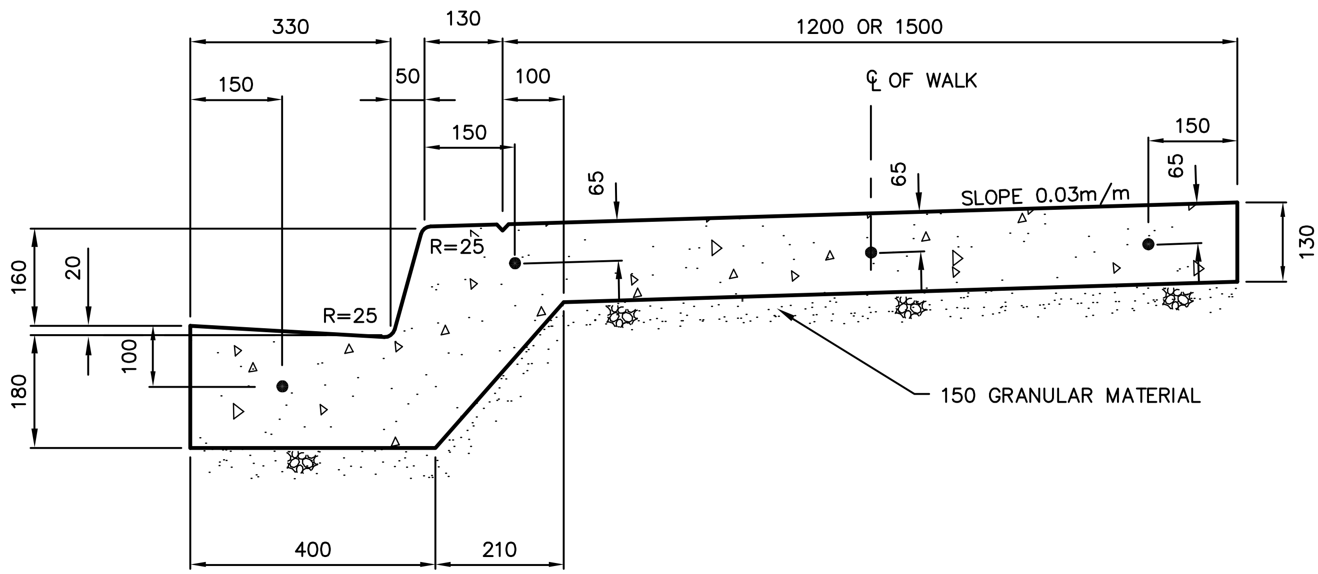
Regina
CITY OF REGINA
Engineering and Works

Description:
Reinforced Monolithic Walk, Curb and Gutter

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7A



ROLLED



STANDARD

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. 10M DOWELS 1 METER LONG
3. GREASE ONE END OF DOWEL.

Date	Revisions	By
Jan/03	GRANULAR MATERIAL DEPTH;	JH
Jan/03	TITLE DESCRIPTION; TITLE BLOCK	JH

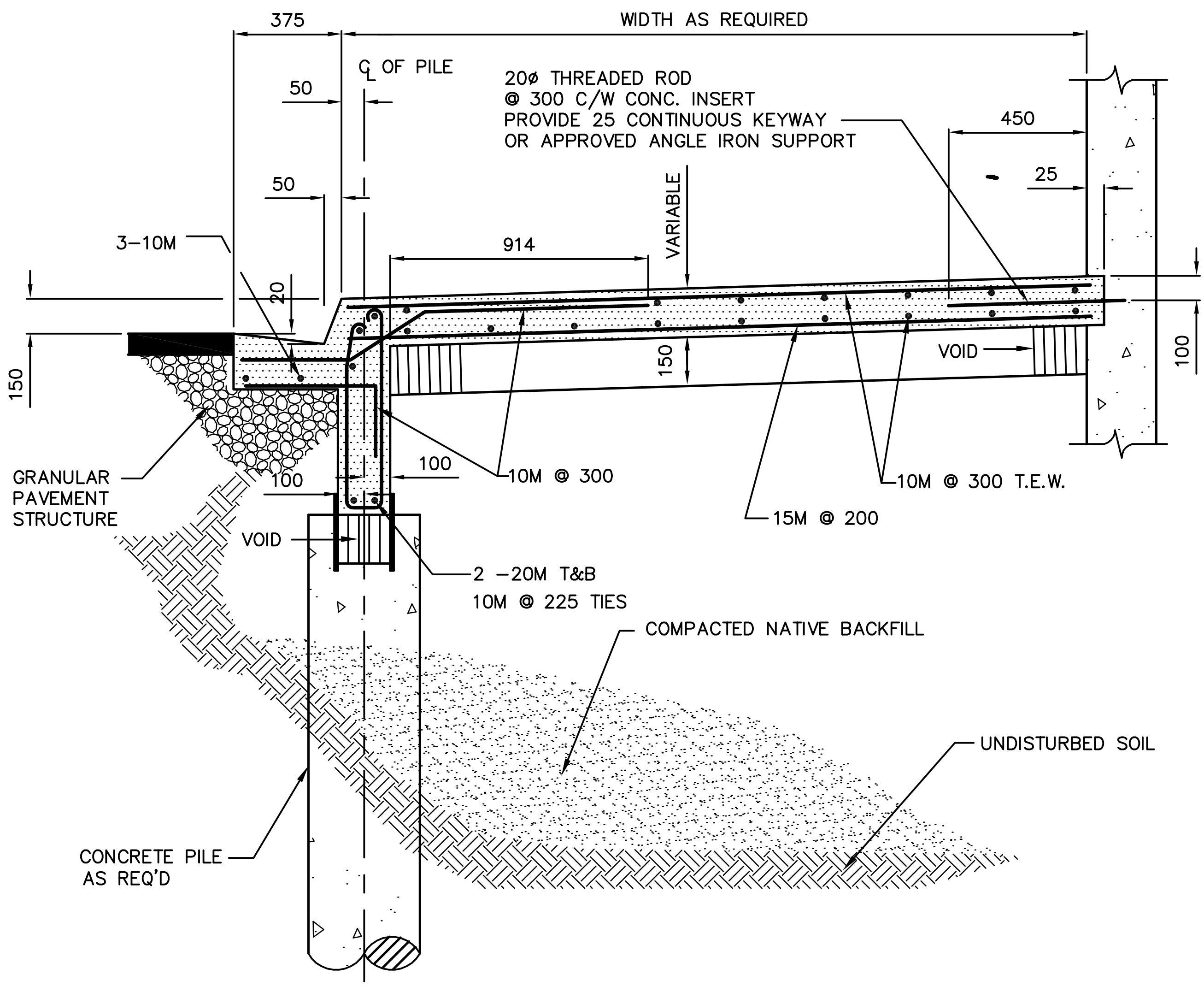
CITY OF REGINA

Engineering and Works

Description:

Dowel Detail For Cold and Expansion Joints

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7B.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7B



NOTES:

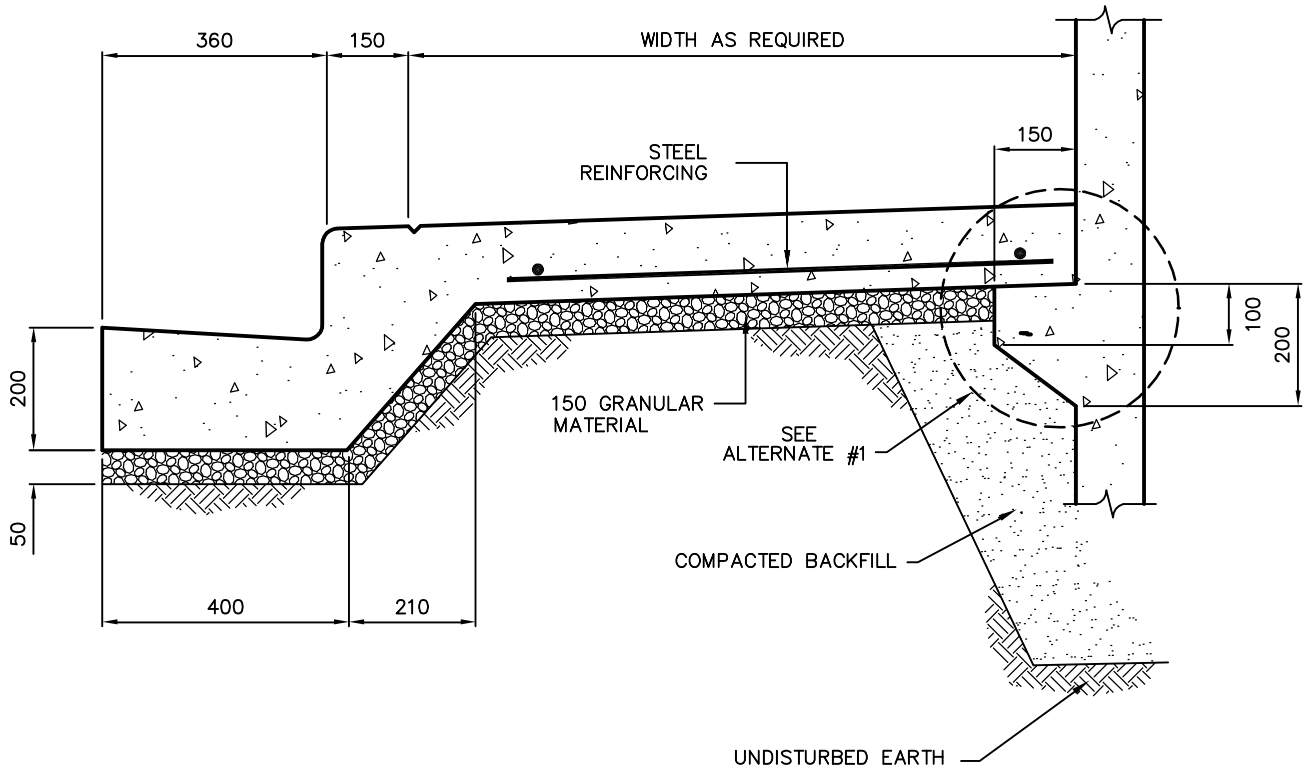
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. THE DIMENSIONS AND REINFORCING, SHOWN FOR THE SIDEWALK AND BEAM BELOW THE CURB, ARE EXAMPLES ONLY. IN EACH CASE, A STRUCTURAL SIDEWALK DESIGN IS TO BE PREPARED AND SUBMITTED TO THE DIRECTOR OF MUNICIPAL ENGINEERING FOR APPROVAL.

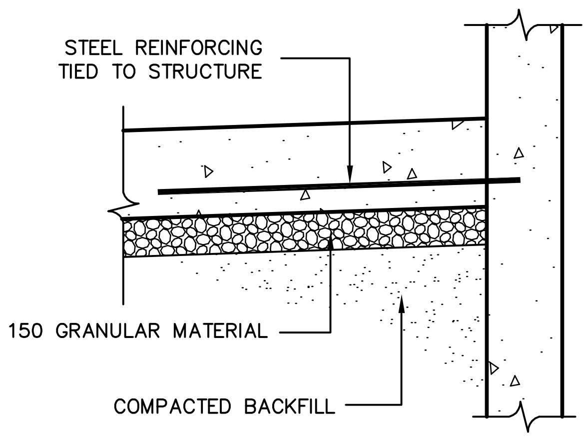
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:
Structural Sidewalk Option #1

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7C.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7C





ALTERNATE #1

NOTE:

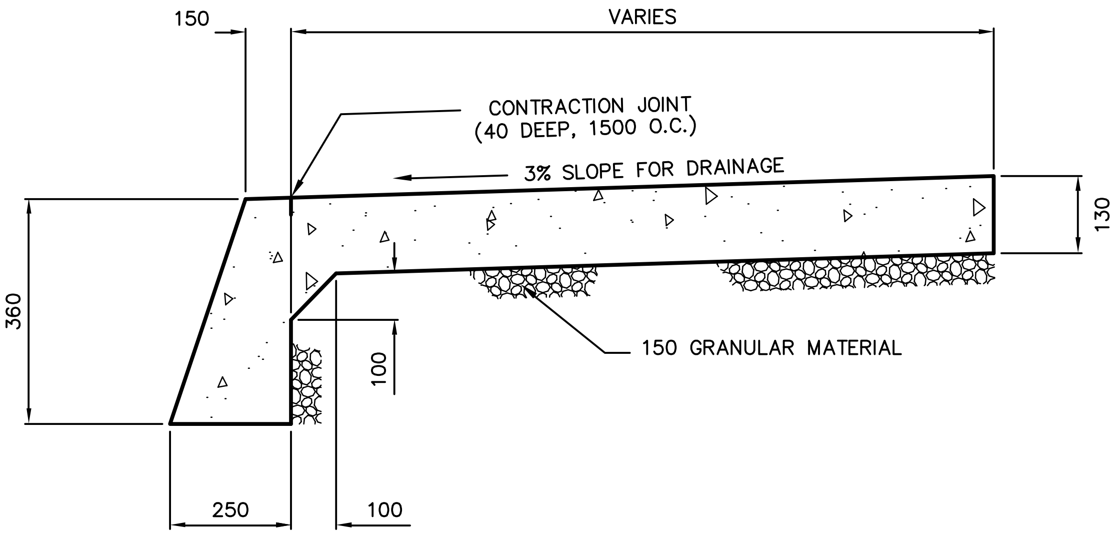
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	GRANULAR MATERIAL DEPTH	JH
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:
Structural Sidewalk Option #2

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7D.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7D



CROSS SECTION

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

2. TO BE USED IN MAINTENANCE LOCATIONS ONLY WHERE REPLACEMENT IS UNDER 30 METERS IN LENGTH.

Date	Revisions	By
Jan/03	GRANULAR MATERIAL DEPTH	JH
Jan/03	TITLE BLOCK	MLG

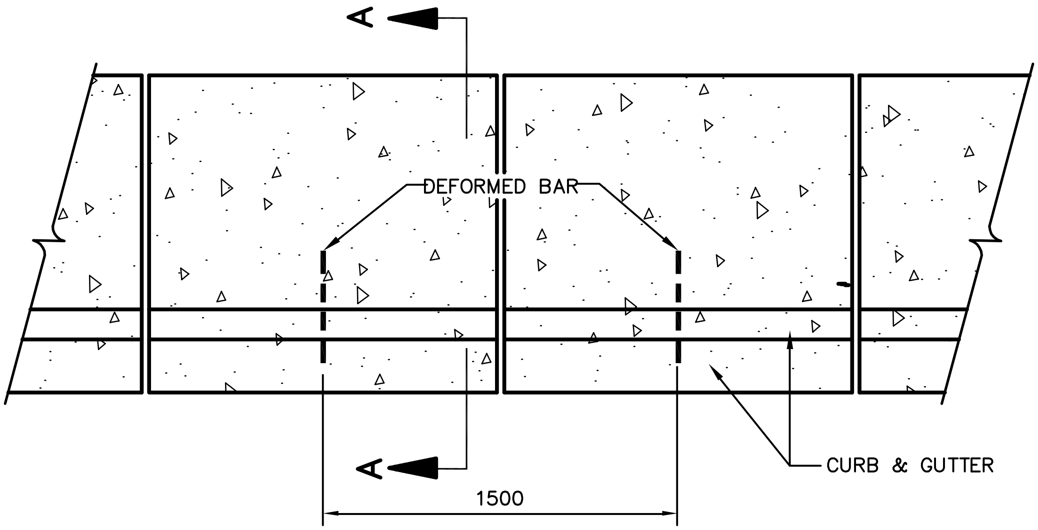
CITY OF REGINA

Engineering and Works

Description:

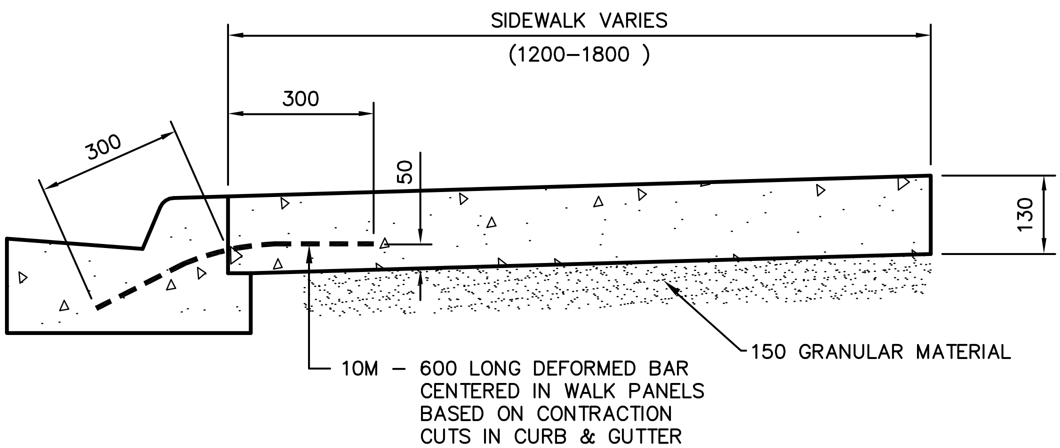
Combined Walk and Curb

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7E.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7E



PLAN

CURB & GUTTER SECTION IN
ACCORDANCE WITH R–3 OR R–4



SECTION A–A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. SEE DRAWING R–7 FOR LOCATION OF LONGITUDINAL REINFORCING.

