SCHEDULE B

UTILITY ENGINEERING STANDARDS

PART 1 WATERWORKS SPECIFICATIONS

The following specifications are intended to govern the design and construction of water transmission, feeder and distribution mains and associated fittings, appurtenances and services.

Waterlines shall not be put into service until such time as the installer has supplied a satisfactory, certified bacteriological test from a sample taken from the line no less than 24 hours after the water main has been disinfected.

1.1 Water Transmission, Feeder and Distribution System Design Criteria

The water transmission, feeder and distribution mains shall be designed in accordance with the following criteria:

- The network shall supply water at the peak hourly demand rate at a pressure between 275 kPa and 550 kPa (40 to 80 psi) and at the peak daily demand rate plus fire flow rate at a pressure not less than 138 kPa (20 psi).

- Average daily demand = 0.720 m^3 per capita per day (160 gpcd).

- Peak daily demand = 1.80 m^3 per capita per day (400 gpcd).

- Peak hourly demand = 2.16 m^3 per capita per day (480 gpcd).

- Fire flow rates shall be in accordance with the recommendations of the Insurer's Advisory Organization of Canada.

- Industrial population equivalent = 37 people per hectare (15 ppa).

- Pipeline capacities to be determined by using manual analysis (e.g. Hardy-Cross method) or a recognized computer model technique. Frictional characteristics of pipelines shall be in accordance with manufacturer's recommendations and applicable to the analysis technique used.

1.2 Pipe Sizing

- Minimum size of water mains in residential developments shall be 150 mm (6 in) diameter.

- Minimum size of water mains in industrial and commercial developments shall be 200 mm (8 in) diameter or as otherwise approved by the City of Drumheller.

- Minimum size of lot service lines for single family lots shall be 20 mm (3/4 in) diameter and for industrial and commercial lots, 25 mm (1 in) diameter. Minimum sizes of service lines for specific buildings shall be those dictated by the Provincial Plumbing Code.

1.3 Pipe Materials

Acceptable pipe materials for water mains are:

- Ductile iron conforming to AWWA C151 (latest issue).

- If ductile iron pipe is proposed, the proposal shall include yellow jacketed internally lined pipe, with proper cathodic protection against corrosion. The approval or rejection of ductile iron as a water main

material shall be affected by the City of Drumheller's evaluation of corrosion potential and ramification thereof.

- Polyvinyl chloride (PVC) conforming to AWWA C900 (latest issue).

- Asbestos cement (AC) conforming to AWWA C400 (latest issue).

- Prestressed concrete pipe with a steel liner conforming to AWWA C301 and/or C303 (latest issue).

Service lines from the main to the lot line, shall be soft copper, Type K.

All pipelines shall be designed for structural capacity in accordance with recommendations of the pipe manufacturer.

1.4 Fire Hydrants

- The minimum size of hydrants and leads shall be 150 mm (6 in).

- Gate valves and valve boxes shall be required on all hydrants and shall be located a maximum of 2 m (6.5 ft) from the hydrant.

- The maximum allowable spacing of hydrants shall be such that a radius of 75 m (246 ft) around each hydrant shall completely cover the service area in industrial and commercial land uses and 150 m (500 ft) in residential areas.

- Hydrants shall be located at the ends of curb returns and opposite lot lines perpendicular or nearly perpendicular to the public right-of-way line (e.g. the street right-of-way).

- Hydrants shall be located no closer than 0.5 m (1.5 ft) to private property lines and shall not be in a position to interfere with pedestrian or vehicular traffic. Hydrants should also be located as close as possible to lot division property lines.

- Hydrants shall be McAvity M67-S and shall include:

  One 144 mm (5 3/4 in) pumper connection
  Two 64 mm (2 1/2 in) hose connections
  Threads for the hose connections shall be as follows:

- 8 threads per inch
- actual outside diameter 2.987 inch
- root diameter 2.825 inch
- pitch diameter 2.906 inch

Threads for the pumper connection shall be as follows:

- 4 threads per inch
- actual outside diameter 5.695 inch
- root diameter 5.371 inch
- pitch diameter 5.535 inch

Color shall be ~~red~~ LIME GREEN

Operating nuts shall be 23 mm (7/8 in) pentagon

Caps shall be painted ~~red~~ SILVER.

1.5 Valves

. The requirement for valves shall be such that any section of pipeline can be isolated by closing a maximum of 3 valves. The isolated section shall contain a maximum of 40 households and 1 hydrant.

. Valves shall also be installed at both ends of a utility right-of-way or easement.

- Valves shall be located at projections of property or right-of-way lines, or as otherwise required by the City of Drumheller.

- Valves shall be the same size as the water main.

- All valves 400 mm (16 in) and less shall conform to AWWA C500. Valves larger than 400 mm may be butterfly valves.

- Valves shall be iron body, bronze mounted resilient seat gate valves (except as above) with a non-rising stem, opened by turning in a counterclockwise direction, or approved equal.

- Valve boxes complete with operating extension stems and a rock disc nut shall be installed with all valves.

- Main line valve operating nuts shall be 50 mm (2 in) square.

- All valves, bends, tees and similar iron body fittings shall be protected against corrosion by one or more of the following methods:

- Poly-taped
- Coal tar epoxy and wrapping, all wrapping shall be with a minimum 25 mil plastic
- Coated with epoxy - "scotchguarding"
- Cathodic Protection

. All lot services shall be installed with curb boxes or valves located on the property line.

. All curb boxes shall be protected against corrosion as described above.

. The Connection between the curb stop and the operating stem shall be made by a brass pin.

1.6 Installation

. All water mains located parallel to sanitary or storm sewer mains shall be located a minimum horizontal distance of 3.0 m from the nearest sanitary or storm sewer main.

. All pipe joints shall be made in accordance with the manufacturer's instructions.

- There shall be a minimum clearance of 300 mm (12 in) between the outside diameters of a water main crossing over a sewer main.

- Water mains shall be installed with a minimum depth of bury of 2.75 m (9 ft) measured from finished grade to the top of the pipe.

- Water service lines shall be installed with a minimum depth of bury of 2.45 m (8 ft) measured from the finished grade to the top of the pipe.

- Water service lines, when laid in the same trench as sewer service lines, shall have a 300 mm separation from the sewer service line. Shared water services shall not be permitted.

- The use of imported bedding materials shall be required if, in the opinion of the City Engineer, in situ ground conditions necessitate the use thereof.

- Reaction or thrust blocks shall be applied at bends, tees and valves over 300 mm or where changes in pipe diameter occur at reducers or in fittings. Thrust

blocks shall not be required on service connections less than 60 mm in diameter. The design of concrete thrust blocks shall be approved by the City of Drumheller.

- All water main taps will be done under full operating pressure in the mains. All service connections shall be tapped into the upper portion of the main at an angle of at least 30° from the horizontal and not exceeding an angle of 60° from the horizontal. Tapping for service connections shall have a mimimum spacing of 1.0 m.

- All tapping of PVC mains shall utilize bronze body, stainless steel double strap saddles. Direct taps of ductile iron and asbestos cement up to taps of 25 mm (1 in) diameter may be made.

- All valve boxes and hydrants shall be constructed plumb.

- All curb box locations shall be marked with a 50 x 100 mm (2 x 4 in) post embedded 1 m (3.3 ft) into the ground and protruding 0.3 m (1 ft) above finished grade with the top of the post painted red.