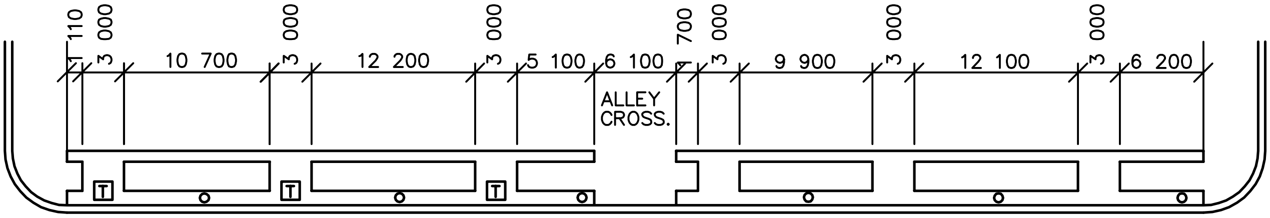
Date	Revisions	By
Jan/03	GRANULAR MATERIAL DEPTH	JH
Jan/03	TITLE BLOCK	MLG

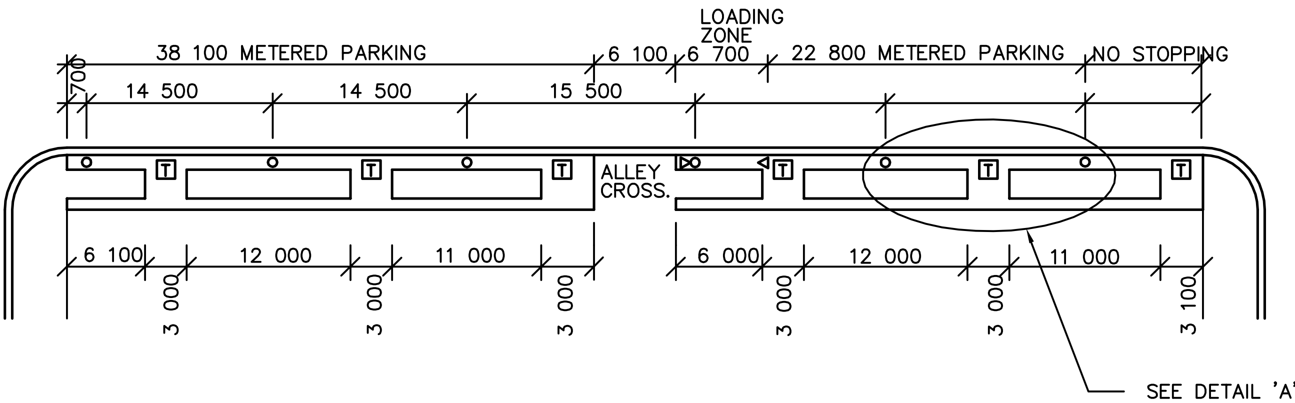
CITY OF REGINA
Engineering and Works

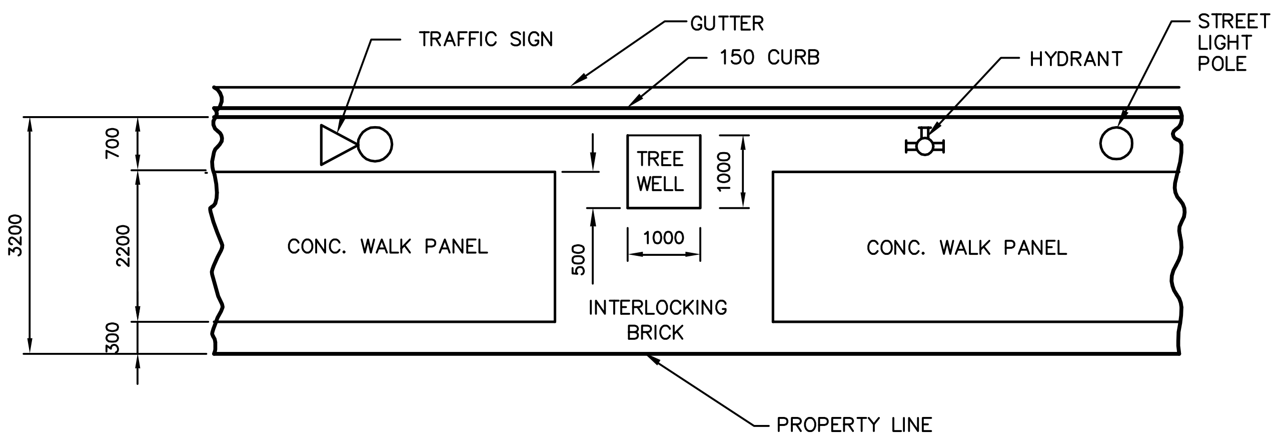
Description:

Concrete Walk

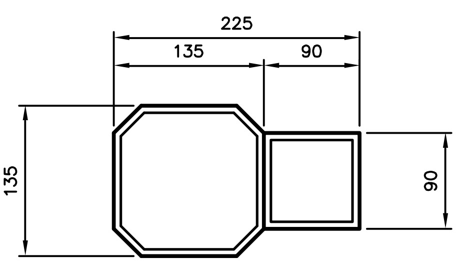
Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7F.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7F







DETAIL 'A'



PAVING STONE

NOTES:

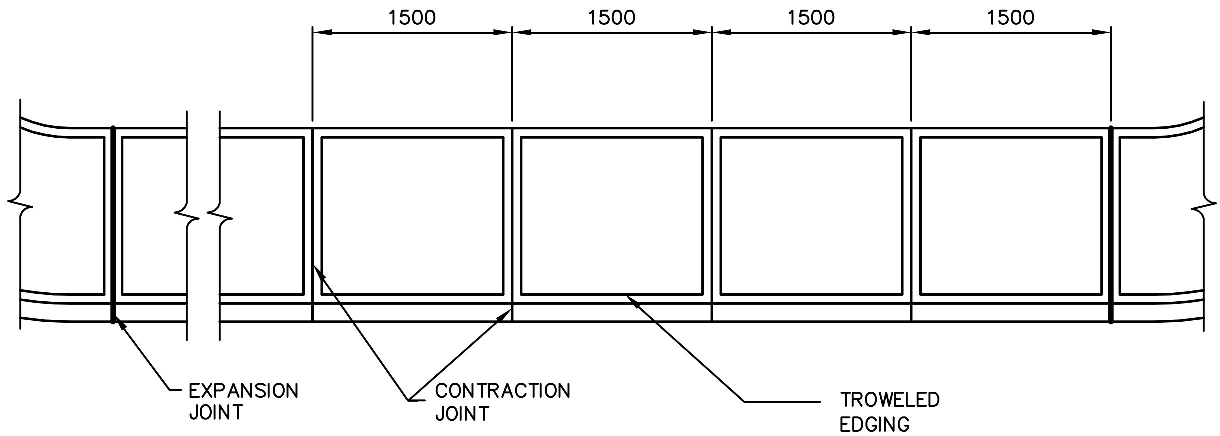
1. STREET LIGHT/METERS CENTERED ON PANELS.
2. NO PARKING WITHIN 3m OF ALLEY
3. TREE WELLS CAN BE ELIMINATED IF NECESSARY.
4. CENTRE TREE WELLS BETWEEN CONCRETE WALK PANELS
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

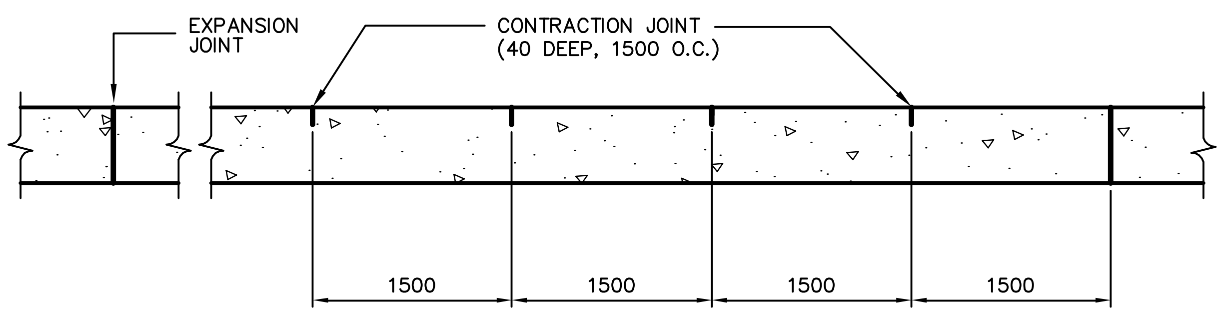
Regina
CITY OF REGINA
Engineering and Works

Description:
Typical Sidewalk Enhancement

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-7G.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-7G



PLAN



ELEVATION

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
2002-01	1500 DIMENSION CORRECTION	JH
Jan/03	TITLE BLOCK	MLG

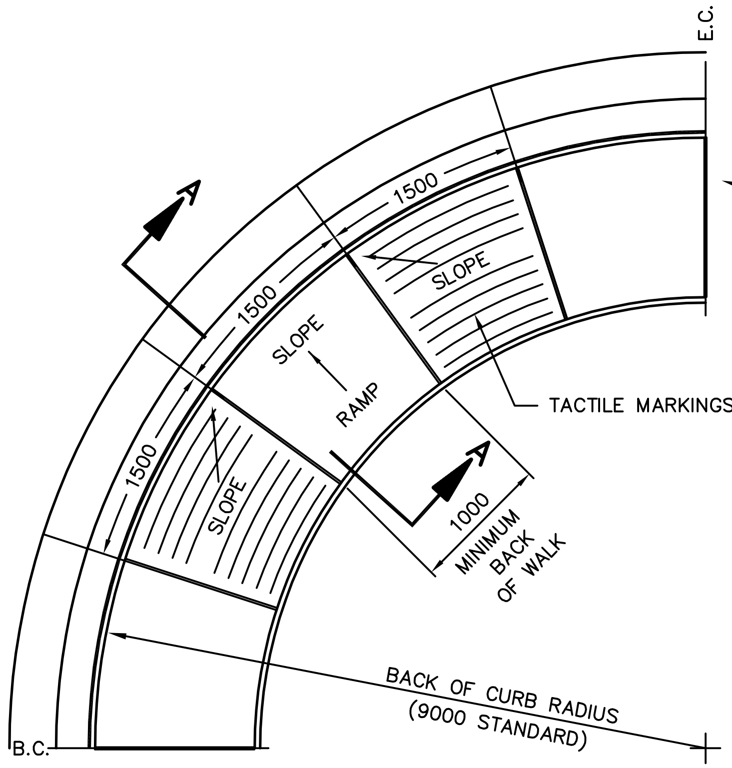
CITY OF REGINA

Engineering and Works

Description:

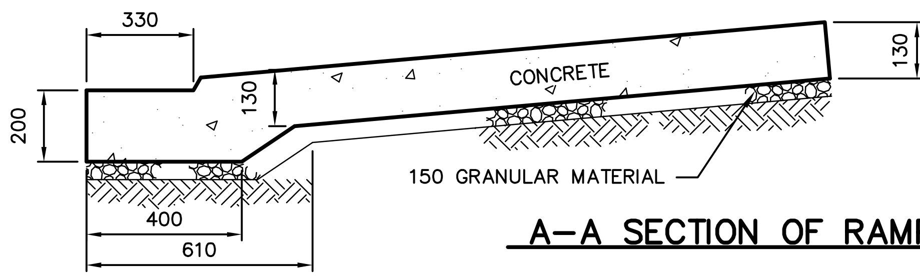
Edging and Joint Detail

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-8.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-8

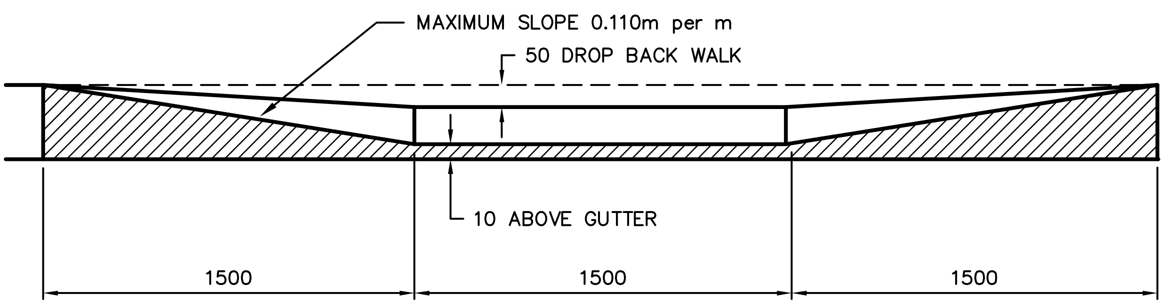


NOTE:
IF WALK DOES NOT CONTINUE BEYOND E.C., TRUNCATE WALK AT E.C.

PLAN VIEW



A–A SECTION OF RAMP



FRONT VIEW

NOTES:

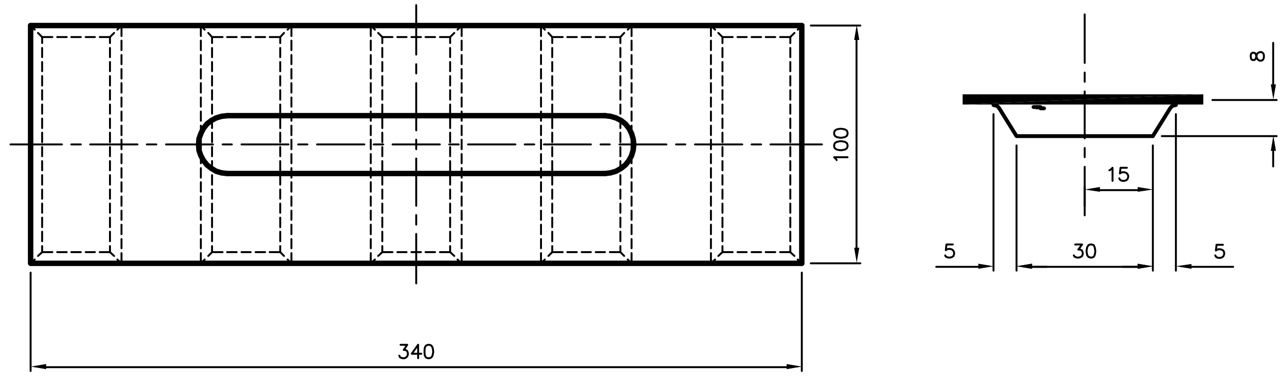
1. ALL DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED.
2. PEDESTRIAN RAMPS TO BE LOCATED AT CENTER OF RADIUS.
3. RED COLOURED PIGMENT TO BE ADDED TO CONCRETE SURFACE OF RAMP ONLY.

Date	Revisions	By
2002–01	NOTE ADDED AT E.C.	JH
Jan/03	GRANULAR MATERIAL DEPTH;	JH
Jan/03	TITLE DESCRIPTION; TITLE BLOCK	JH
Dec/04	DEPTH OF LIP	JH

Regina
CITY OF REGINA
Engineering and Works

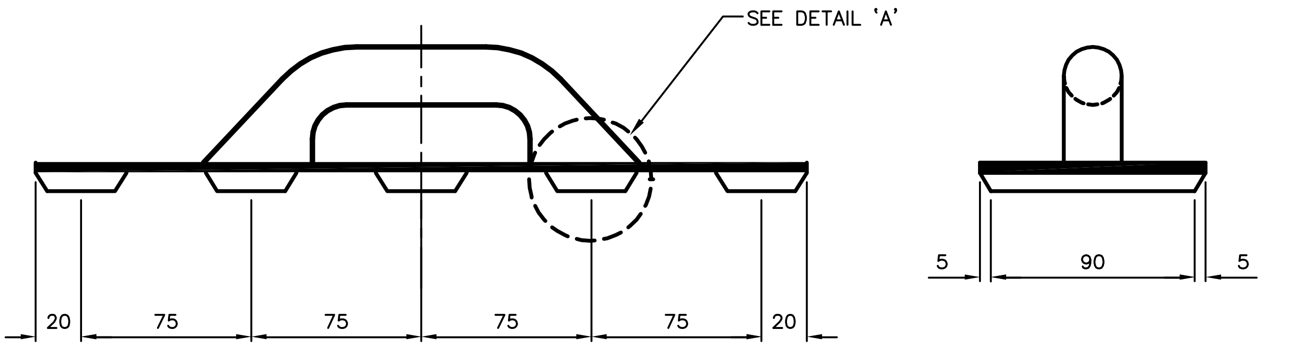
Description:
Typical Pedestrian Ramp at Radius

Manager	Date: January/98	Digital File: STDR-9A.DWG
Approved	Scale: NTS	Dwg: R-9A



TOP VIEW

DETAIL 'A'



SIDE VIEW

END VIEW

NOTE:
ALL DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED.

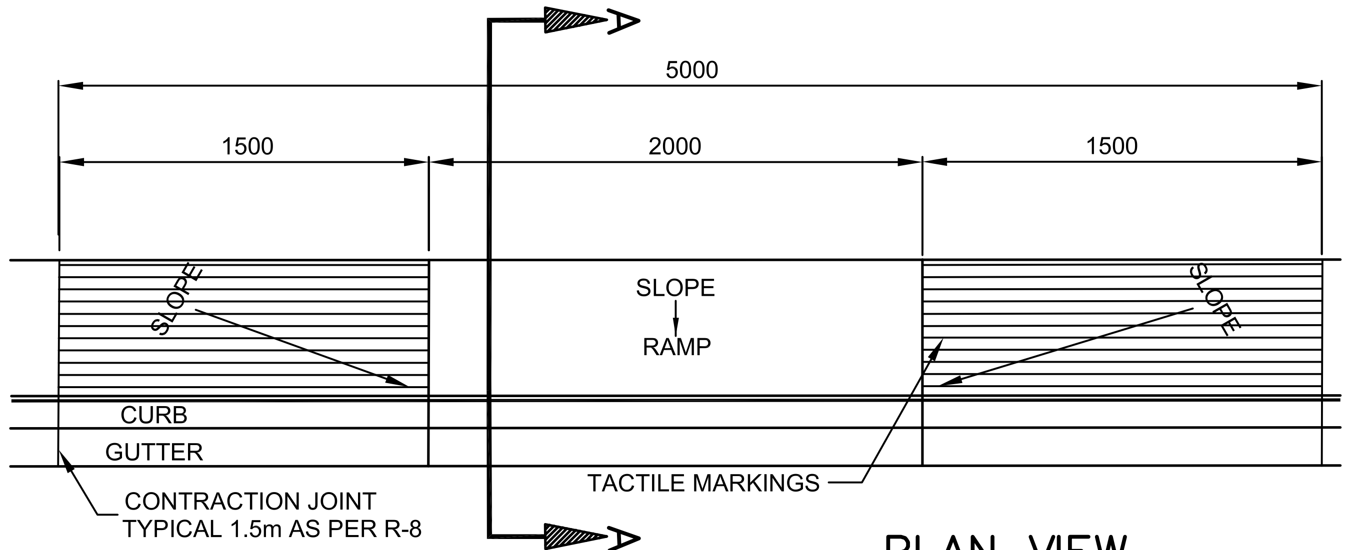
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

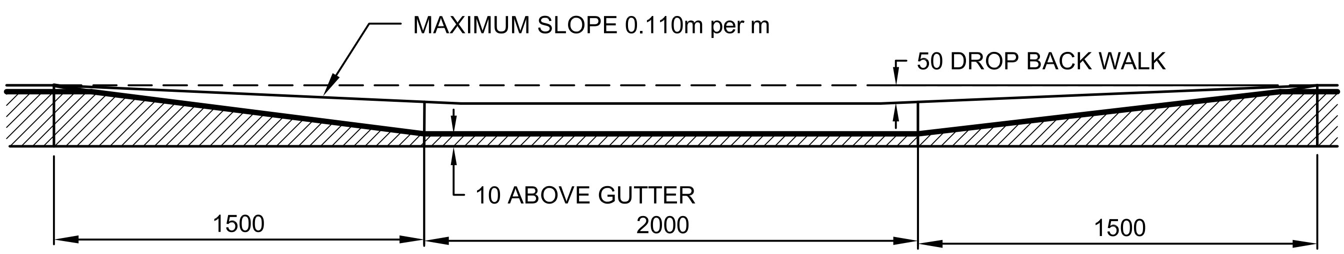
Description:

Tactile Marking Tool

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-9B.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-9B



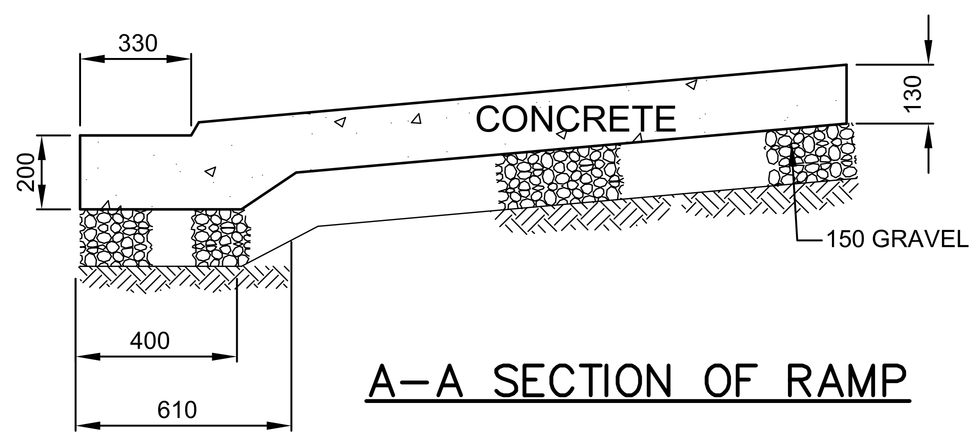
PLAN VIEW



FRONT VIEW

NOTES:

1. ALL DIMENSIONS ARE MILLIMETRES UNLESS OTHERWISE NOTED.
2. PATHWAY RAMPS TO BE LOCATED AT CENTER OF PATHWAY.
3. RED COLOURED PIGMENT TO BE ADDED TO CONCRETE SURFACE OF RAMP ONLY.



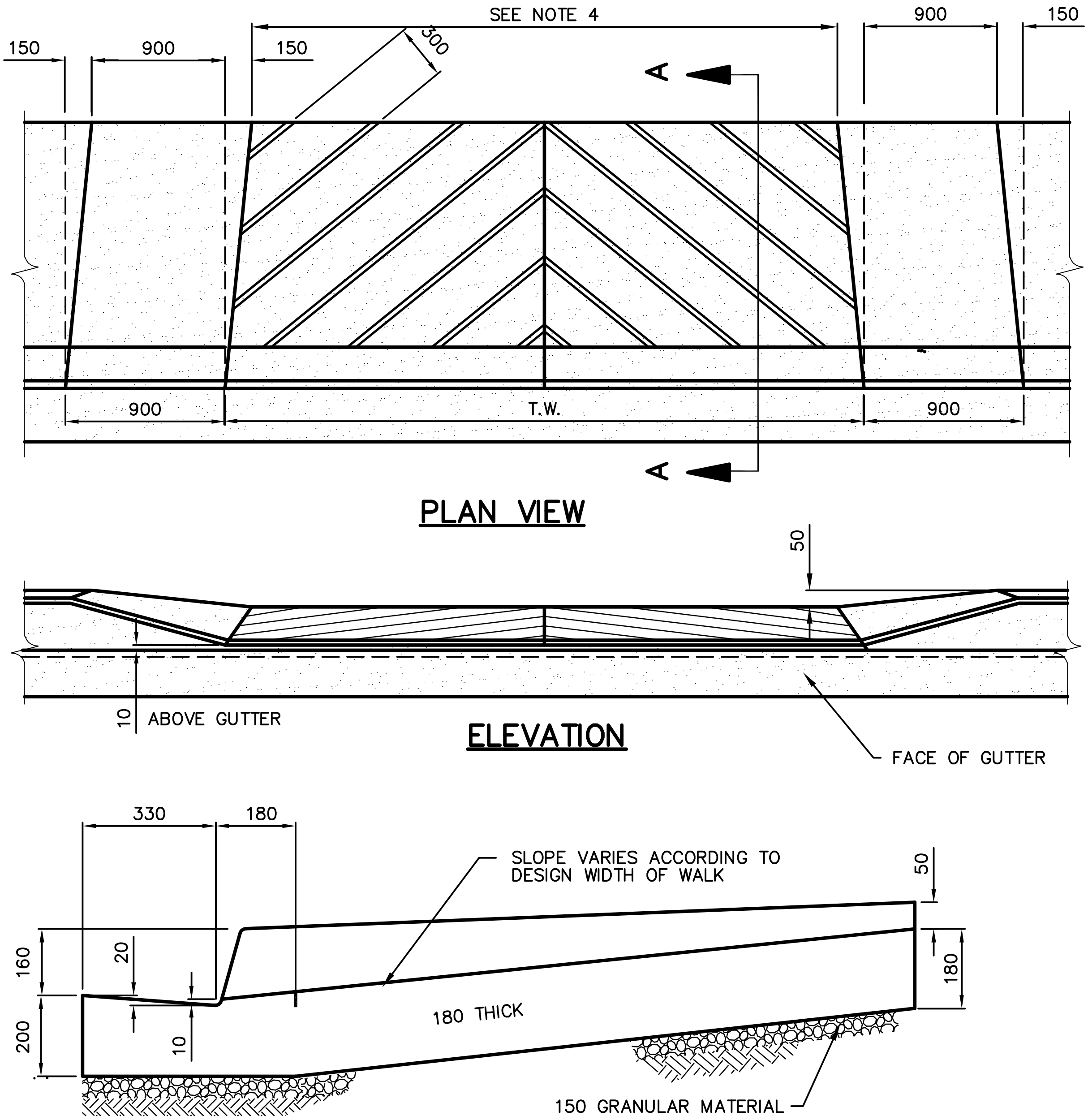
A—A SECTION OF RAMP

Date	Revisions	By
Dec/04	DEPTH OF LIP	JH

Regina
CITY OF REGINA
Engineering and Works

Description:
Typical Pathway Ramp at Mid-Block Crossing

Manager	Date: January/ 03	Digital File: STDR-9C.dwg
Approved	Scale: NTS	Dwg: R-9C



NOTES:

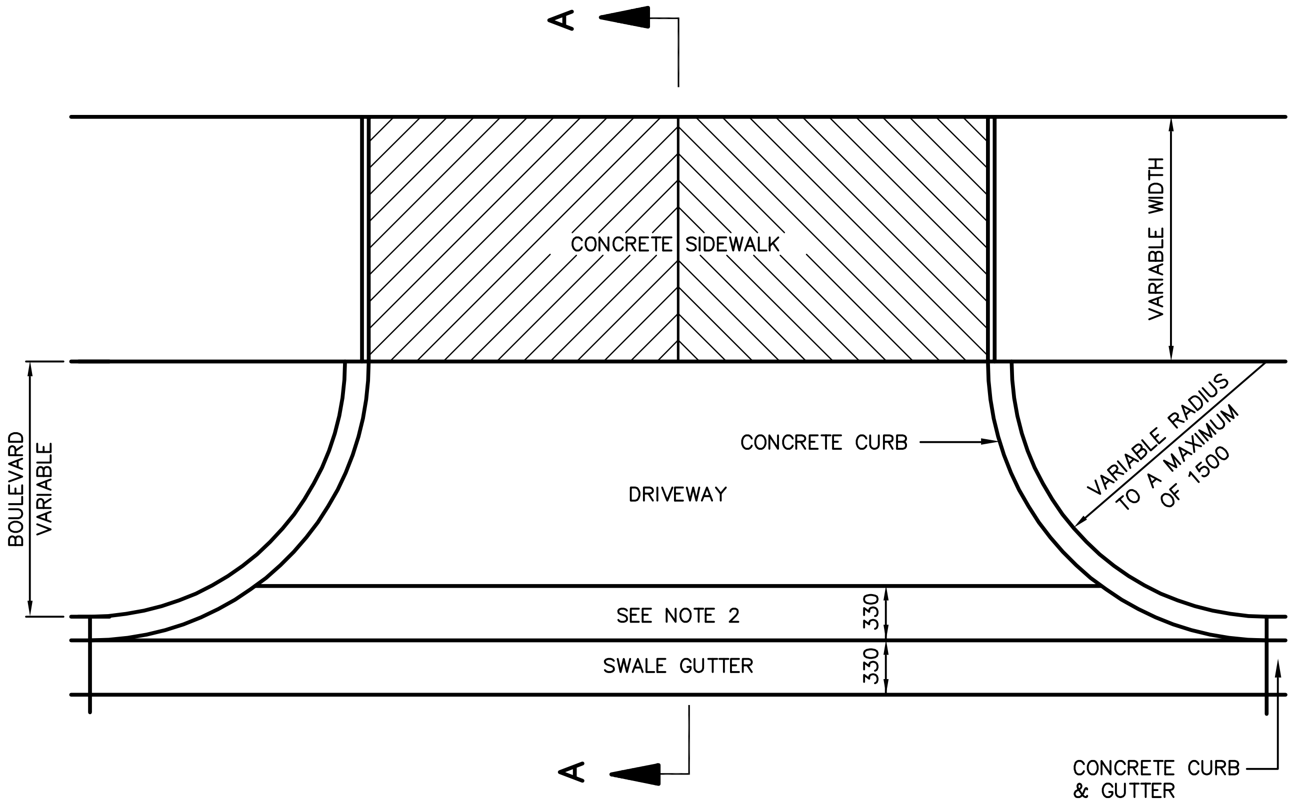
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. SEE DRAWING R–7A AND SECTION 2550 FOR LOCATION AND APPLICATION OF REINFORCING.
3. DIAGONAL JOINTS MAY BE ELIMINATED AT PRIVATE CROSSINGS IN RESIDENTIAL AREAS
4. WIDTH AT BOW TO MATCH ALLEY PAVEMENT WIDTH SHOWN IN R–2C FOR ALLEY CROSSINGS

Date	Revisions	By
2001–01	WIDTH AT ALLEY	
Jan/03	GRANULAR MAT'L DEPTH; NOTE 2.	JH
Jan/03	TITLE BLOCK	MLG
Dec/04	DEPTH OF LIP	JH

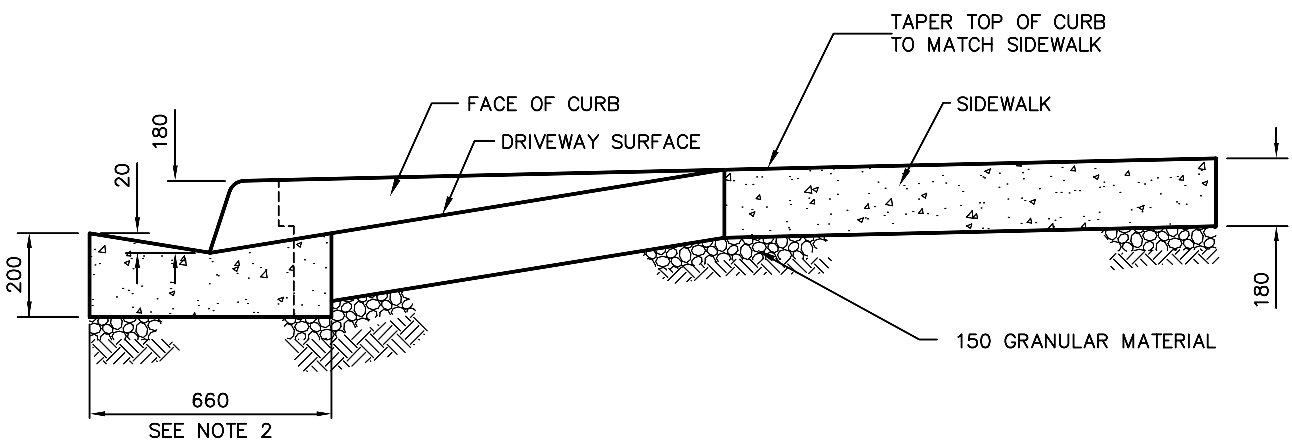
CITY OF REGINA
Engineering and Works

Description:
Combined Concrete Walk Curb and Gutter Crossing

Manager	Date: January/98	Digital File: STDR-10.DWG
Approved	Scale: NTS	Dwg: R-10



PLAN VIEW



SECTION A–A

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. USE 550 SWALE IF BOULEVARD DRIVEWAY IS CONCRETE.
3. SEE DRAWING R–7A AND SECTION 2550 FOR LOCATION AND APPLICATION OF REINFORCING.

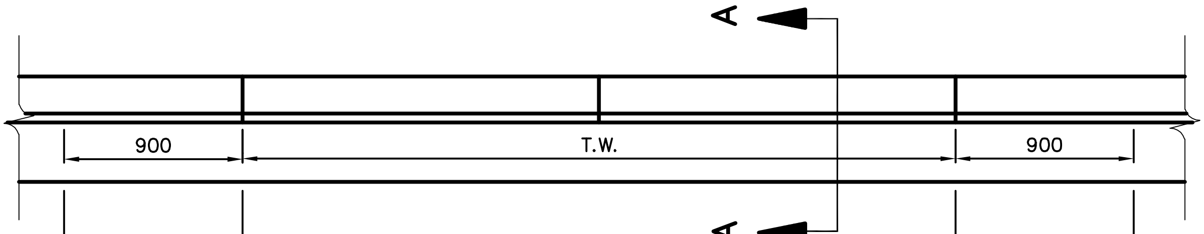
Date	Revisions	By
Jan/03	GRANULAR MAT'L DEPTH: NOTE 3.	JH
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

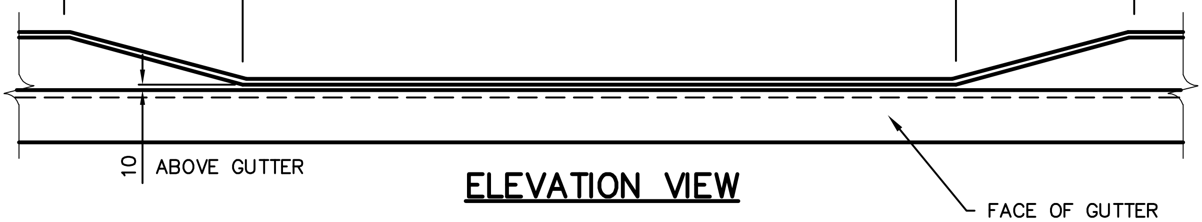
Description:

Curb and Gutter Crossing With Boulevard

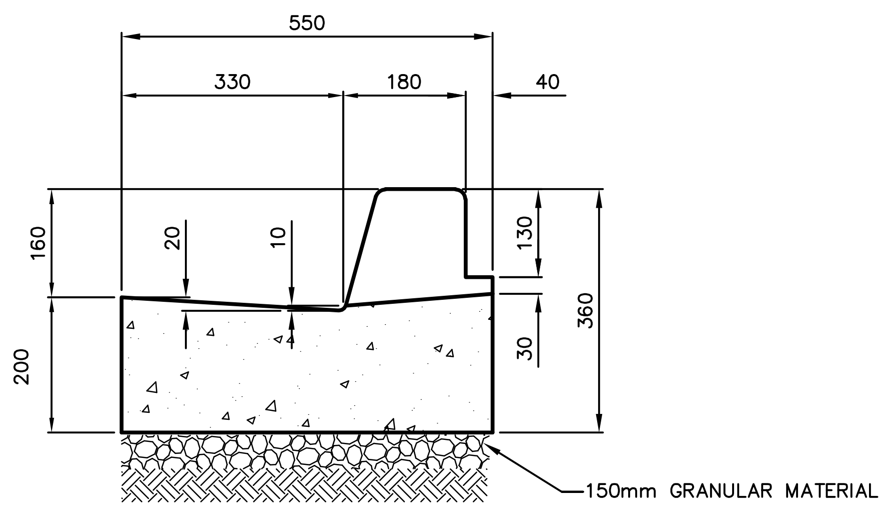
Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-10A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-10A



PLAN VIEW



ELEVATION VIEW



SECTION A–A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

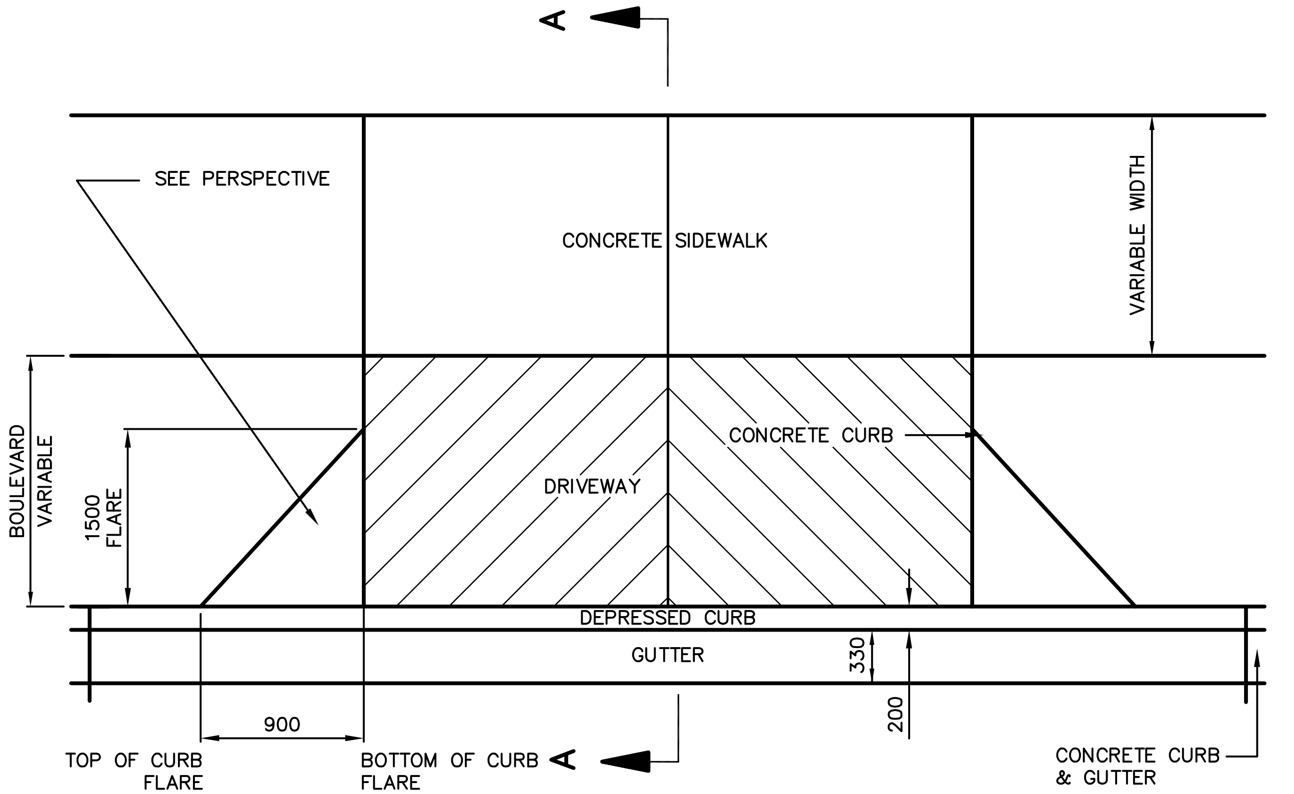
2. SEE DRAWING R–4 AND SECTION 2550 FOR LOCATION OF REINFORCING AND DETAILED DIMENSIONS FOR CURB AND GUTTER.

Date	Revisions	By
Jan/03	GRANULAR MATERIAL DEPTH	JH
Jan/03	TITLE BLOCK	MLG
Dec/04	DEPTH OF LIP & NOTE	JH

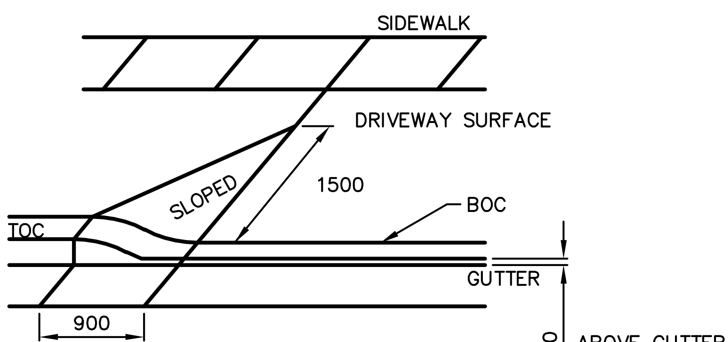
Regina
CITY OF REGINA
Engineering and Works

Description:
Concrete Curb and Gutter Crossing

Manager	Date	Digital File:
HARLAN RITCHIE	January/01	STDR-10B.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-10B



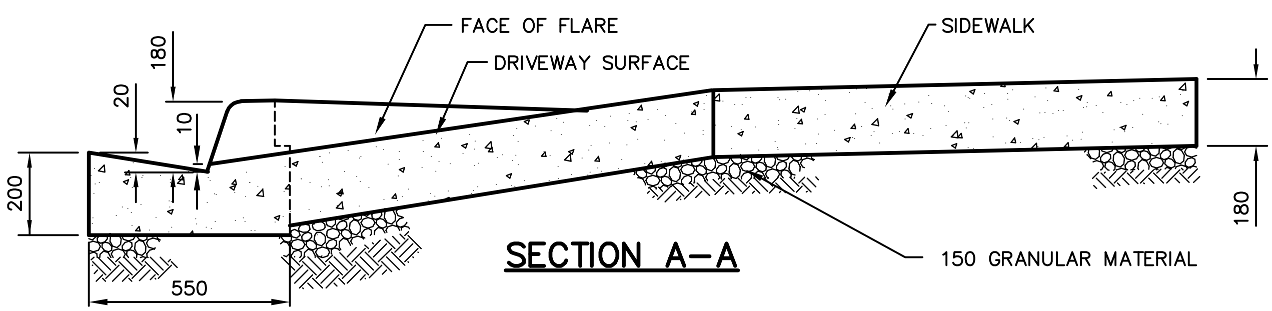
PLAN VIEW



PERSPECTIVE

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. TO BE USED ON STREETS THAT HAVE EXISTING BARRIER CURB.