. Under streets and lanes, all backfilled and native material shall be compacted to a minimum density not less than 95% of the density obtained from a Standard Proctor density test. In other areas, backfill shall be compacted to a mimimum density of not less than 90% of the density obtained from a Standard Proctor density test. Compaction results shall be taken and recorded on a mimimum basis of one density test per 150 m (492 ft) of trench for each 1.5 m (5 ft) of compacted vertical backfill depth.

1.7 Pressure Testing

Testing of the water distribution system and services shall be carried out according to AWWA Specifications at a pressure of 1,035 kPa (150 psi). The test on any portion of the system shall last a mimimum of 2 hours. The maximum amount of leakage per hour shall be determined by the following formula:

L = NDP/8880

L = the allowable leakage in Imperial gallons per hour

N = the number of joints in the test section, each service shall count as 1 joint

D = the nominal diameter of the pipe being tested in inches

P = the square root of the test pressure in psi

The test shall be witnessed by an authorized representative of the City of Drumheller and a report shall be submitted to the City Engineer after the test, giving the location, the allowable leakage and the test results.

1.8 Disinfection

Before being placed into service, all new mains shall be chlorinated throughout their lengths. The method to be used to introduce the chlorine shall be approved by the City of Drumheller. Chlorine must be added to attain a concentration of 50 parts per million throughout the system and this solution will then be retained for 24 hours, after which time the chlorine solution must not have dropped below 25 parts per million. After chlorination is completed, the mains shall be flushed throughout until the replacement water is equal chemically and bacteriologically to the supply. All work performed shall be in accordance with AWWA Standard C601 (Latest Issue) for disinfecting water mains.

PART 2 SANITARY SEWER SPECIFICATIONS

The following specifications are intended to govern the design and construction of gravity mode collector and trunk sewers and sewer services to individual lots.

After the installation of sewer mains and services and prior to testing, all mains shall be flushed in an acceptable manner to remove all debris.

Sewer service lines shall be flushed prior to capping.

All sewer lot service lines shall be marked at their termination with a 50 x 100 mm (2 x 4 in) marker from the service invert to an elevation 0.15 m (6 in) above finished grade of the ground surface.

2.1 Sanitary Sewage Design Criteria

The sanitary sewage collector mains shall be designed in accordance with the following criteria:

- Average daily sewage flow - 0.365 m^3 (80 Igpm) per capita per day.

- Industrial and commercial population equivalent - 37 people per hectare (15 ppa).

- Infiltration allowance - 4.7 m^3 per hectare per day (420 Imperial gallons per acre per day).

- Peak sewage load (m^3/day) = (365 P) M + 4.7 A

  Where P = population (equivalent expressed in thousands)

  A = area in hectares

  M = $5/P^{0.2}$

- Pipeline capacity - to be determined from the Manning's or Kutter's formulae utilizing the following pipe roughness factors:

Concrete	0.013
PVC	0.010
Asbestos Cement	0.011

- Pipeline gradients - collector pipeline gradient shall be sufficient to provide for a mimimum flow velocity of 0.75 m (2.5 ft) per second at the designed peak loading. Where the hydraulic loading is insufficient to achieve the minimum velocity, the minimum gradient shall not be less than 0.6% for a Manning's "N" value of 0.010 and 1.0% for a Manning's "N" value of 0.013.

Collector pipeline gradients shall not exceed that which will permit flow velocities in excess of 5.5 m (18 ft) per second at design peak loadings. Lot service gradients shall be a minimum of 2.0%.

2.2 Pipe Sizing

- Minimum pipe size for sanitary sewage collectors shall be 200 mm (8 in).

- Minimum pipe size for lot service lines shall be 100 mm (4 in). Shared sanitary sewer service lines shall not be permitted.

2.3 Pipe Materials

Acceptable pipe materials for collector sewers are:

- Polyvinyl chloride (PVC) conforming to ASTM D-3034 with a standard dimensional ratio (SDR) not exceeding 35.

- Sulphate resistant concrete pipe conforming to ASTM C-14 or C-76 with joints conforming to ASTM C-443.

- Asbestos cement conforming to ASTM C-428 (latest issue).

Acceptable pipe materials for lot service line shall be:

. the same as those for collector sewers.

. vitrified clay tile pipe conforming to ASTM C700 (latest issue).

All pipelines shall be designed for structural capacity in accordance with recommendations of the pipe manufacturer.

All collector sewers and lot service lines shall be constructed using rubber gasketted joints. All service line ends shall be installed with watertight caps.

2.4 Manholes

Manholes shall be located at all changes in direction and/or gradient in collector sewer lines and where two or more collector sewers intersect. The maximum distance between manholes on any collector sewer shall be 120 m (394 ft).

Where four or fewer inlet and outlet pipes intersect at a manhole, no pipe is larger than 750 mm (30 in) in diameter and where the intersecting angles of the pipelines are sufficient, the minimum inside diameter of

the manhole shall be 1,200 mm (48 in). Where the preceding condition cannot be satisfied, a special manhole requiring special design approval is required.

All manholes shall be constructed of sulphate resistant concrete. Precast sections shall be joined using a flexible bituminous gasket. No grouting of precast manhole section joints shall be permitted.

Manhole frames and covers shall be designed to withstand highway loading. Frames shall be mortared to the slab top of the manhole to a point 25 mm (1 in) below the top of the frame.

Manholes shall contain foot rings, aligned for easy access into the manhole. The foot rings shall be made of 20 mm galvanized iron with a spacing of 400 mm (16 in).

Where the difference in elevation between inverts of an inlet sewer and the outlet sewer is 0.6 m (2 ft) or more, an exterior drop structure incorporating a drop pipe of 2/3 the diameter of the inlet sewer, but not less than 200 mm (8 in) shall be required.

All manholes shall be constructed with shaped channels to provide for the transfer of piped material from the inlet to the outlet with minimal energy loss and potential for

solids deposition. The minimum elevation difference between inlets and the outlet to and from a manhole shall be 25 mm (1 in).

2.5 Installation

All collector sewers shall be located a minimum of 2.1 m (7 ft) below finished grade, measured from the top of the pipe.

All lot service lines shall be located a minimum of 2.1 m (7 ft) below finished grade at property line measured from the top of the pipe.

All sanitary sewer mains and service lines shall be bedded in sand material with a minimum thickness of 100 mm below the bottom of main and 300 mm (1 ft) above the top of the main. The sand bedding shall be uniformly compacted to 95% Standard Proctor density.

All pipe joints shall be made in accordance with manufacturer's instructions.

Lot service lines shall be connected to the collector sewer in the upper portion of the main with a tee saddle, compatible to the sewer main material being used. The

saddle shall fit snugly to the sewer main with a gasket there between, and be secured with two stainless steel straps.

All manholes shall be constructed plumb.

Under streets and lanes, all backfill and native material shall be compacted to a minimum density not less than 95% of the density obtained from a Standard Proctor density test. In other areas, backfill shall be compacted to a minimum density of not less than 90% of the density obtained from a Standard Proctor density test. Compaction results shall be taken and recorded on a minimum basis of one density test per 150 lin m (492 ft) of trench for each 1.5 m (5 ft) of compacted vertical backfill depth.

2.6 Pumping Station

When a sewer lift station is required, the location and specifications must be approved by the City of Drumheller. A standby generator shall be installed with all permanent lift station installations.

2.7 Testing

All collector sewers, manholes and lot service lines shall be required to pass an exfiltration test simultaneously. The test shall be performed as follows:

. The test shall be performed for a period of 1 hour under a hydrostatic head. The test shall be performed by filling an upstream manhole to a level of 1.0 m (3.3 ft) below the elevation of the top of the frame with the inlet(s) to the manhole plugged and the inlet of the downstream manhole plugged. The maximum allowable leakage shall be 0.14 L per mm diameter per 100 m per hour (300 gallons per inch diameter per mile per day).