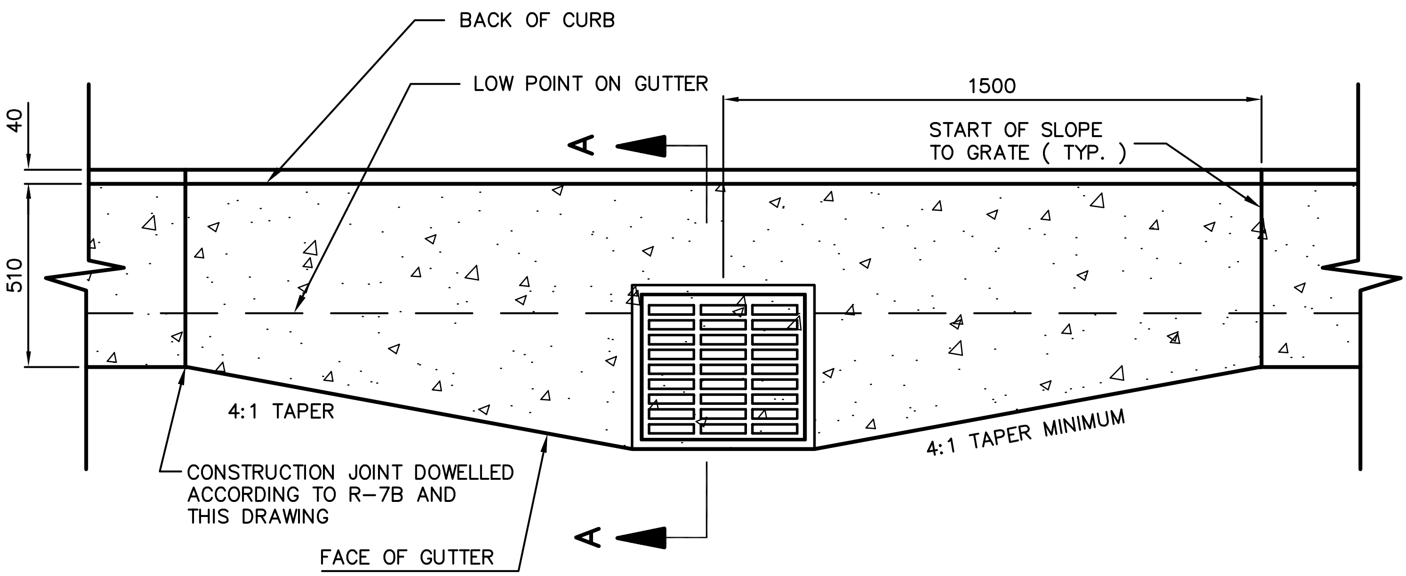
SECTION A–A

Date	Revisions	By
Jan/03	GRANULAR MATERIAL DEPTH	JH
Jan/03	TITLE BLOCK	MLG
Dec/04	DEPTH OF LIP	JH

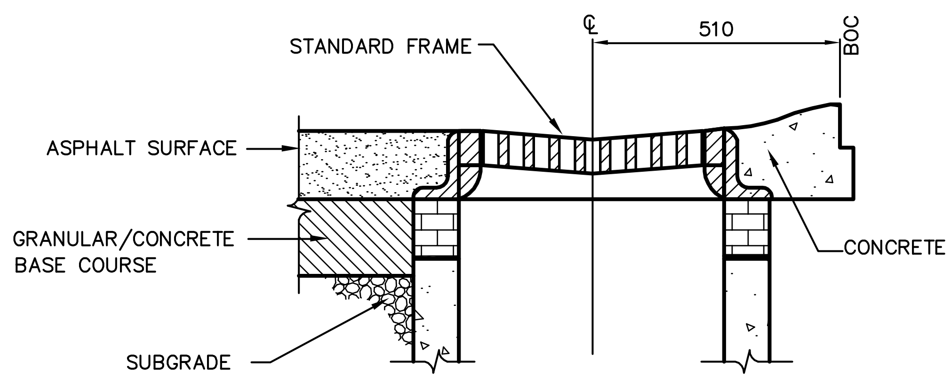
Regina
CITY OF REGINA
Engineering and Works

Description:
Curb and Gutter Residential Crossing with Boulevard

Manager	Date: January/01	Digital File: STDR-10C.DWG
Approved	Scale: NTS	Dwg: R-10C



ROLLED CURB & GUTTER



SECTION A–A

NOTES:

1. UNITS SHOWN ARE MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	CONSTRUCTION JOINT	JH
Jan/03	TITLE BLOCK	MLG

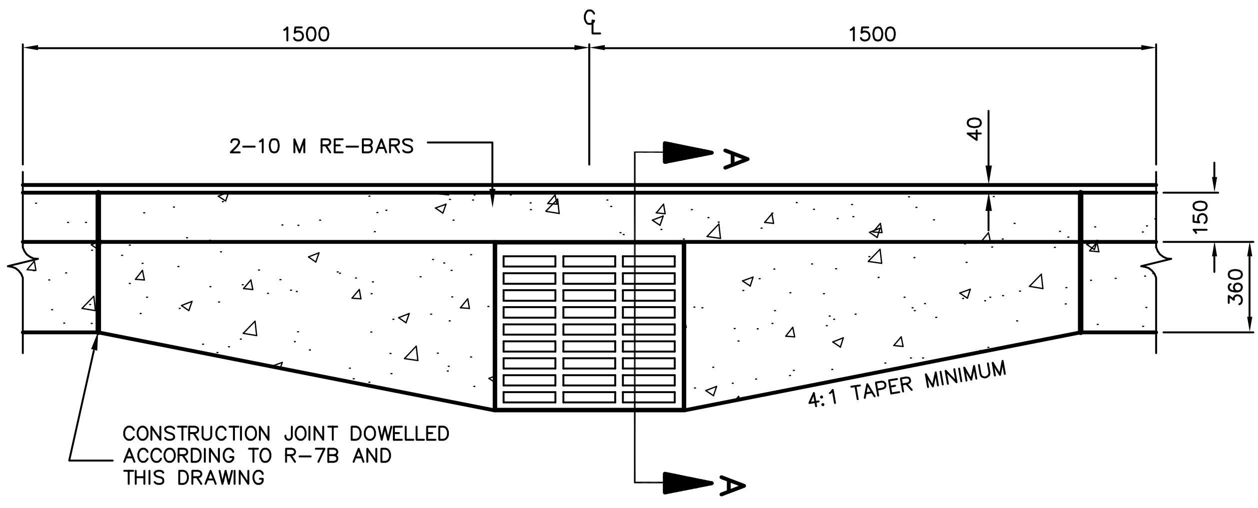
CITY OF REGINA

Engineering and Works

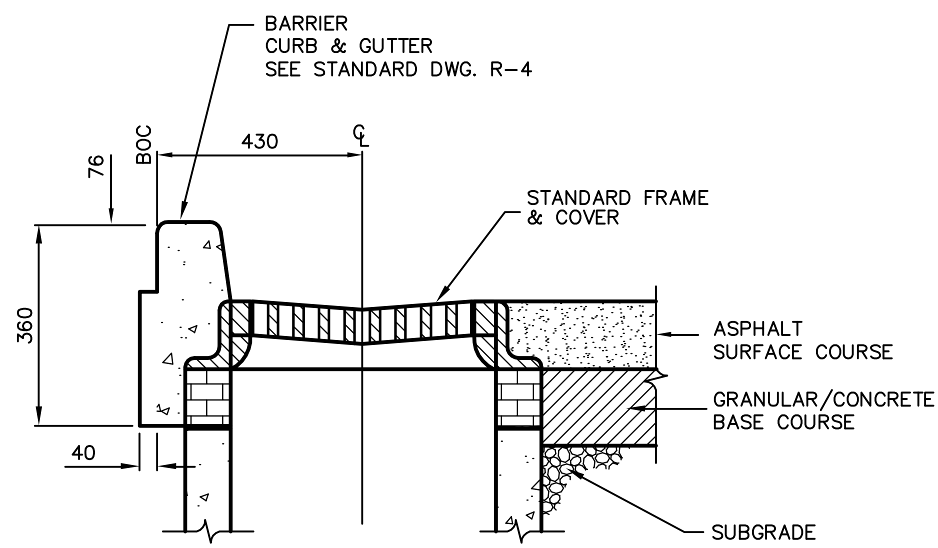
Description:

Catch Basin Box-Out (Rolled Curb)

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-11.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-11



SECTION OF RAMP



SECTION A–A

NOTES:

1. UNITS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

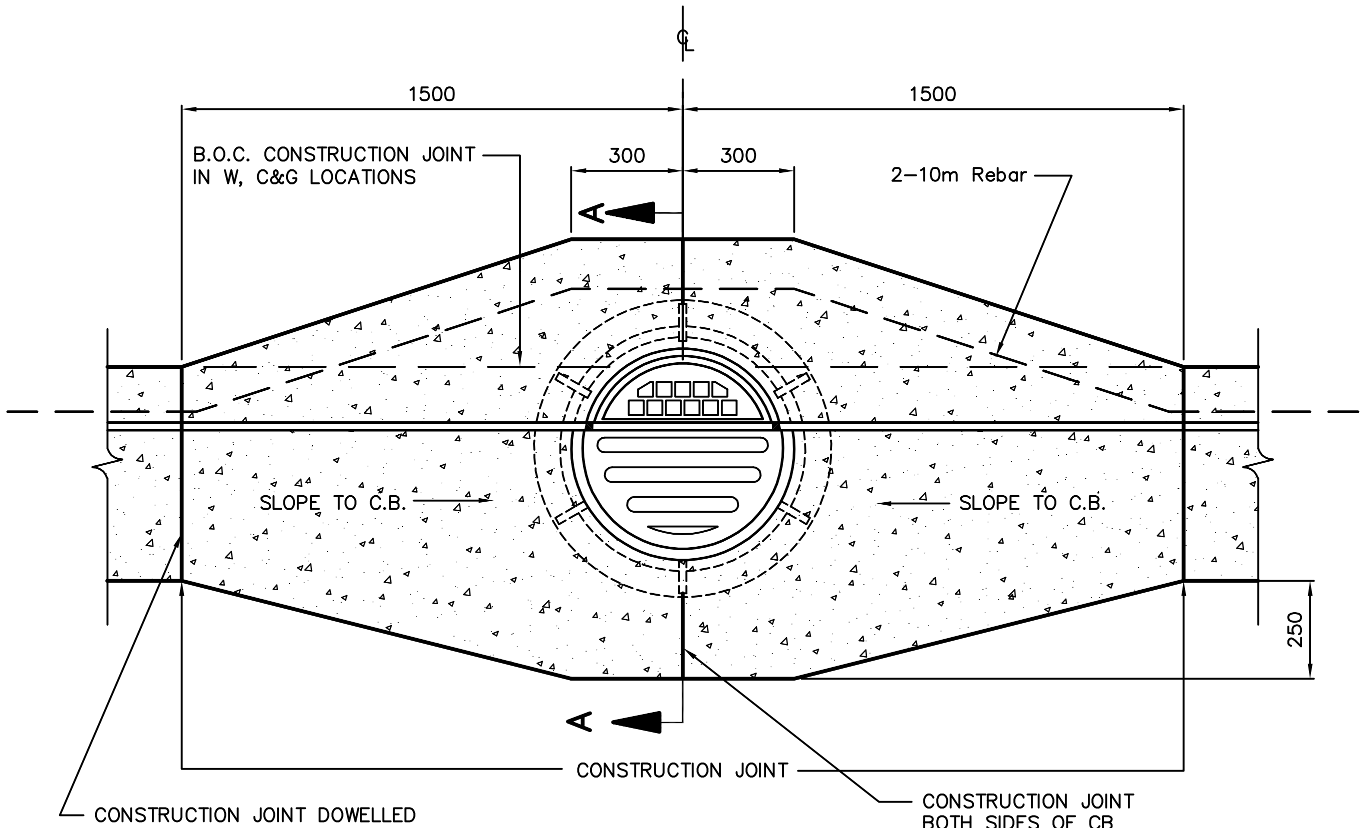
Date	Revisions	By
Jan/03	CONSTRUCTION JOINT; TAPER	JH
Jan/03	REBAR REMOVED; TITLE BLOCK	JH

Regina
CITY OF REGINA
Engineering and Works

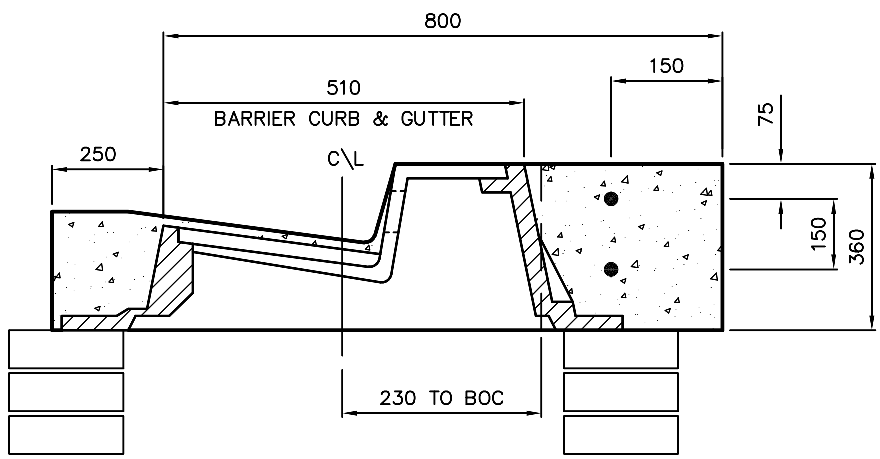
Description:

Catch Basin Box-Out (Barrier Curb and Gutter)

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-11A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-11A



PLAN VIEW



SECTION A–A

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. BACK OF BURB REBAR REQUIRED FOR COLLECTOR AND ARTERIAL STREETS

Date	Revisions	By
Jan/03	CONSTRUCTION JOINT; TAPER	JH
Jan/03	BOX OUT AT F.O.G; TITLE BLOCK	JH
Jan/05	REBAR ADDED	JH

Regina

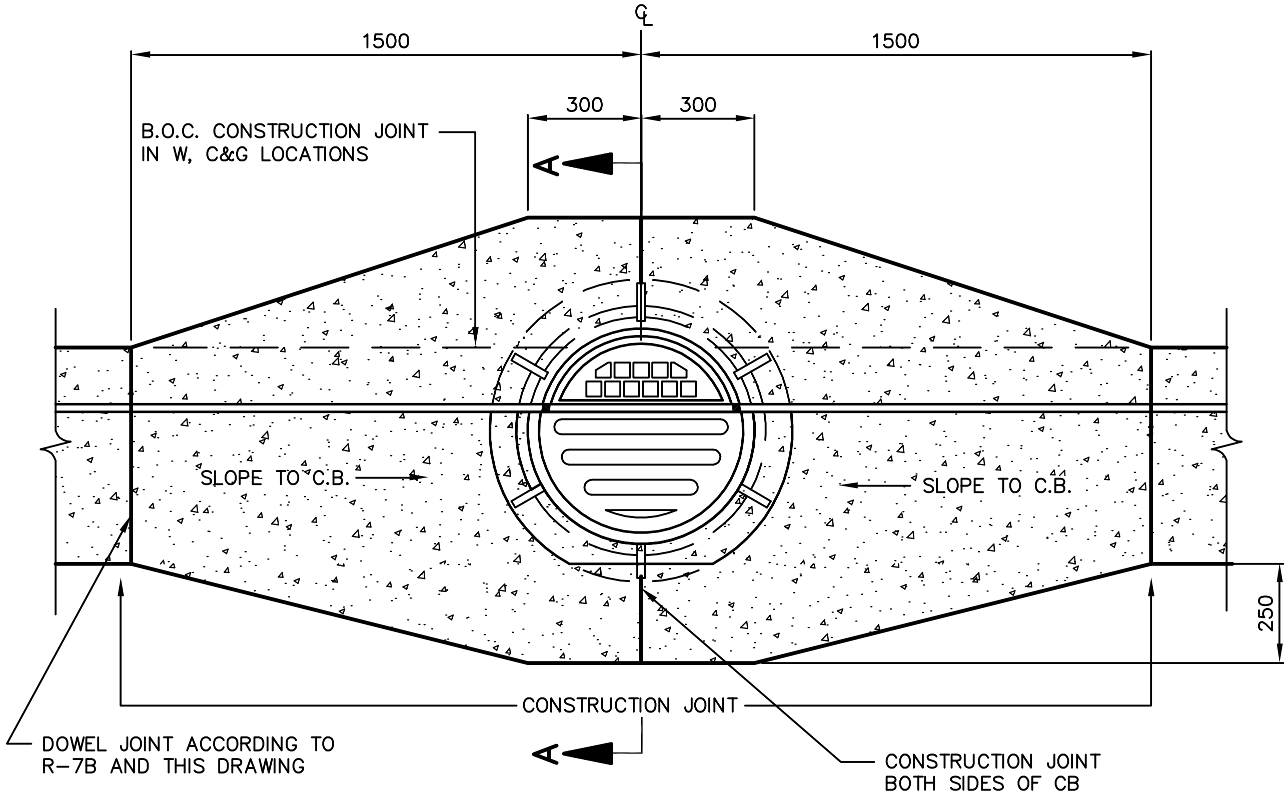
CITY OF REGINA

Engineering and Works

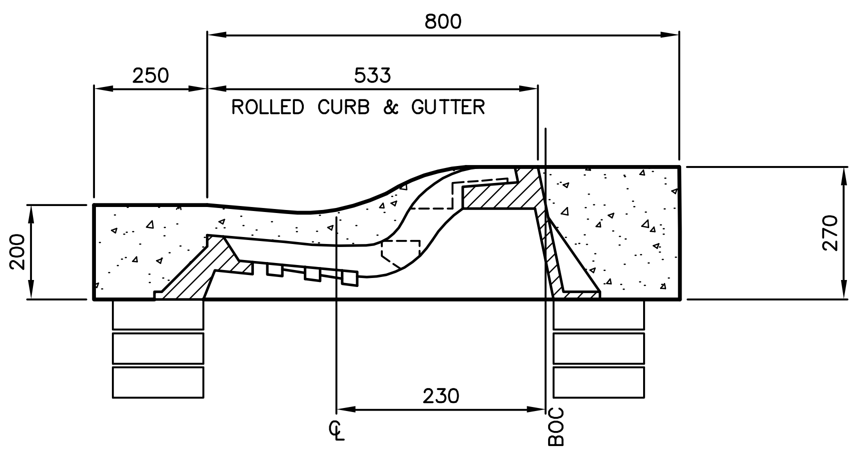
Description:

Box-Out for Side Inlet Catch Basins (Barrier Curb)

Manager: HARLAN RITCHIE	Date: January/98	Digital File: STDR-11B.DWG
Approved: DAVID CALAM	Scale: NTS	Dwg: R-11B



PLAN VIEW



SECTION A–A

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

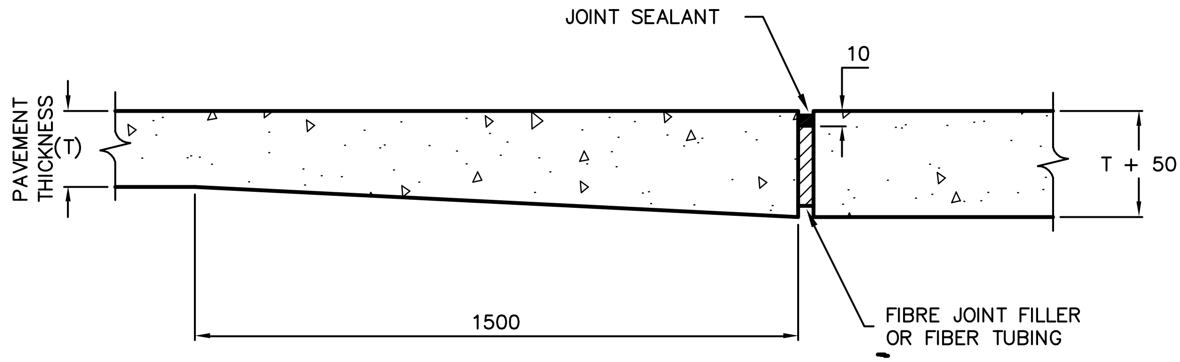
Date	Revisions	By
Jan/03	CONSTRUCTION JOINT; TAPER	JH
Jan/03	BOX OUT AT F.O.G; TITLE BLOCK	JH

Regina
CITY OF REGINA
Engineering and Works

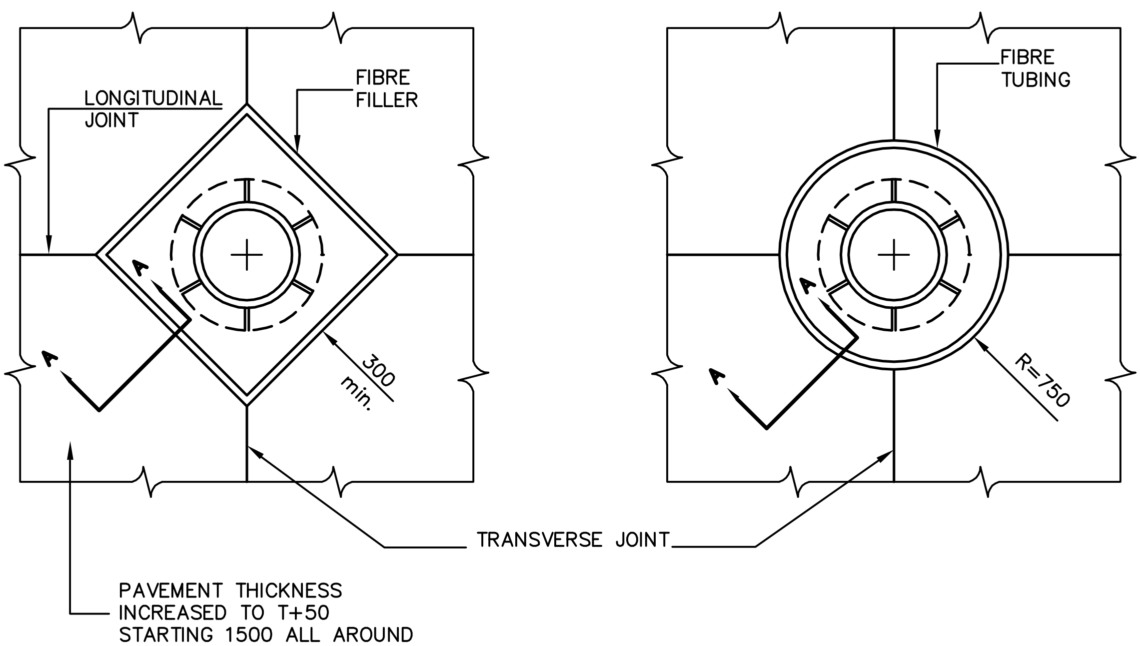
Description:

Box-Out for Side Inlet Catch Basins (Rolled Curb)

Manager: HARLAN RITCHIE	Date: January/98	Digital File: STDR-11C.DWG
Approved: DAVID CALAM	Scale: NTS	Dwg: R-11C



SECTION A–A
FOR MANHOLE



NOTES:

1. ALL MANHOLES SHALL BE ISOLATED FROM THE PAVEMENT BY BOXING OUT WITH EITHER RECTANGULAR OR CIRCULAR CONFIGURATION SHOWN ABOVE. JOINT FILLER MATERIAL SHALL EXTEND COMPLETELY THROUGH THE SLAB.

2. WHEN A TRANSVERSE JOINT FALLS WITHIN 1500 OR CONTACTS A MANHOLE, SHORTEN ONE OR MORE PANELS EITHER SIDE OF OPENING TO ASSURE JOINT IS ALIGNED WITH THE CENTER OF THE MANHOLE FRAME.

3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

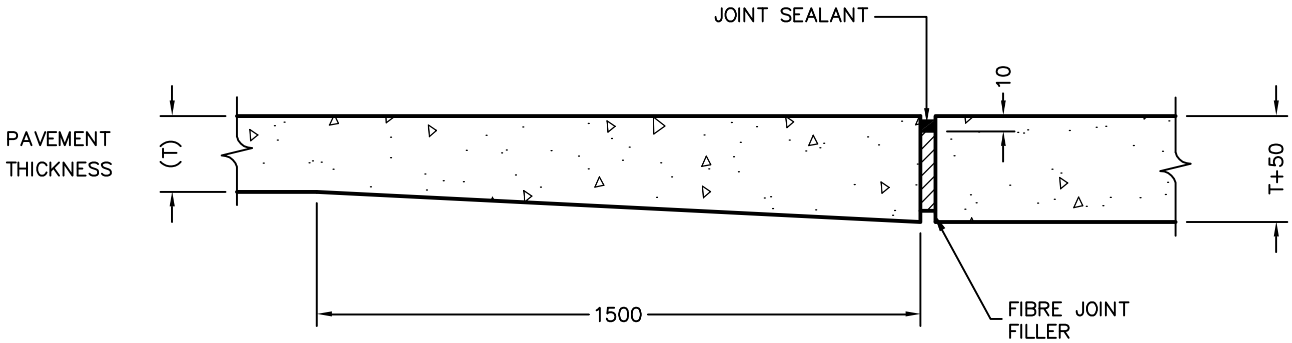
CITY OF REGINA

Engineering and Works

Description:

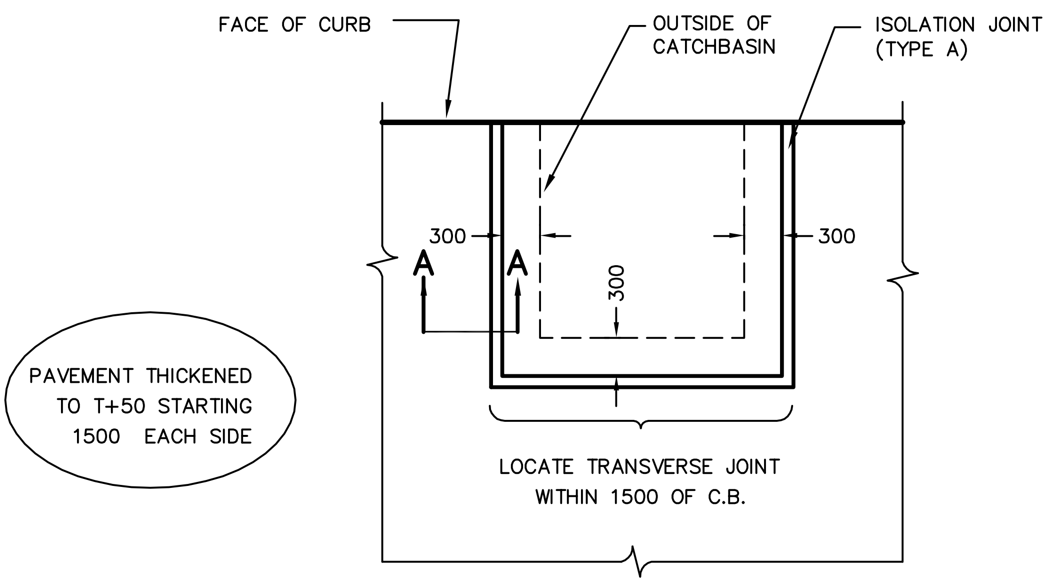
Concrete Pavement Manhole Isolation Detail

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-11D.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-11D



SECTION A–A

ISOLATION JOINT FOR CATCH BASIN TYPE "A"



NOTES:

1. ALL CATCH BASINS SHALL BE ISOLATED FROM THE PAVEMENT AND CURB BY BOXING OUT AROUND AS SHOWN ABOVE. JOINT FILLER MATERIAL SHALL EXTEND COMPLETELY THROUGH CURB AND SLAB.

2. WHEN A JOINT FALLS WITHIN 1500 OF, OR CONTACTS CATCH BASINS OR OTHER STRUCTURES, SHORTEN ONE OR MORE PANELS EITHER SIDE OF OPENING TO ASSURE TRANSVERSE JOINT FALLS AT OR BETWEEN CORNERS OF ISOLATION BOX–OUT.

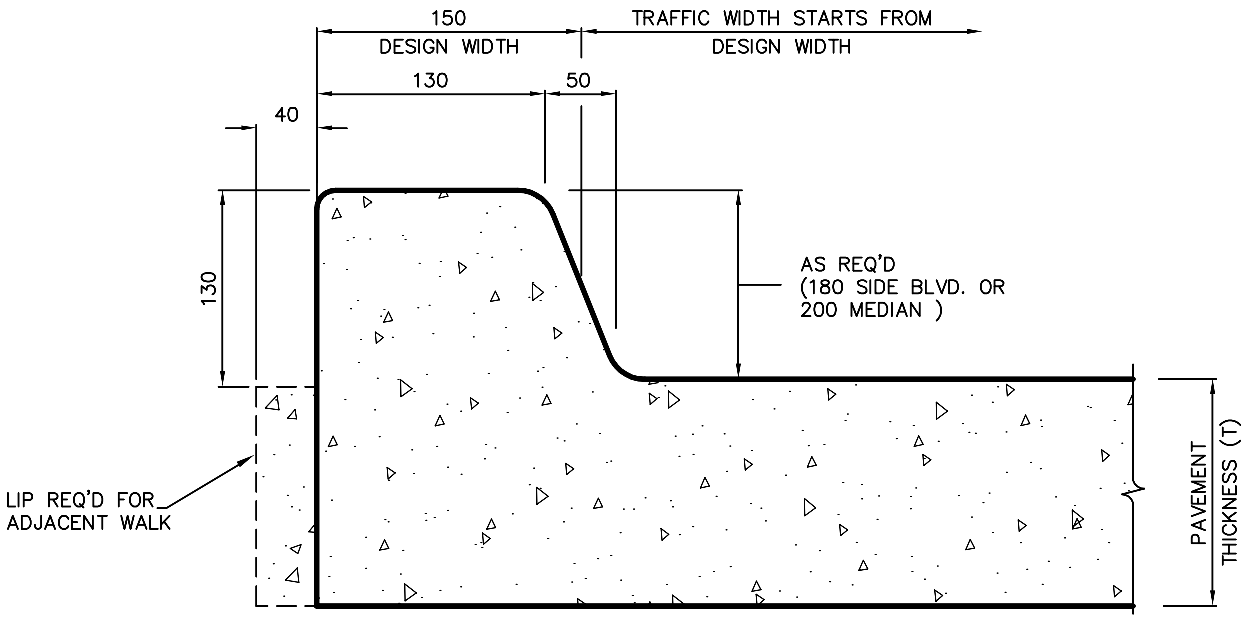
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:
Concrete Pavement
Catch Basin Isolation Detail

Manager: HARLAN RITCHIE	Date: January/98	Digital File: STDR-11E.DWG
Approved: DAVID CALAM	Scale: NTS	Dwg: R-11E



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

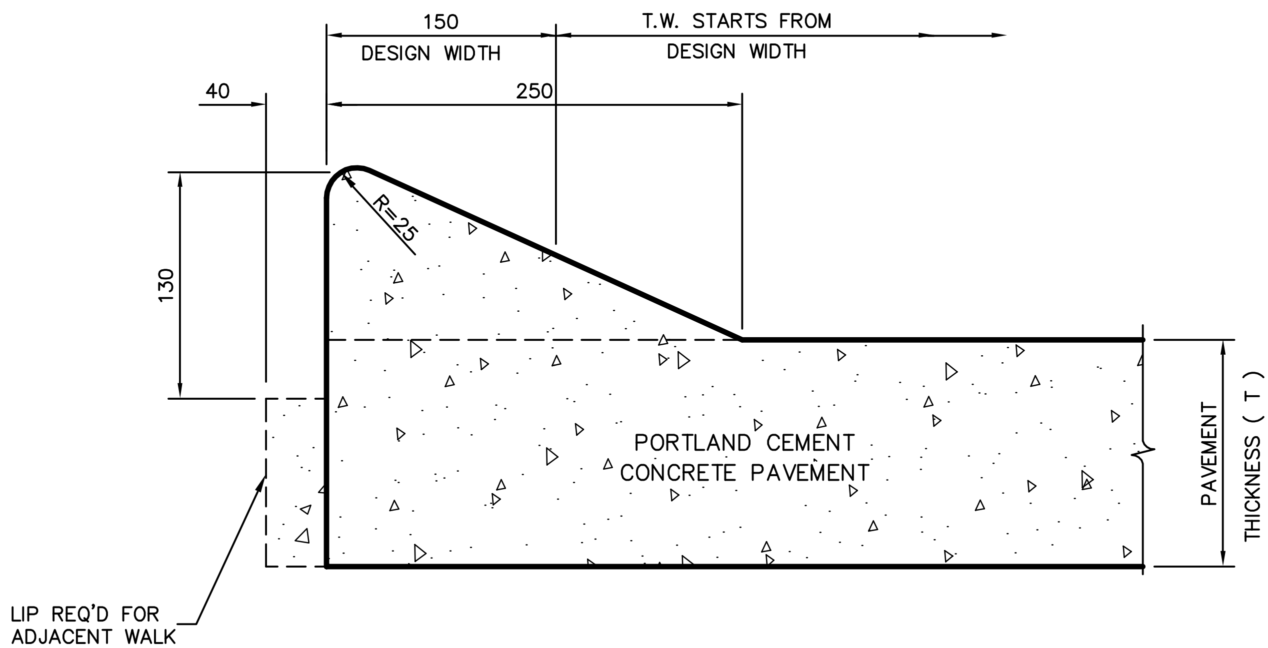
CITY OF REGINA

Engineering and Works

Description:

Concrete Pavement Barrier Curb (Integral)

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-12.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-12



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

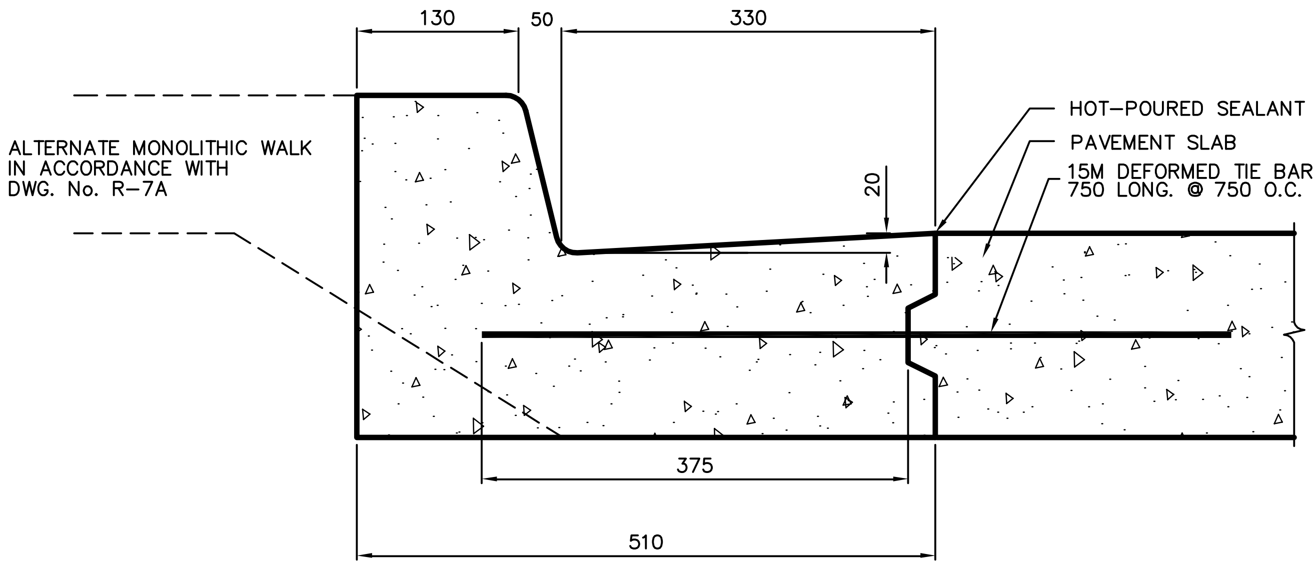
CITY OF REGINA

Engineering and Works

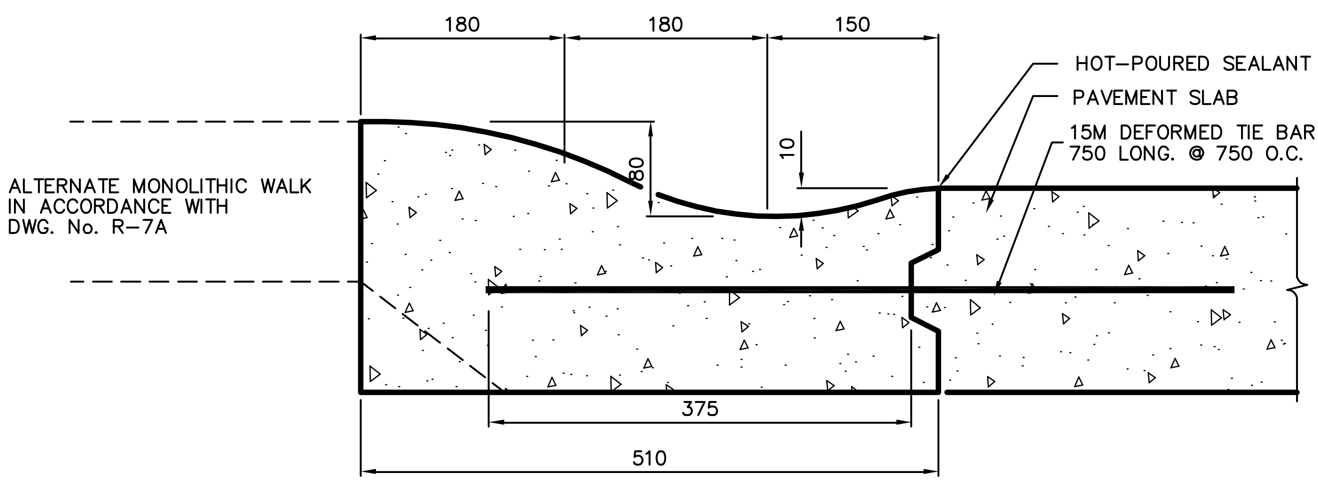
Description:

Concrete Pavement Lip Curb (Integral)

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-12A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-12A



BARRIER
CURB & GUTTER



ROLLED
CURB & GUTTER

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

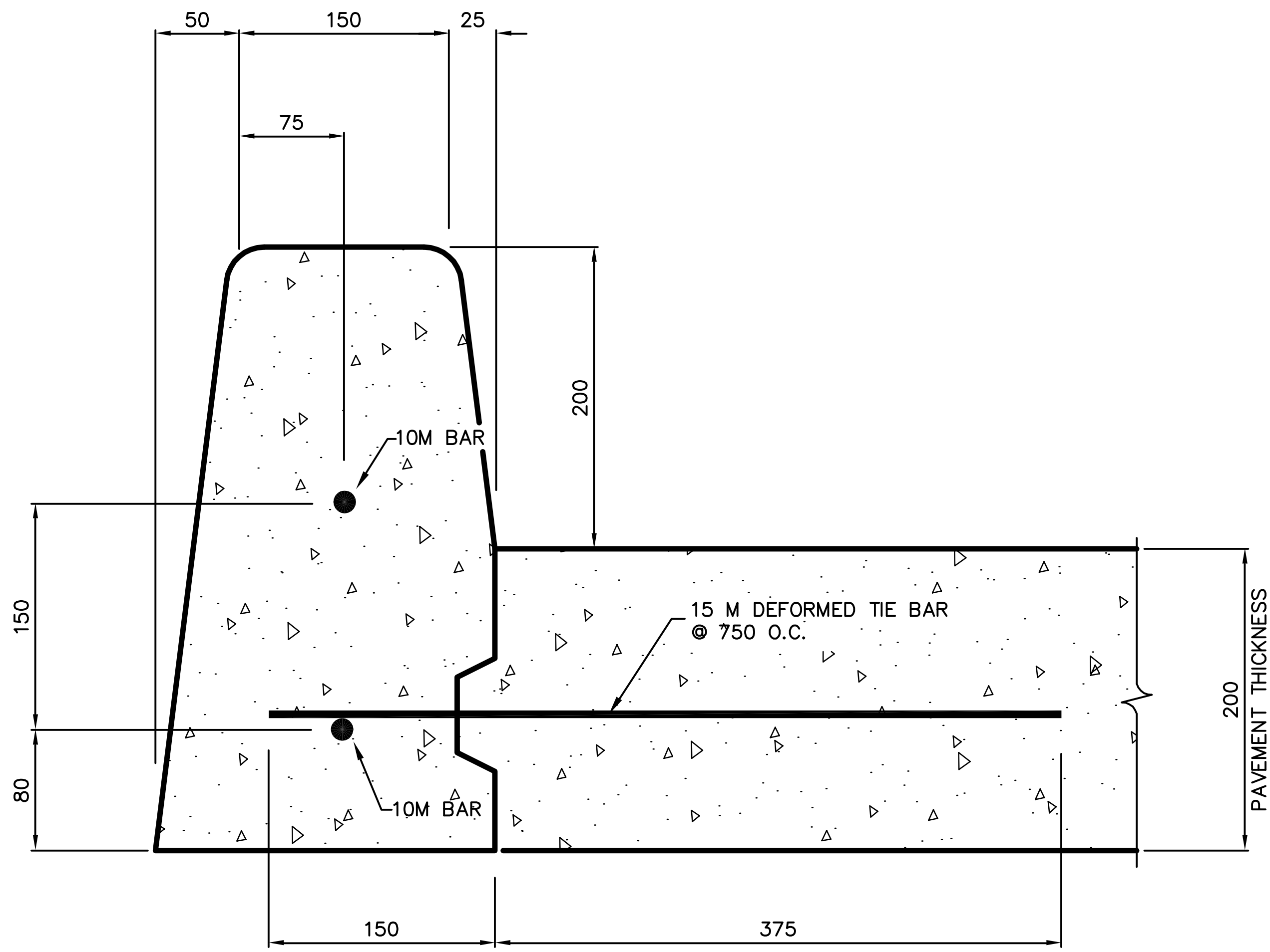
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:

Concrete Pavement Curb and Gutter Tie to Pavemnet

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-13.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-13



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina

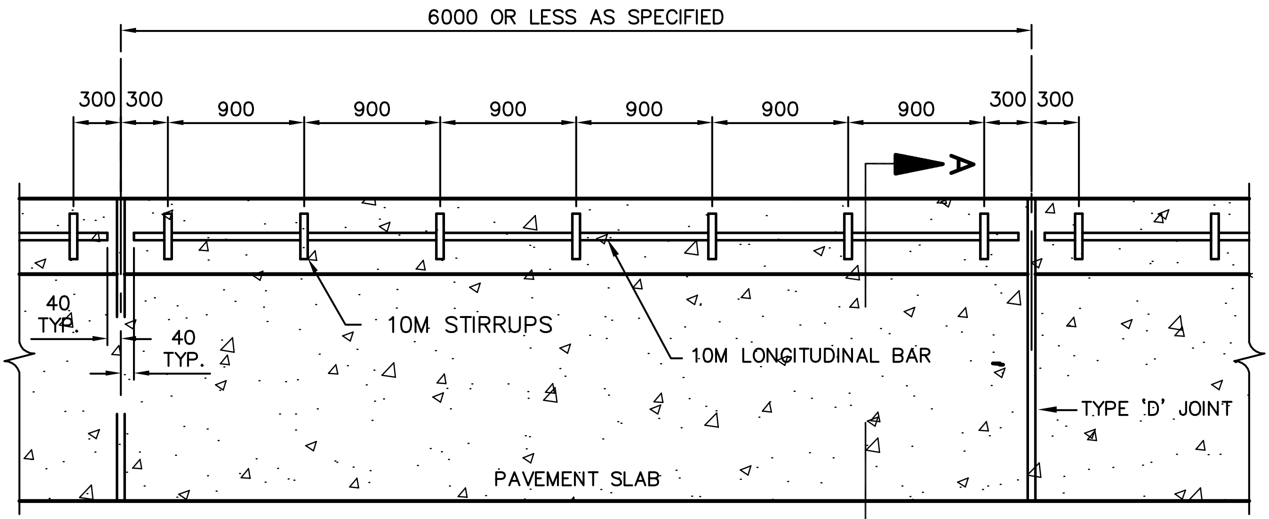
CITY OF REGINA

Engineering and Works

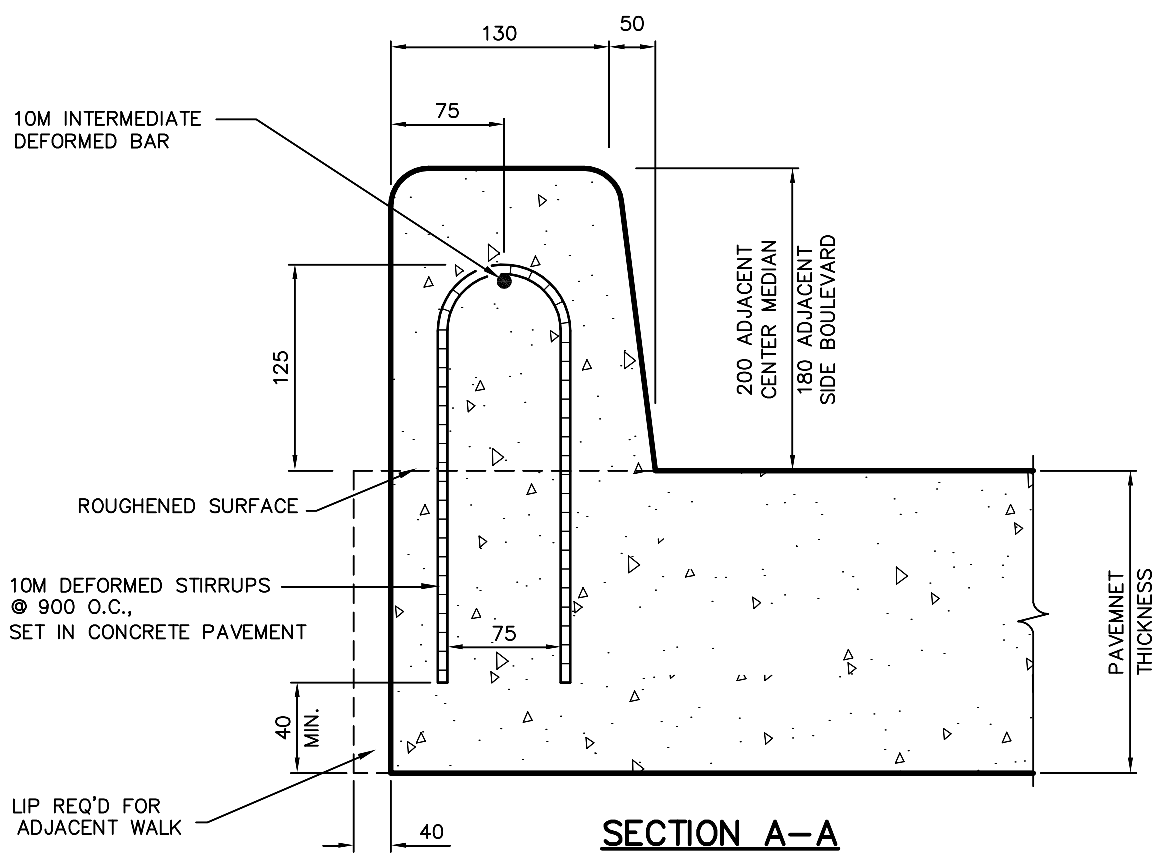
Description:

Concrete Pavement Barrier Curb Tie to Pavement

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-13A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-13A



PLAN VIEW



SECTION A–A

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

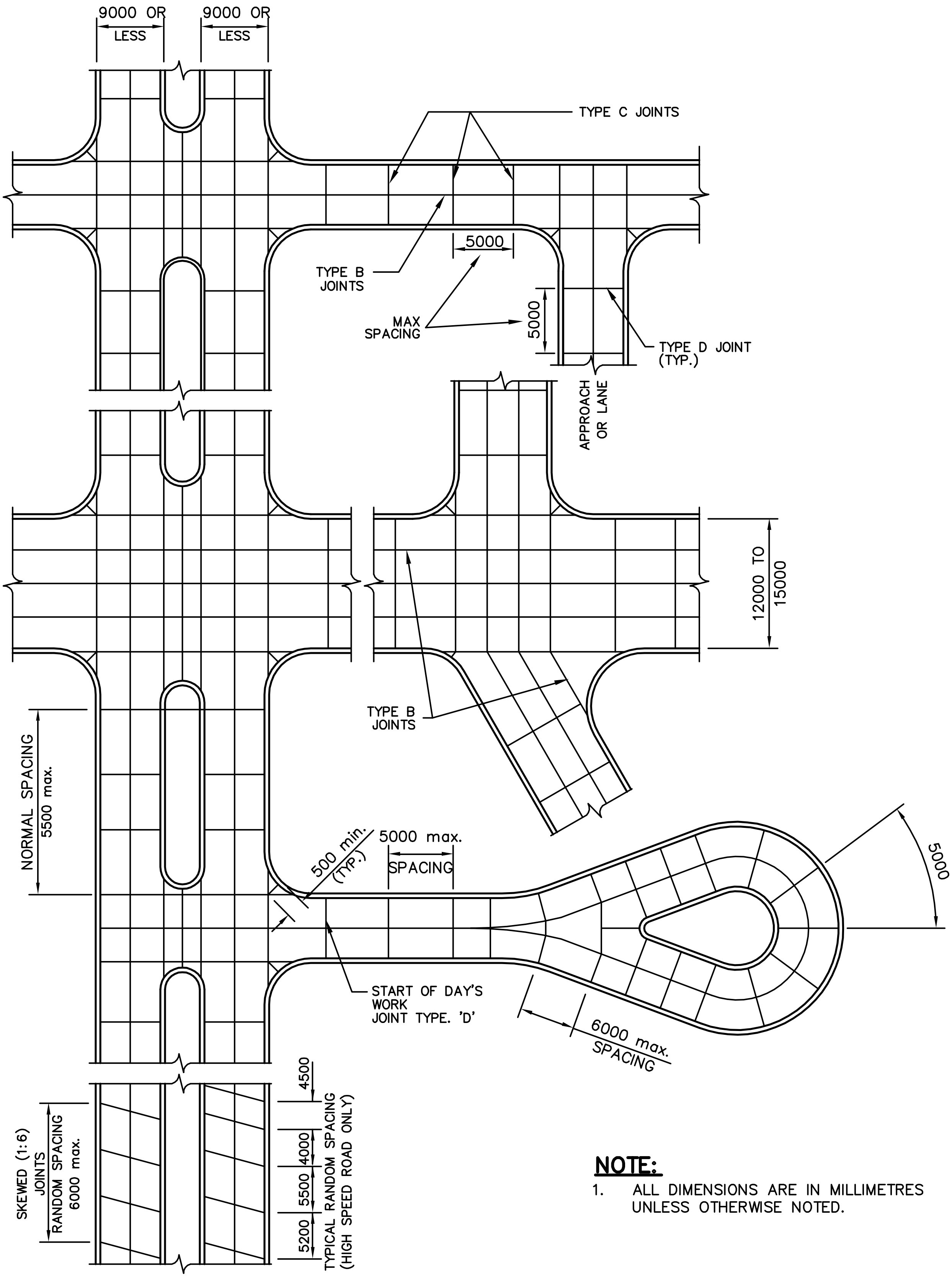
CITY OF REGINA

Engineering and Works

Description:

Concrete Pavement Barrier Curb (Separate)

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-13B.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-13B



NOTE:

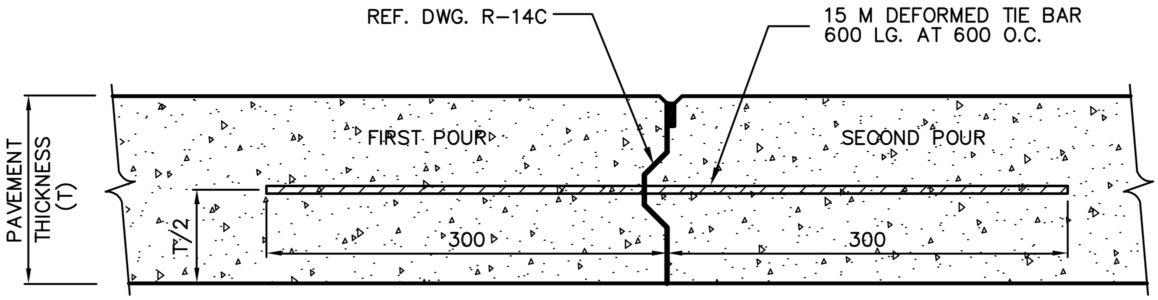
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

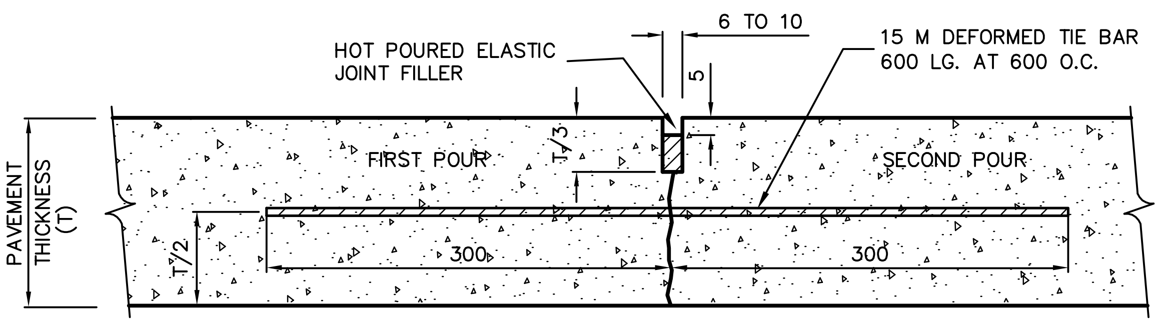
Regina
CITY OF REGINA
Engineering and Works

Description:
Concrete Pavement Typical Joint Arrangement

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-14.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-14



LANE-AT-A-TIME PAVING (B1)



FULL WIDTH PAVING (B2)

NOTE:

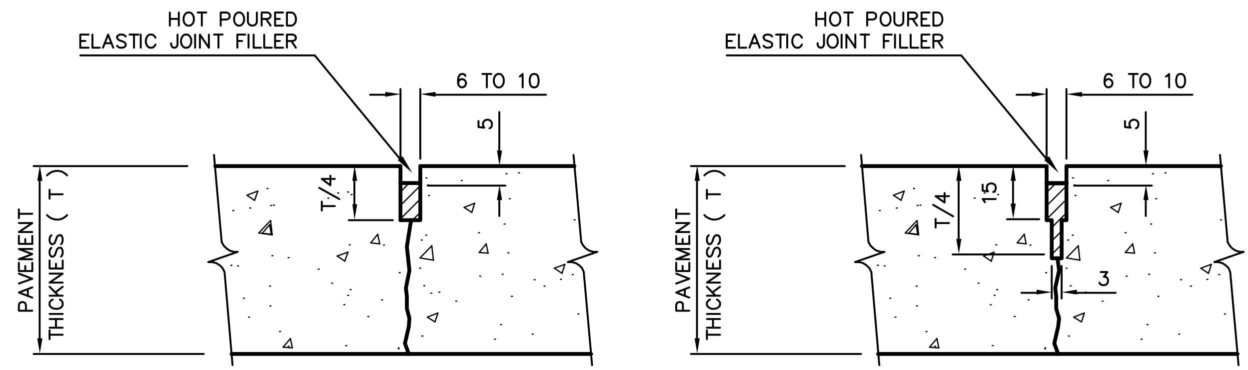
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

CITY OF REGINA

Engineering and Works

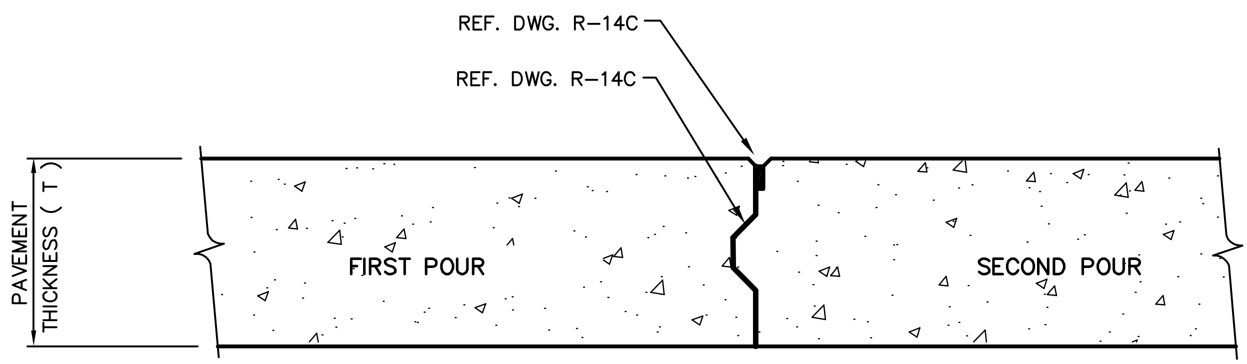
Description:		
Concrete Pavement Longitudinal Joints		
Manager: HARLAN RITCHIE	Date: January/98	Digital File: STDR-14A.DWG
Approved: DAVID CALAM	Scale: NTS	Dwg: R-14A