No separate allowance shall be made for lot service lines and manholes.

The test shall be witnessed by an authorized representative of the City of Drumheller.

All sewage collection lines shall be subjected to a "light test", where a light is shone through the sewer at a manhole and observed from an adjacent manhole. An acceptable line shall permit the observation of at least 2/3 of the full cross-sectional area of the pipeline from each end.

PART 3 STORM DRAINAGE FACILITIES SPECIFICATIONS

The following specifications are intended to govern the design and construction of storm drainage facilities, including but not limited to, storm sewers, drainage ditches, subsurface drainage elements, catchbasins and storm water retention and detention facilities.

After the installation of buried pipelines and structures and prior to testing, all pipelines shall be flushed in an acceptable manner to remove all debris.

All weeping tile service lines to lots shall be marked at their termination with a 50 x 100 mm (2 x 4 in) marker from the service invert to an elevation 0.15 m (6 in) above finished grade of the ground surface.

All drainage ditches, storm water ponding facilities, etc. shall be constructed complete with surface treatments, e.g. grass, rip rap, etc.

3.1 Storm Drainage Design Criteria

Surface runoff interception and transmission systems shall be designed in accordance with the following criteria except where storm water detention or retention facilities are employed:

- Rational method of surface runoff calculation shall be used.

- Inlet systems, e.g. catchbasins, shall be designed using the 5 year return frequency storm curve for the City of Drumheller.

- Pipeline and ditch systems used for transporting surface runoff shall be designed using the 5 year return frequency storm curve for the City of Drumheller.

- Runoff coefficients shall require specific approval of the City Engineer for the specific area being considered.

- Minimum inlet times for surface runoff determination shall be 10 minutes in areas zoned C-B (Central Commercial District) and 20 minutes for all other areas.

- Surface contouring shall be designed and constructed in such a manner than a 100 year return frequency storm can be accommodated within and downstream of the development without flooding buildings, either existing or proposed.

- The attached Plate SR-1, defines storm intensity/ duration curves for the 2, 5 and 100 year return frequencies for the City of Drumheller.

- Pipeline and ditch capacity - to be determined from the Manning Formula utilizing the following roughness factors:

Concrete Pipe	0.013
AC Pipe	0.011
Corrugated Metal Pipe	0.024
Grassed Channel	0.035
Rip Rapped Channel	0.030
Asphalt Lined Channel	0.015

- Pipeline and ditch gradients - pipeline and ditches shall have gradients sufficient to provide for minimum velocities of flow of 0.61 m per second (2 ft per second) at designed peak loading. Similarly, gradients shall not provide for velocities of flow in excess of 5.5 m per second (18 ft per second) in pipelines and 2.4 m per second (7.9 ft per second) in ditches. If ditches are lined with either concrete or asphalt, velocities of flow of 5.5 m per second shall be permitted.

- Where surface runoff detention or retention facilities are employed, they shall be sized using recognized analytical methods. Piping in and out of detention and retention facilities shall be designed in accordance with the methods outlined above. The return frequency of storms used to size detention and retention facilities shall be 5 years.

- In development areas located above the Drumheller Valley, the use of storm water retention and detention facilities is required. In these areas, retention and detention facilities shall be sized to limit discharge rates from these areas to 0.025 m^3 per second per hectare (0.34 ft^3 per second per acre) under the conditions imposed by a 5 year return frequency storm.

3.2 Pipe Sizing

. The minimum size of a storm sewer or catchbasin lead shall be 250 mm (10 in) diameter.

. Where developments are provided with weeping tile drainage systems for building foundations, 300 mm (12 in) diameter collector mains and 150 mm (6 in) diameter weeping tile service connections shall be permitted.

3.3 Pipe Materials

. Acceptable materials for storm sewers, catchbasin leads and weeping tile service connections are:

- Sulphate resistant concrete or reinforced concrete pipe conforming to ASTM C-14 or ASTM C-76 (latest editions) and joints conforming to ASTM C-443 (latest edition).
- Asbestos cement (AC) conforming to ASTM C-428 (latest edition).
- Bituminous coated galvanized corrugated steel pipe conforming to AASHO M-36 (latest issue).

- All pipelines shall be designed for structural capacity in accordance with the recommendations of the pipe manufacturer.

- All storm sewers, catchbasin leads and weeping tile service connections shall be constructed using rubber gasket joints.

3.4 Manholes

Manholes shall be located at all changes in direction and/or gradient in storm sewer lines and where more than two storm sewers intersect, except if the intersecting pipe has a diameter less than 50% of that of the receiving pipe. The maximum distance between manholes on storm sewers shall be 120 m (394 ft) for pipes less than 450 mm (18 in) in diameter and 175 m (574 ft) for pipes 450 mm and larger.

Where four or fewer inlet and outlet pipes intersect at a manhole, no pipe is larger than 750 mm (30 in) in diameter and where the intersecting angles of the pipelines are sufficient, the minimum inside diameter of the manhole shall be 1,200 mm (48 in). Where the preceding condition cannot be satisfied, a special manhole requiring special design approval is required.

All manholes shall be constructed of sulphate resistant concrete. Precast sections shall be joined using a flexible bituminous gasket. No grouting of precast manhole section joints shall be permitted.

Where inlet or outlet pipes at manholes are made of asbestos cement, concrete or reinforced concrete, the inlet and outlet pipes shall be constructed with a rubber gasket joint located within 1 m of the exterior manhole wall. The space defined by the joint, the manhole wall, the bottom and sides of the excavation and the spring line of the pipe shall be filled with slurry concrete.

Manhole frames and covers shall be designed to withstand highway loading. Frames shall be mortared to the slab top of the manhole to a point 25 mm (1 in) below the top of the frame.

Manholes shall contain foot rings, aligned for easy access into the manhole. The foot rings shall be made of 20 mm galvanized iron with a spacing of 400 mm (16 in).

Where the difference in elevation between inverts of an inlet sewer and outlet sewer is 0.6 m (2 ft) or more, an exterior drop structure incorporating a drop pipe of 2/3 the diameter of the inlet sewer, but not less than 200 mm (8 in) shall be required.

All manholes shall be constructed with shaped channels to provide for the transfer of piped material from the inlet to the outlet with minimal energy loss and potential for solids deposition. The minimum elevation difference between inlets and the outlet to and from a manhole shall be 25 mm (1 in).

3.5 Catchbasins

- Catchbasins collecting street runoff shall not drain street areas in excess of 500 m^2 (5,379 ft^2) where the gradient is 5% or less and 400 m^2 (4,303 ft^2) where the gradient is in excess of 5%.

- The minimum size of a catchbasin shall be 900 mm (36 in) in diameter.

- Catchbasins shall have no sump.

- All catchbasins shall be constructed of precast sections of sulphate resistant concrete. Precast

sections shall be joined using a flexible bituminous gasket. No grouting of precast catchbasin section joints shall be permitted.

- Where the outlet pipe at a catchbasin is made of asbestos cement, concrete or reinforced concrete, the outlet pipe shall be constructed with a rubber gasket joint located within 1 m of the exterior catchbasin wall. The space defined by the joint, the catchbasin wall, the bottom and sides of the excavation and the spring line of the pipe shall be filled with slurry concrete.

- Catchbasin frames and covers shall be designed to withstand highway loading. Frames shall be mortared to the slab top of the catchbasin to a point 25 mm (1 in) below the top of the frame.

3.6 Subsurface Drainage

- Where the interception of subsurface drainage in public rights-of-way, by storm sewers is necessitated by natural conditions, e.g. springs, high groundwater levels, sensitive subsoils, etc., the collection of groundwater shall be carried out using a system whose specific design, including the provision of graded filters, filter cloths, etc., intended to prevent the

washout of fine soil particles, requires the formal approval of the City Engineer. The preceding does not apply to the interception of subsurface drainage around building foundations.

3.7 Installation

- All storm sewer mains shall be located at a minimum of 1 m (3.3 ft) below finished grade measured from the top of the pipe.

- All weeping tile lot service lines shall be located at a minimum of 1.8 m (5.9 ft) below finished grade measured from the top of the pipe.

- All catchbasin leads shall be located at a minimum of .5 m (1.5 ft) below finished grade measured from the top of the pipe.

- All storm sewer mains, service lines and catchbasin leads shall be bedded in sand material with a minimum thickness of 100 mm below the bottom of main and 300 mm (1 ft) above the top of the main. The sand bedding shall be uniformly compacted to 95% Standard Proctor density.

- All pipe joints shall be made in accordance with manufacturer's instructions.

- Lot service lines shall be connected to the collector sewer in the upper portion of the main with a tee saddle, compatible to the sewer main material being used. The saddle shall fit snugly to the sewer main with a gasket there between and be secured with two stainless steel straps.

- No service connections to manholes shall be permitted.

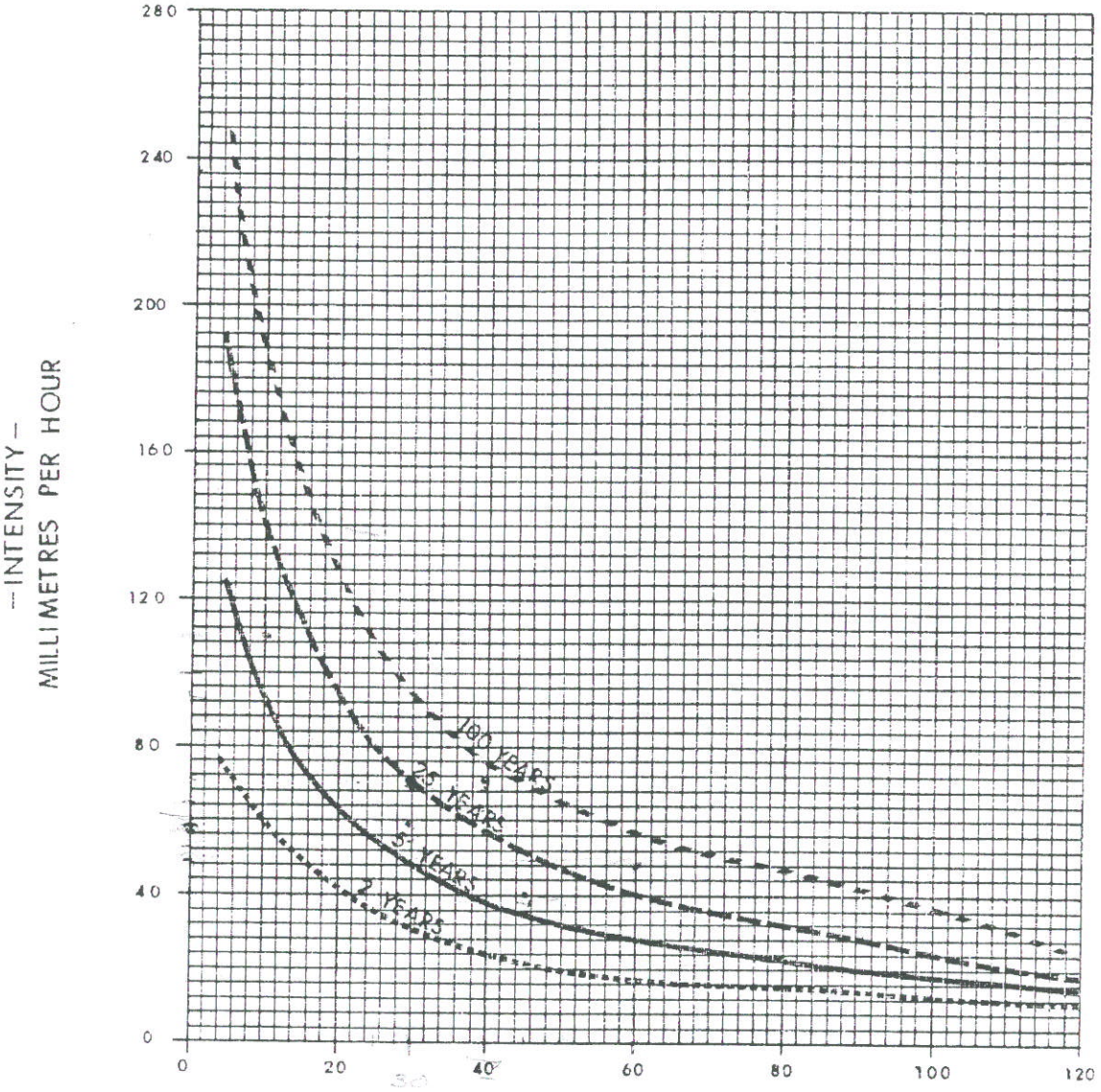
- All manholes and catchbasins shall be constructed plumb.

- Under streets and lanes, all backfill and native material shall be compacted to a minimum density not less than 95% of the density obtained from a Standard Proctor density test. In other areas, backfill shall be compacted to a minimum density of not less than 90% of the density obtained from a Standard Proctor density test. Compaction results shall be taken and recorded on a minimum basis of one density test per 150 lin m (492 ft) of trench for each 1.5 m (5 ft) of compacted vertical backfill depth.

3.8 Testing

- All storm sewer mains, catchbasin leads and culverts shall be subjected to a "light test" where a light is shone through the pipeline from a manhole, catchbasin or similar access point and observed from an adjacent similar location. An acceptable line shall permit the observation of at least 2/3 of the full cross-sectional area of the pipeline from each end.

- The test shall be witness by an authorized representative of the City of Drumheller.



CITY OF DRUMHELLER

RAINFALL INTENSITY CURVES

PLATE SR-1

PART 4 STREETS AND LANES SPECIFICATIONS

The following specifications are intended to govern the design and construction of streets and lanes, including subbase preparation, subgrade development, bituminous paving, sidewalks, curbs and gutters.

All streets shall be paved. All streets shall be drained using either curbs and gutters and storm sewers or by formal roadside ditches.

All lanes shall be gravelled unless otherwise noted. Drainage from lanes shall be picked up by a formal drainage system.