ALTERNATIVE 1

ALTERNATIVE 2

SAWED TRANSVERSE JOINT (TYPE 'C')



KEYED TRANSVERSE CONSTRUCTION JOINT (TYPE 'D')

NOTE:

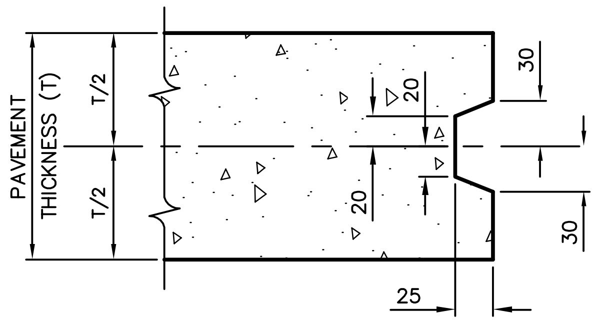
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

2. ALL TRANSVERSE JOINTS MUST EXTEND THROUGH CURB AND BE CONTINUOUS ACROSS PAVEMENT.

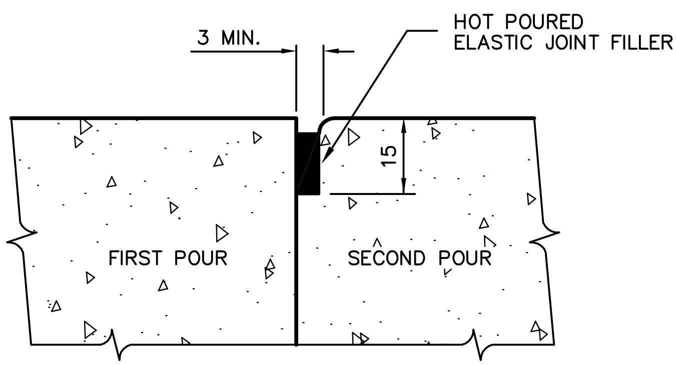
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:		
Concrete Pavement Transverse Joints		
Manager: HARLAN RITCHIE	Date: January/98	Digital File: STDR-14B.DWG
Approved: DAVID CALAM	Scale: NTS	Dwg: R-14B



KEYWAY DETAIL



TOOLED SEALANT RESERVOIR

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

2. BOTH EDGES ARE HAND TOOLED WHILE CONCRETE IS STILL PLASTIC.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

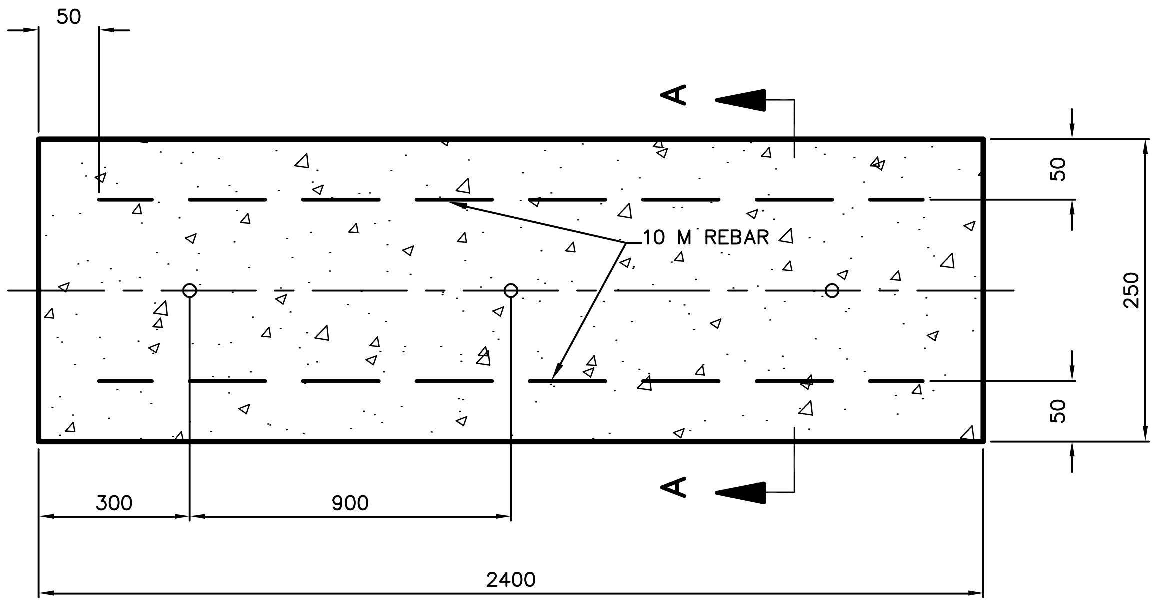
CITY OF REGINA

Engineering and Works

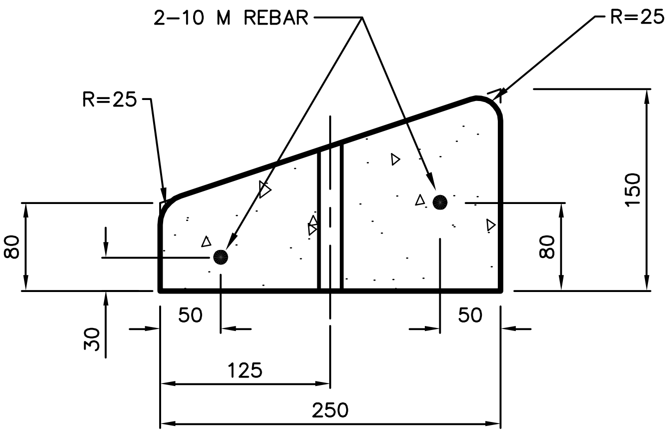
Description:

Concrete Pavement Joint Detail

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-14C.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-14C



PLAN OF CURB



SECTION A–A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES
UNLESS OTHERWISE NOTED.

2. CURBS SHALL BE SECURED TO THE FOUNDATION.
WITH EITHER DRIFT PINS OR EPOXY RESINS.
PINS SHALL BE 16ø x 380 LG.. EACH.
PIN SHALL HAVE A SHARP POINT & NO HEAD.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

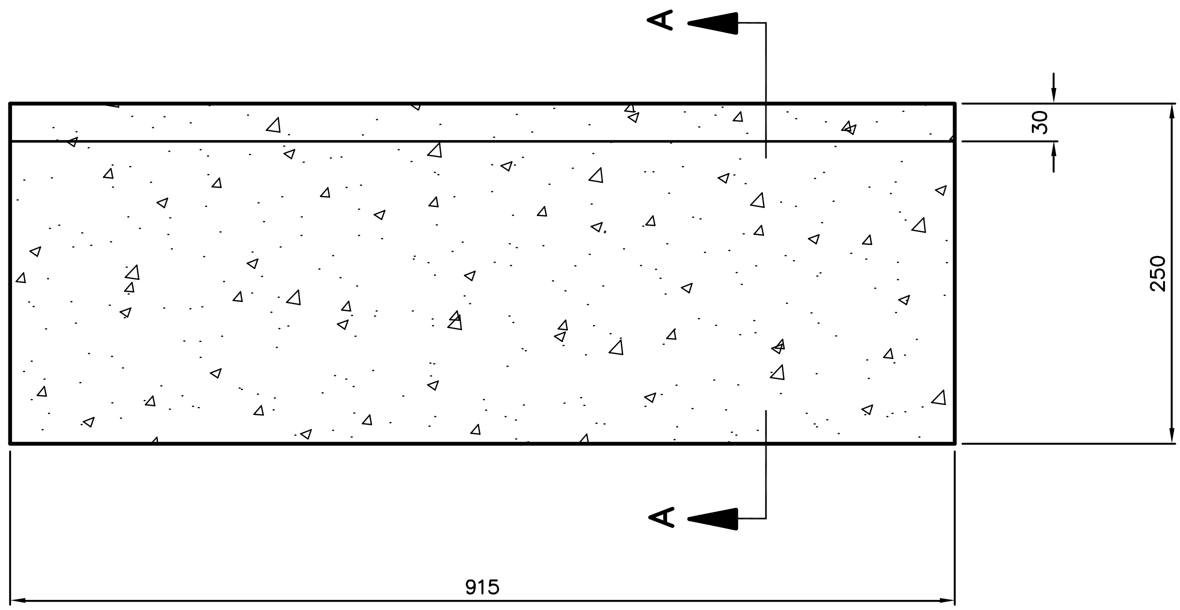
CITY OF REGINA

Engineering and Works

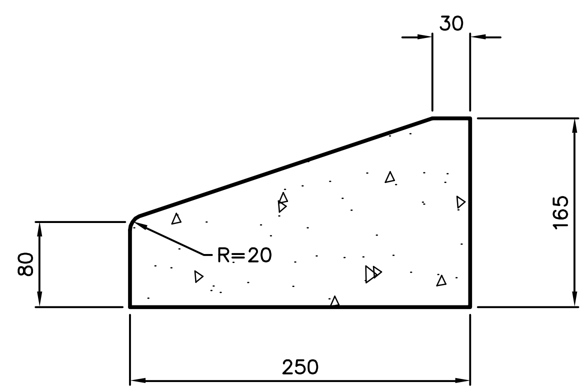
Description:

Precast Concrete Curb

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-15.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-15



PLAN OF CURB



SECTION A–A

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

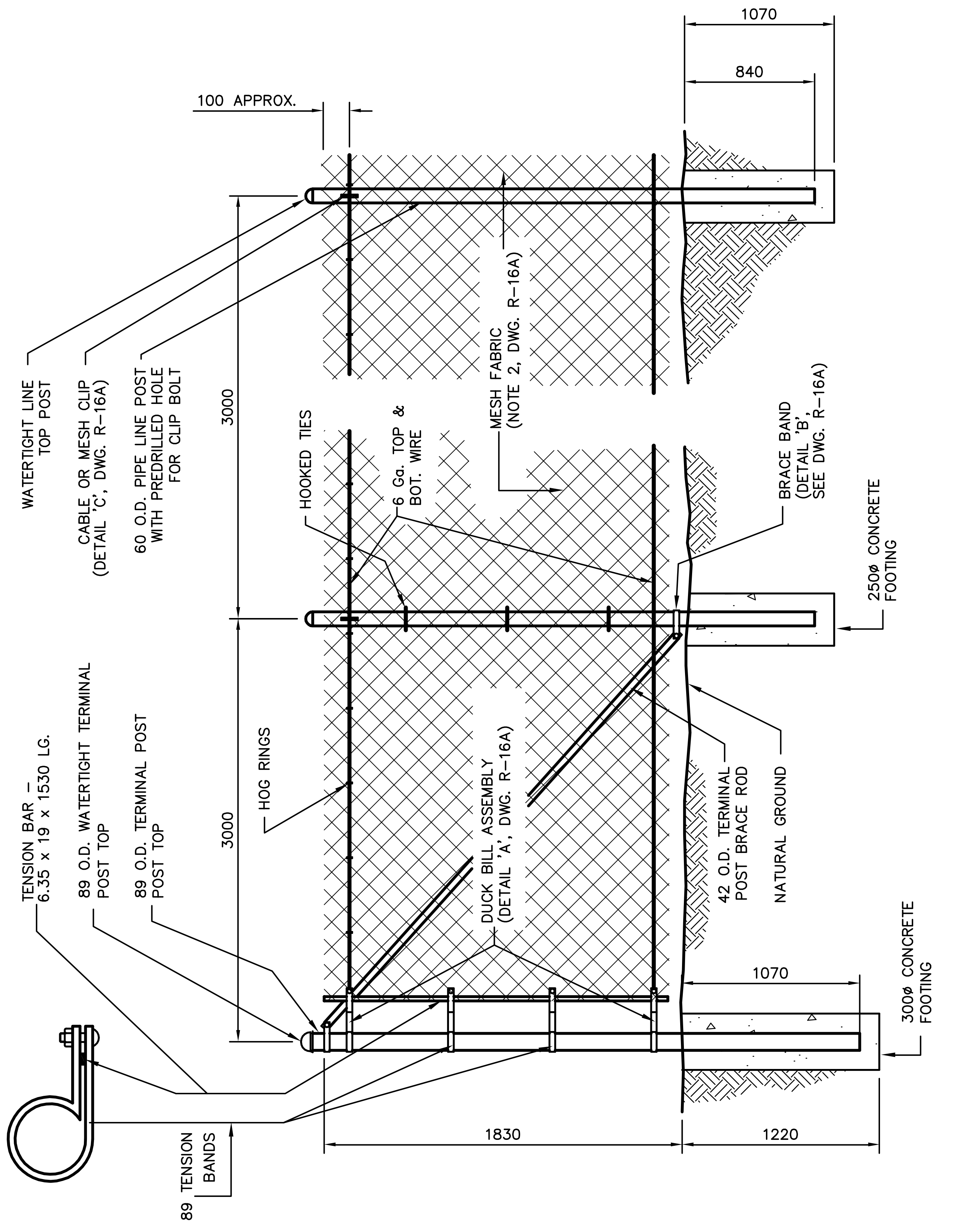
2. CURBS SHALL BE SECURED TO THE FOUNDATION WITH EPOXY RESIN APPROVED BY THE ENGINEER.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:
Hydraulically Pressed Concrete Curb

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-15A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-15A



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

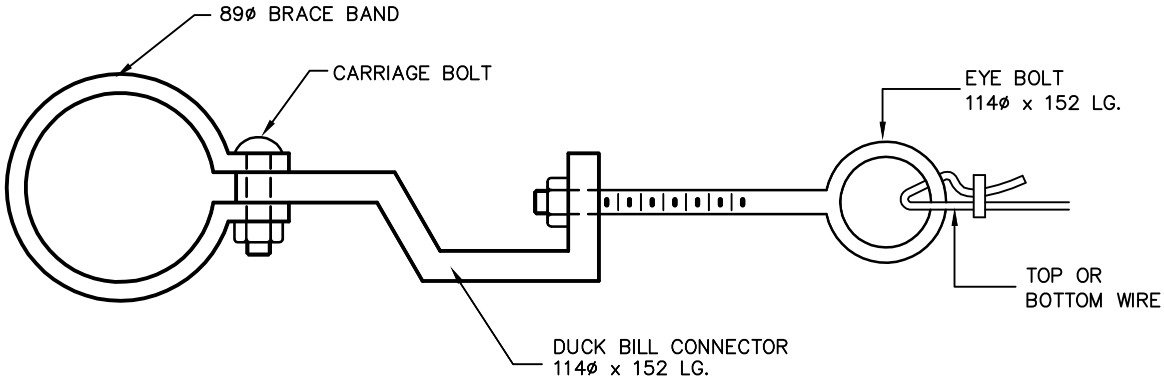
CITY OF REGINA

Engineering and Works

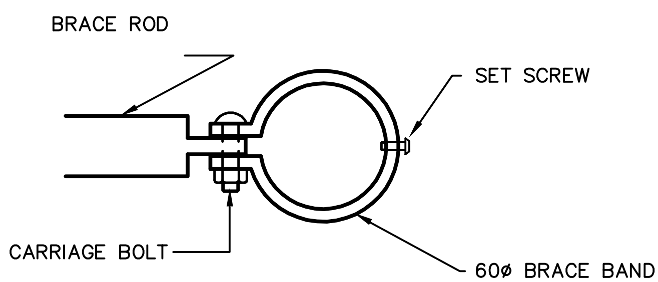
Description:

Chain Link Fence Type "A"

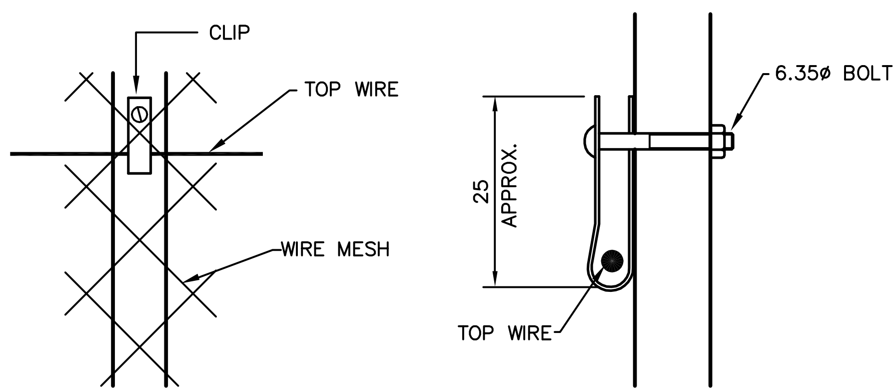
Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-16.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-16



DETAIL "A" – DUCK BILL ASSEMBLY



DETAIL "B" CABLE OR MESH CLIP



DETAIL "C" BRACE BAND

NOTES:

1. MAXIMUM SPACING BETWEEN BRACING SHALL BE 150 METRES
2. CHAIN LINK FENCE FABRIC SHALL BE 3.05 THICK. (9 GAUGE), 50 MESH UNLESS SPECIAL CIRCUMSTANCES MAKE A HEAVIER GAUGE DESIRABLE.
3. TOP WIRE ONLY IS TO BE THREADED THROUGH CLIPS WITH MESH ATTACHED TO WIRE.
4. CHAIN LINK FABRIC SHALL BE FASTENED AT NOT MORE THAN 350 ON LINE POSTS AND NOT MORE THAN 450 ON THE TOP AND BOTTOM WIRE.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