4.1 Functional Design Criteria

Functional design shall be carried out in accordance with the following table:

Item	Local Street (ULU)	Collector Street (UCU)	Arterial Street (UAU)
Function	Provide direct access to property	Distribute local traffic to an arterial street	Move vehicles between major traffic generators
Projected Traffic Volume	Less than 1,000 vehicles/day	1,000 - 5,000 vehicles/day	More than 5,000 vehicles/day

Item	Local Street (ULU)	Collector Street (UCU)	Arterial Street (UAU)
Normal Operating Speed	Less than 50 km/hr	50 km/hr	50 - 70 km/hr

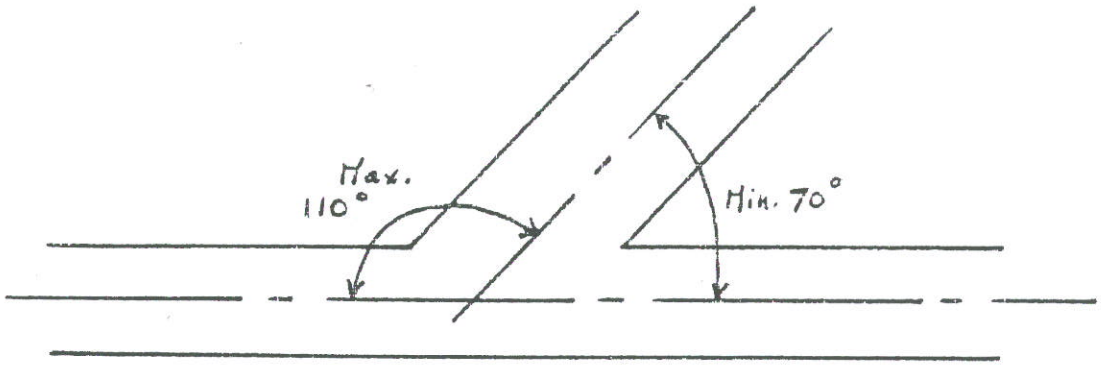
4.2 Geometric Design Criteria

Item	Local Street (ULU)	Collector Street (UCU)	Arterial Street (UAU)
Design Speed	50 km/hr	70 km/hr*	80 km/hr
Minimum Stopping Sight Distance	65 m	110 m	140 m
Minimum Intersection Spacing	75 m	75 m	220 m
Minimum Horizontal Curvature - Radius	none	190 m	250 m
Maximum Super-elevation m/m	0.02	0.06	0.06
Vertical Crest Curve - K Value	7 min. (10 desirable)	22 min. (35 desirable)	35 min. (55 desirable)
Vertical Sag Curve - K Value	6 min. (11 desirable)	15 min. (25 desirable)	20 min. (30 desirable)
Street Gradients	0.60% min. 10.0% max.	0.60% min. 8.0% max.	0.60% min. 6.0% max.
Maximum Gradients for Stop Roads at Intersections	3.5%	3.5%	2.0%
Minimum Right-of-Way Width	as required	20 m	30 m

Item	Local Street (ULU)	Collector Street (UCU)	Arterial Street (UAU)
Minimum Pavement Width, Measured From Lip of Gutter to Lip of Gutter Where Curb and Gutter are Installed	10.4 m	12 m	14 m
Minimum Pavement Width Measured From Edge of Pavement to Edge of Pavement Where Curb and Gutter are not Installed	Curb & Gutter Required	8 m	11 m
Minimum Shoulder Width Measured From Edge of Pavement to Top of Slope of Ditch	Curb & Gutter Required	1.5 m	2 m
Minimum Curb Return Radius	8 m	11 m	15 m
Minimum Monolithic Sidewalk Curb and Gutter Width	1.2 m	1.3 m	-
Minimum Separate Sidewalk Width	1.2 m	1.3 m	1.5 m

* Should physical constraints dictate, collector streets may be designed to a speed of 60 km/hr in accordance with Geometric Design Standards for Canadian Roads and Streets as published by the Roads and Transportation Association of Canada.

Angles of intersecting collector roads shall be between 70° and 110°.



Intersections of more than 2 collector roads shall not be permitted.

Access to any adjacent land use shall be at locations greater than 25 m distant from the centreline of the intersection of collector roads.

4.3 Cul-de-Sacs

Maximum length of a cul-de-sac shall be 109 m measured from the edge of the connecting street right-of-way to the beginning of the bulb.

Cul-de-sacs shall have the minimum bulb dimensions as shown on Figure S/L-1.

Cul-de-sacs shall be designed in accordance with the Local Street Geometric Design Standards in residential areas and in accordance with the Collector Street Geometric Design Standards in commercial and industrial areas.

All cul-de-sacs shall be graded so that they drain by gravity out to the connecting street. Trapped lows in cul-de-sacs shall not be permitted.

4.4 Curb, Gutter and Sidewalks

The use of curb and gutter is optional on all but local streets. If curb and gutter are not used, a formal roadside ditch drainage system shall be employed to provide drainage control.

Where curb and gutter are used, the following guidelines shall be employed:

- Local Streets - Low profile curb, gutter and monolithic sidewalk on one side of the street except for cul-de-sacs, where no sidewalk is required.

- Collector Streets - Low profile curb, gutter and monolithic sidewalk on both sides of the street.

- Arterial Streets - Standard curb, gutter and separate sidewalk on both sides of the street.

- Park Areas, School Sites, Multi-family and Apartment Sites - Standard curb and gutter along the boundary. The use of monolithic or separate walk is contingent on the street standard as described above.

Where roadside ditches are used, the following guidelines shall be employed:

- Collector Streets - Separate sidewalk on both sides of the street located between the roadside ditches and the right-of-way boundaries.

- Arterial Streets - No sidewalk required.

- At intersections, all sidewalks shall be connected to the paved street over a culvert.

- Wheelchair ramps are required at all intersections where curbs separate sidewalks from roadways. Wheelchair ramps shall be located at the midpoint of the curb return.

- Barriers to wheelchairs and baby carriages are not permitted in walkways that connect dwellings or that connect dwellings with other land uses.

- Minimum width of walkways between dwelling units and parking areas, garbage areas, adjacent open space or wider walkways is 1.0 m.

- Minimum width of walkways between dwelling units or groups of dwelling units is 1.0 m while preferred width is 1.5 m.

- Minimum width of walkways between groups of dwellings and community, recreation or commercial facilities is 1.5 m while preferred width is 2.0 m.

- Utility fixtures shall be located so that there is a minimum distance of 0.30 m from any fixture to the face of a curb or sidewalk.

- Utilities shall not be continuously aligned underneath a curb, gutter or sidewalk.

- Minimum gutter grades shall be 0.4% (0.6% preferred).

- Minimum gutter grades on curves with a radius less than 23 m (75 ft) shall be 0.8% (1.0% preferred).

- Concrete shall have an air content of between 5 and 7% and a minimum 28 day compressive strength of 25 MPa (3,500 psi).

. All concrete sections passing over service excavations shall be reinforced.

4.5 Boulevards

All portions of street rights-of-way not covered by asphalt, concrete or specified gravels (e.g. road shoulders) shall be covered with a minimum of 100 mm of topsoil and seeded to grass. The developer shall be responsible for maintenance of the boulevard for the same period of time as for the streets except for boulevards abutting occupied lots.

4.6 Lanes

Minimum lane rights-of-way shall be 9 m where lots back on both sides and 7 m where lots back on one side only.

The minimum carriageway width shall be 5 m.

The lane cross section shall be a centreline vee with a 3% cross fall. The minimum lane gradient shall be 1%. Lanes with gradients in excess of 5% shall be paved with the same cross section as local streets.

4.7 Street Name and Traffic Control Signs

All street names and traffic control signs shall be located as approved or directed by the City Engineer.

Street name signs shall be placed at every intersection and shall have double nameplates. Erection by the developer of temporary street name signs is required at all intersections prior to the issuance of building permits. The temporary signs shall be maintained by the developer in a legible condition until such time as the permanent street name signs are erected. Permanent signs shall be in place prior to the issuing of the Construction Completion Certificate for roads and walks.

All traffic control signs require location in conformance to the RTAC manual for Uniform Traffic Control Devices for Canada.

Generally, signs should be located on the right hand side of the roadway where the driver is in the habit of looking for them and should be mounted at right angles to the direction of and facing the traffic they are intended to serve. Signs in any other position will be considered supplementary to signs in the normal position.

In cases where the RTAC manual does not specify sign locations (i.e., dead end barricades), the signs shall be located as shown on the engineering drawings and approved by the City Engineer.

Traffic control signs require conformance in size and color in all respects to the current provincial regulations.

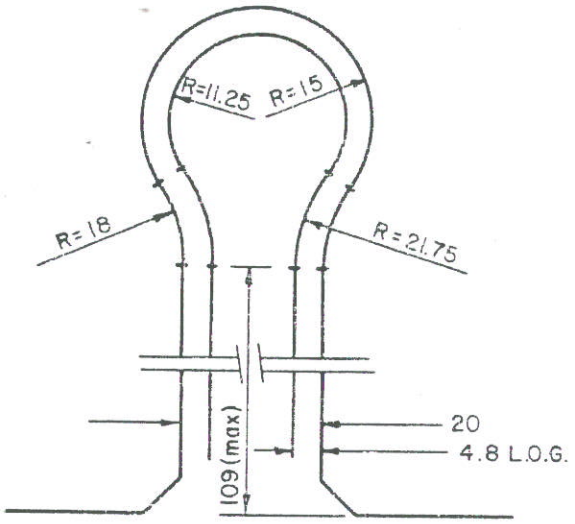
Signs shall be individually erected on separate posts. Two signs for different purposes shall not be erected closer together than 30 m if it can reasonably be avoided. Sign posts and their foundations require construction so as to hold the sign rigidly in a proper and permanent position and to prevent the sign from swaying in the wind or from being turned or otherwise displaced by irresponsible persons.

4.8 Street Pavement Structures

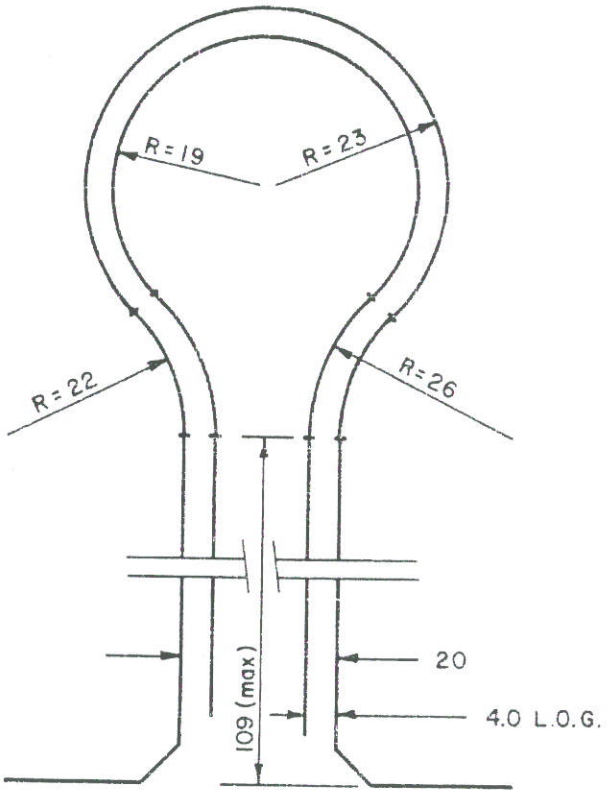
Subgrade CBR - Value Greater Than 3

Street Classification	Subbase Structure	Base Structure	Pavement	TA (Deep Strength Equivalent
Local (ULU)	75 mm crushed gravel, 200 mm deep	20 mm crushed gravel, 50 mm deep	65 mm deep	165 mm (6.5 in)
Collector (UCU) and Light Industrial	75 mm crushed gravel, 250 mm deep	20 mm crushed gravel, 75 mm deep	75 mm deep	205 mm (8.0 in)
Arterial (UAU) and Truck Routes	75 mm crushed gravel, 275 mm deep	20 mm crushed gravel, 100 mm compacted depth	100 mm deep	250 mm (10.0 in)

- Subgrade to be compacted to not less than 95% of its design strength.
- Subgrade with CBR values (soaked) between 2 and 3, add 25 mm depth to pavement thickness or equivalent gravel thickness.
- Subgrade with CBR values (soaked) less than 2, add 50 mm depth to pavement thickness or equivalent gravel thickness.



RESIDENTIAL CUL-DE-SAC



INDUSTRIAL & COMMERCIAL

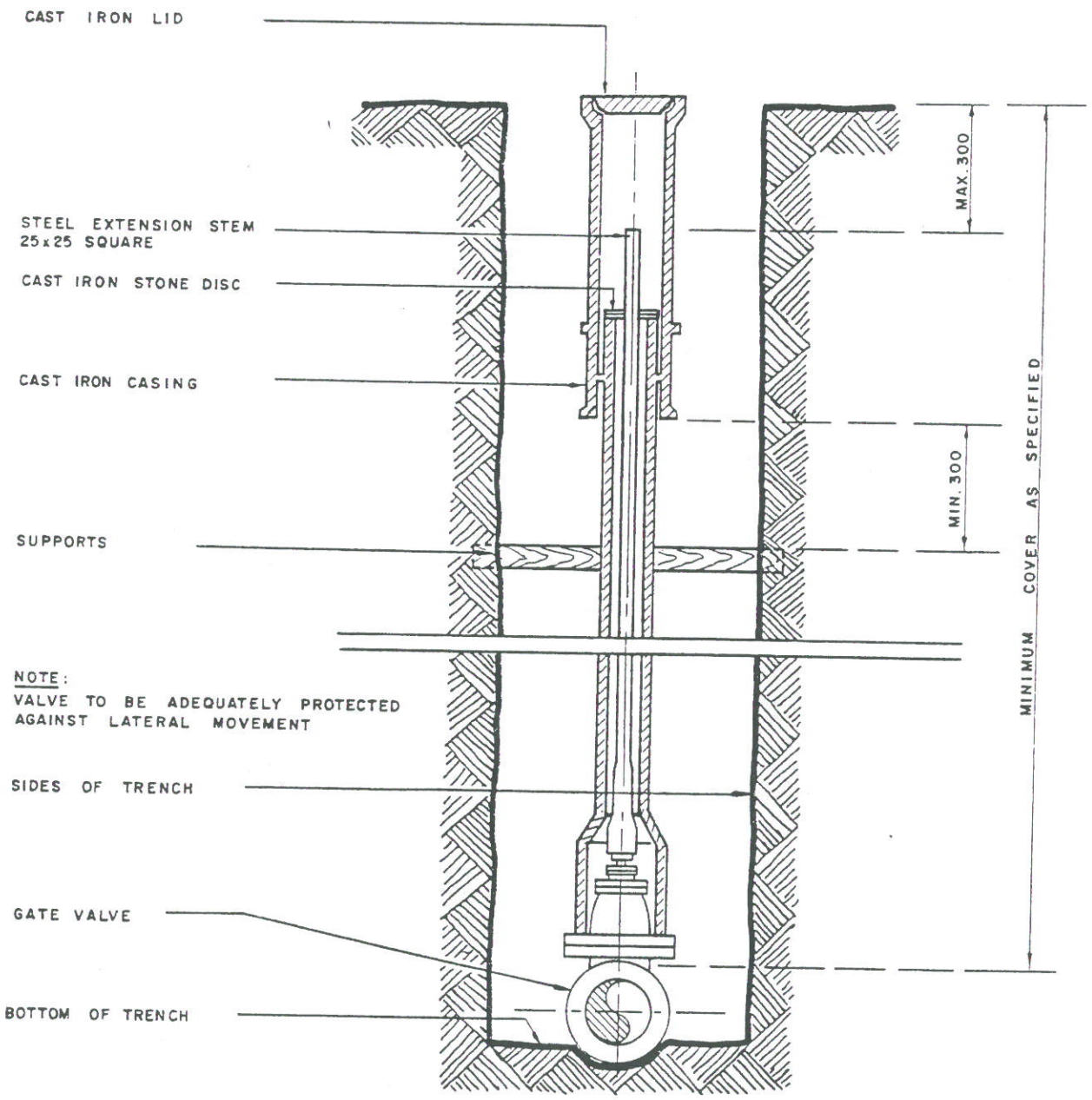
NOTE:

ALL DIMENSIONS ARE IN METRES
N.T.S.