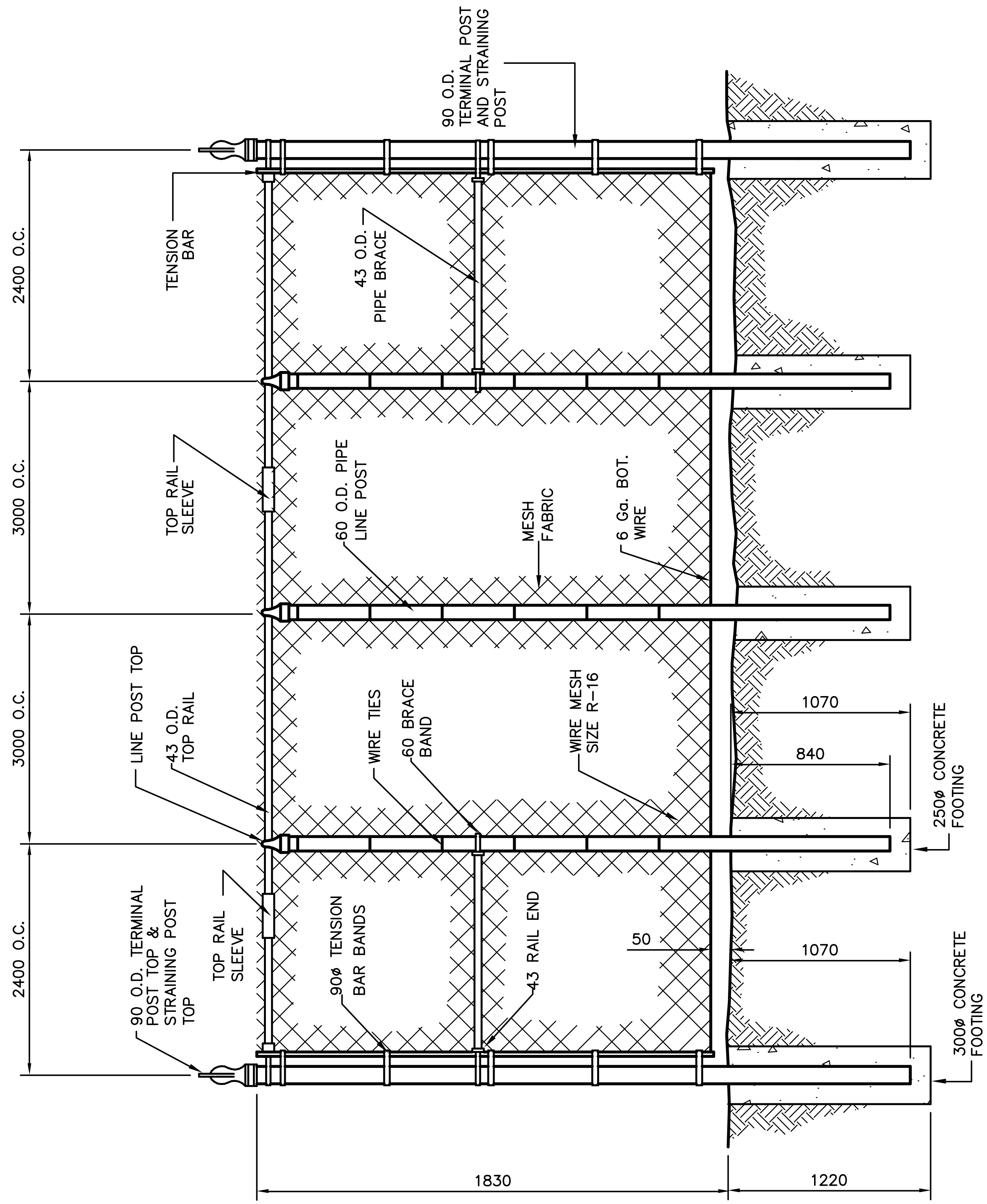
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:

Chain Link Fence
Type "A" - Banding Details

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-16A.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-16A



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina

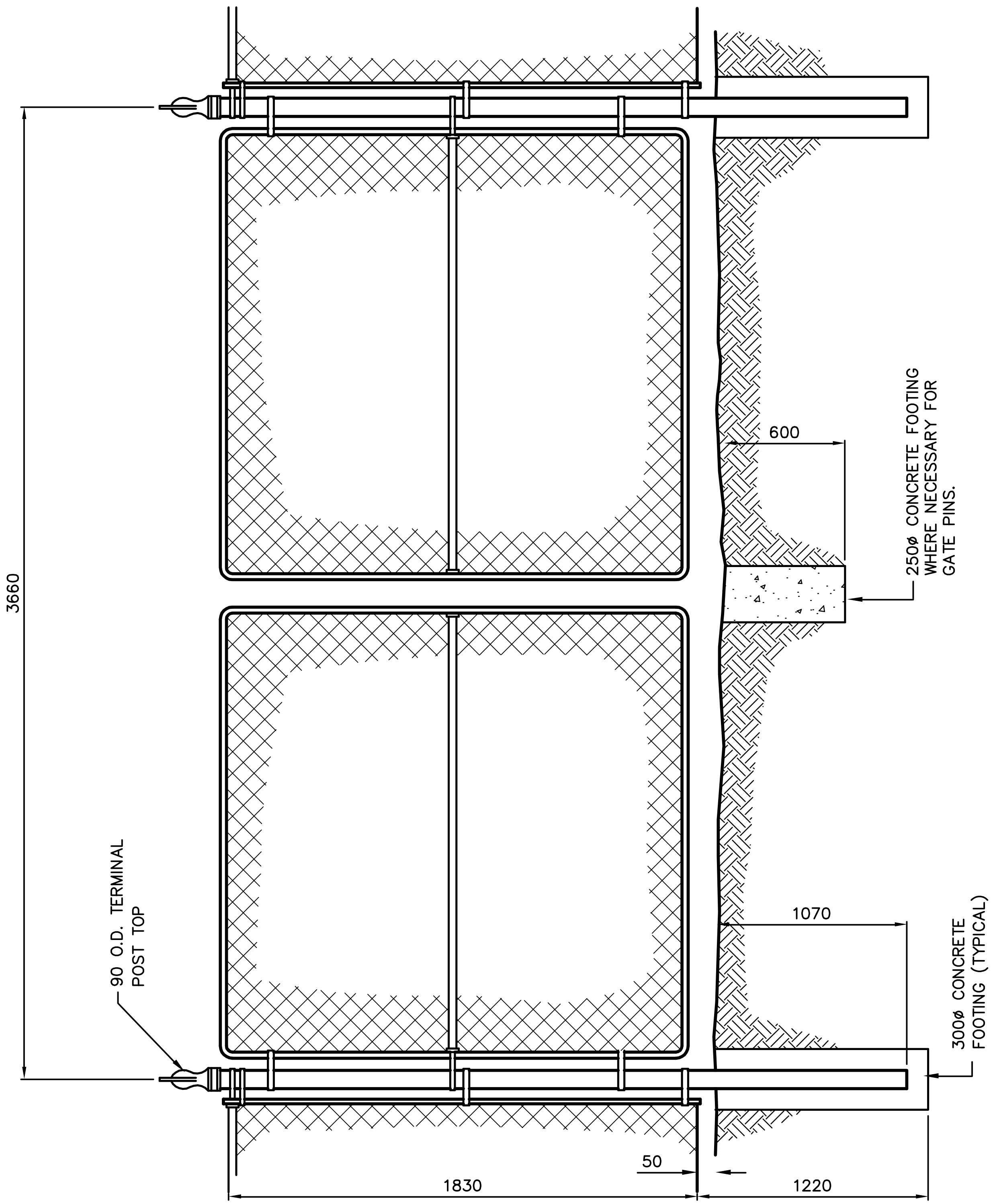
CITY OF REGINA

Engineering and Works

Description:

Chain Link Fence Type "B"

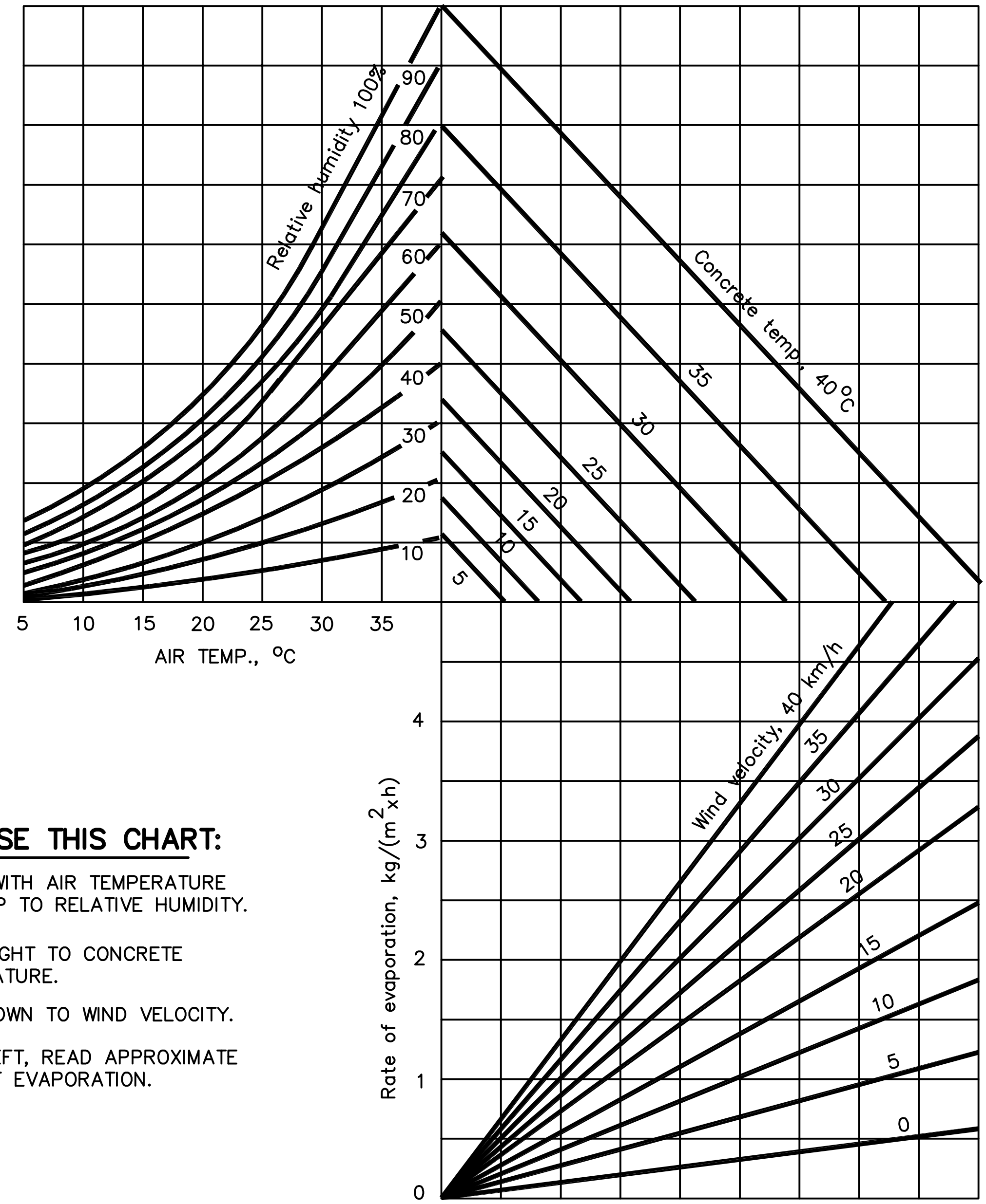
Manager HARLAN RITCHIE	Date January/98	Digital File: STDR-17A.DWG
Approved DAVID CALAM	Scale NTS	Dwg: R-17A



NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

Date	Revisions	By		Description:		
Jan/03	TITLE BLOCK	MLG	CITY OF REGINA	Gate Detail Type "B"		
				Manager: HARLAN RITCHIE	Date: January/98	Digital File: STDR-17B.DWG
			Engineering and Works	Approved: DAVID CALAM	Scale: NTS	Dwg: R-17B



TO USE THIS CHART:

1. ENTER WITH AIR TEMPERATURE
   MOVE UP TO RELATIVE HUMIDITY.
2. MOVE RIGHT TO CONCRETE
   TEMPERATURE.
3. MOVE DOWN TO WIND VELOCITY.
4. MOVE LEFT, READ APPROXIMATE
   RATE OF EVAPORATION.

ADAPTED FROM: DESIGN AND CONTROL OF CONCRETE MIXTURES
CANADIAN PORTLAND CEMENT ASSOCIATION
CANADIAN METRIC EDITION 1984

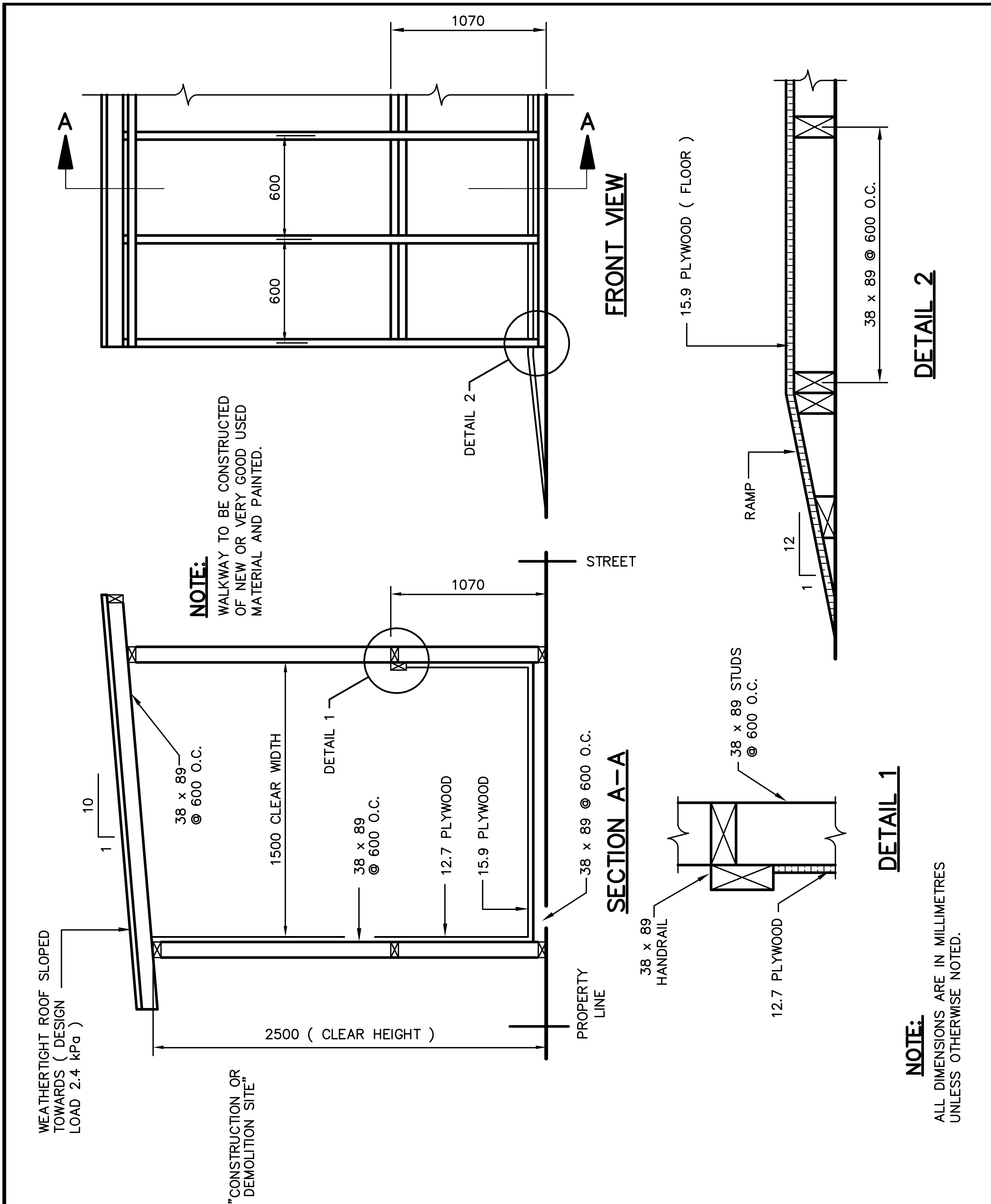
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

CITY OF REGINA
Engineering and Works

Description:

Rate of Evaporation Nomograph

Manager	Date	Digital File:
HARLAN RITCHIE	January/98	STDR-18.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-18



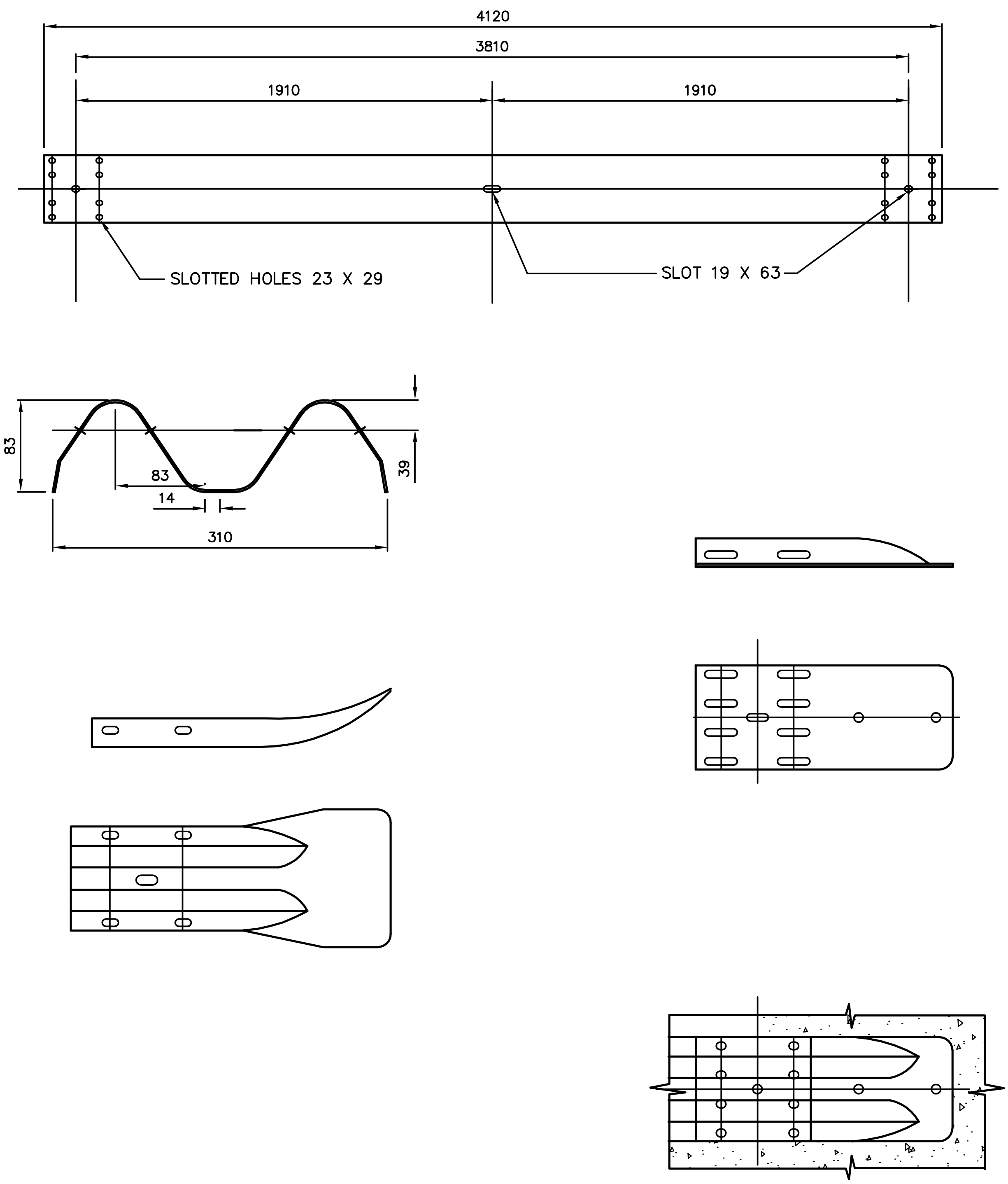
Date	Revisions	By
Jan/03	TITLE BLOCK	MLG

Regina
CITY OF REGINA
Engineering and Works

Description:

Hoarding for Walkway

Manager	Date	Digital File:
HARLAN RITCHIE	January/01	STDR-19.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-19



Date	Revisions	By

CITY OF REGINA

Engineering and Works

Description:

W-Beam Elements and End Sections

Manager	Date	Digital File:
HARLAN RITCHIE	January/ 03	STDR-20.DWG
Approved	**Scale**	**Dwg:**
DAVID CALAM	NTS	R-20