CITY OF DRUMHELLER

STANDARD CUL-DE-SACS

PLATE SL-1



SECTIONAL DETAIL THROUGH VALVE INSTALLATION

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Consulting Engineers and Planners
Alberta

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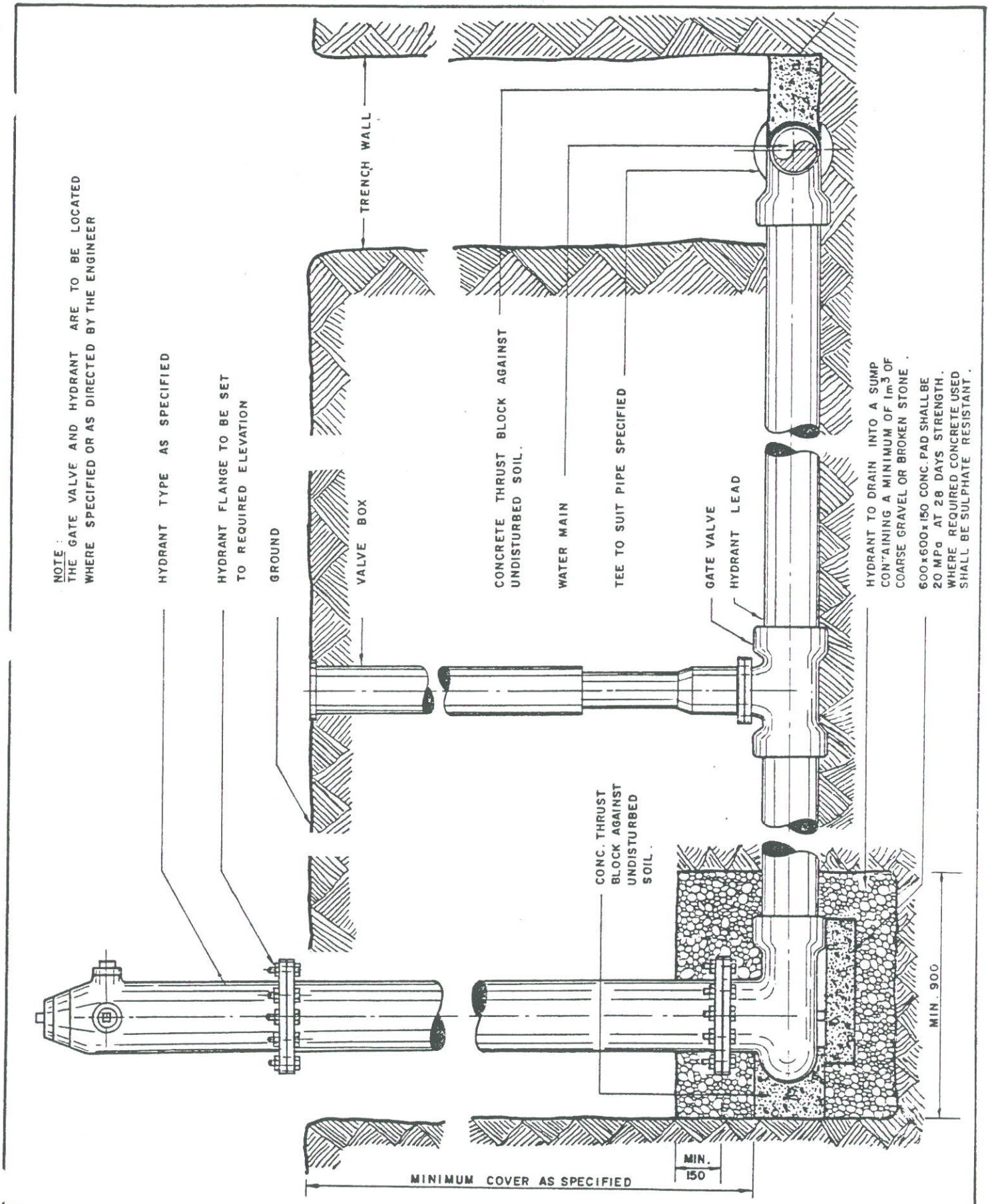
STANDARD XXIII - 01

DETAIL SHOWING VALVE INSTALLATION

02/79

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN



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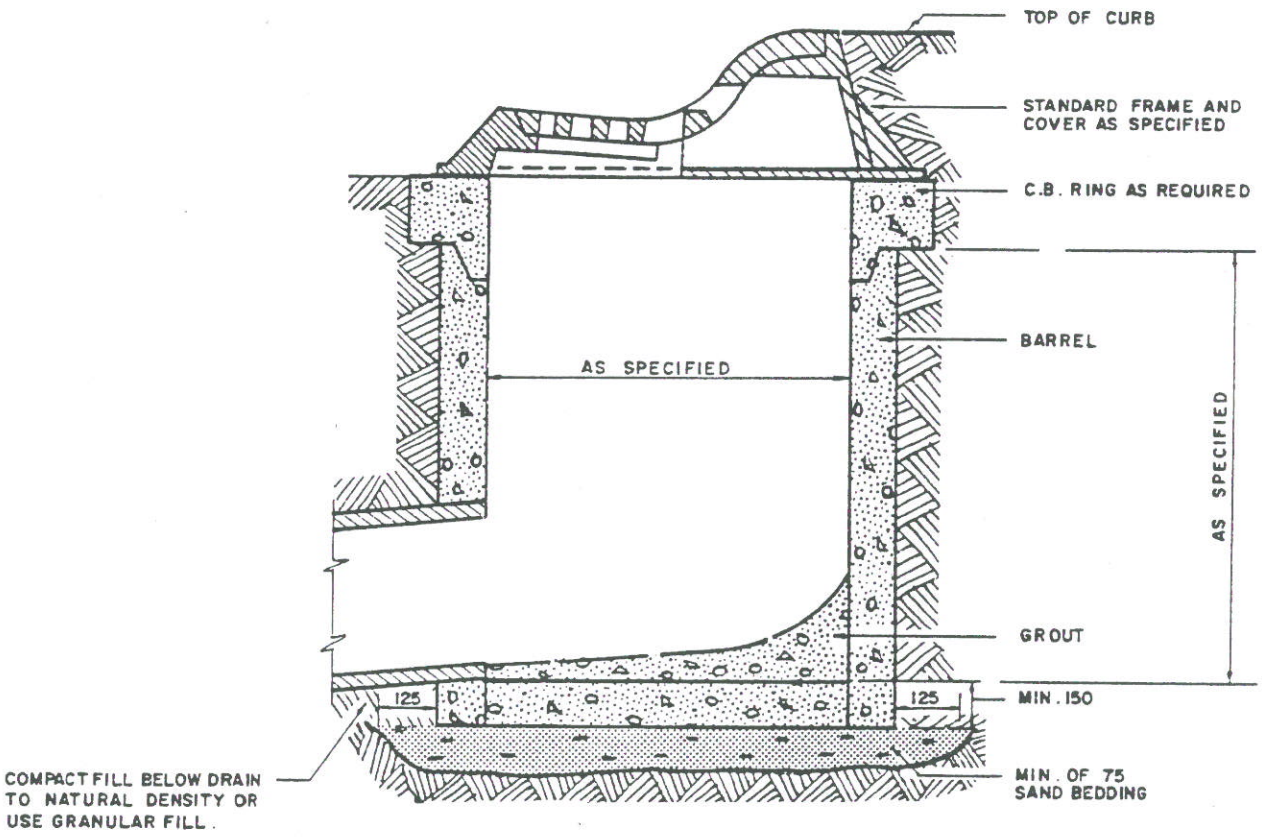
STANDARD XXIII-02

SIDE ELEVATION OF OFF-LINE FIRE HYDRANT CONNECTION

02/79



SECTION

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Alberta

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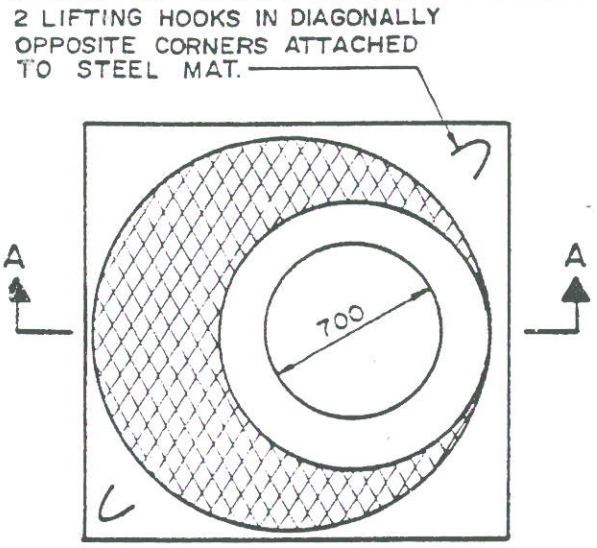
STANDARD XXIV-06

PRECAST CATCH BASIN WITHOUT SUMP

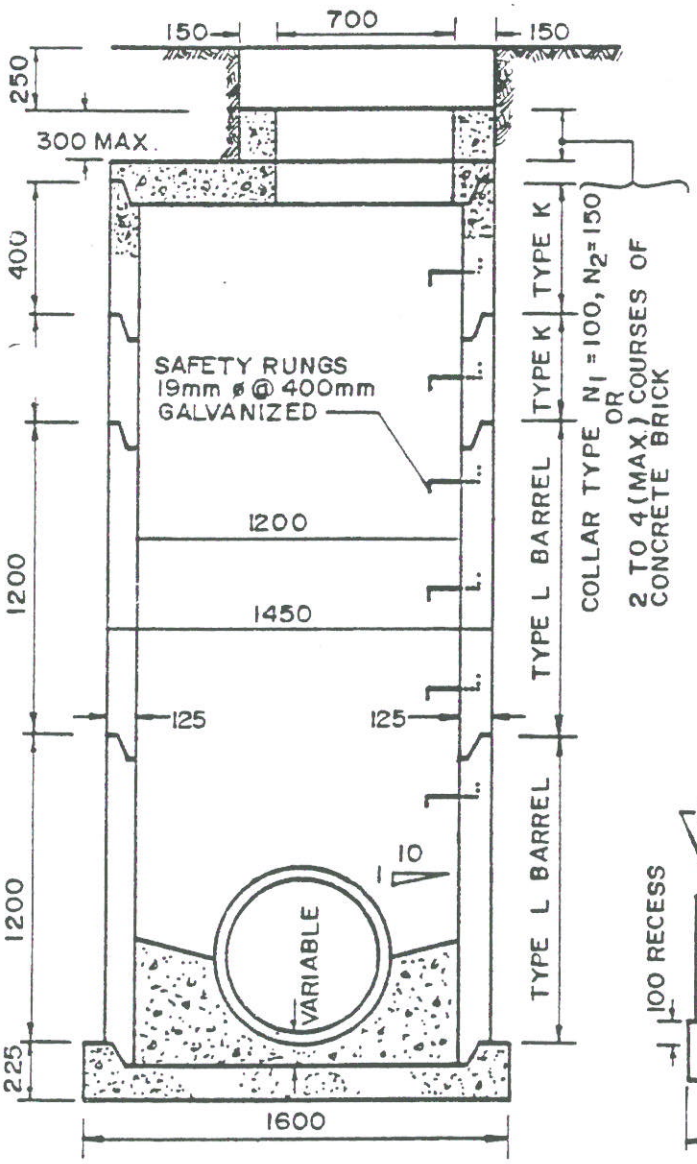
02/79



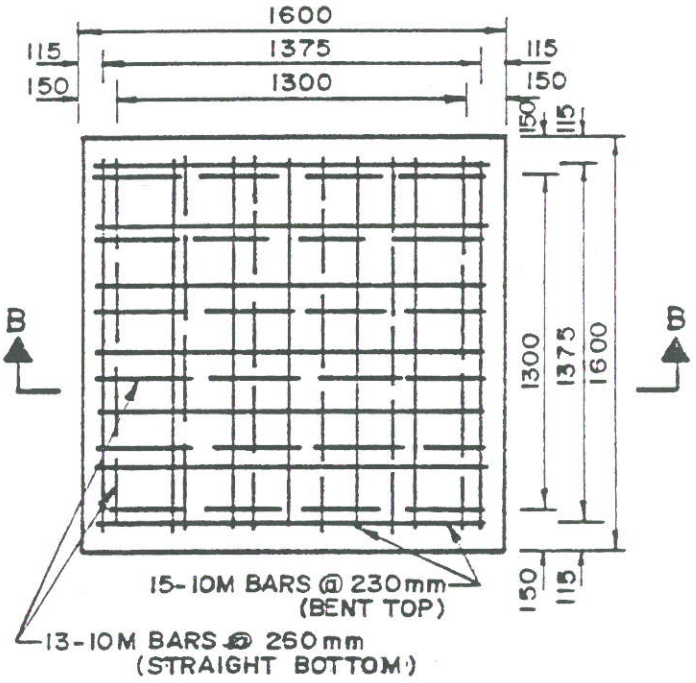
PLAN

NOTES:

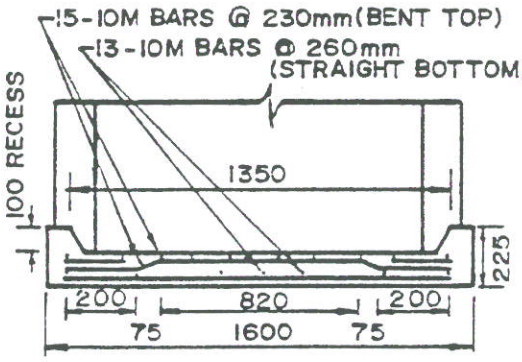
1. USE DEFORMED BARS THROUGHOUT.
2. COVER FOR REINFORCING STEEL SHALL BE 50mm EXCEPT FOR BOTTOM ROW OF BARS IN BASE SLAB WHERE 75mm COVER SHALL BE USED.
3. CONCRETE STRENGTH TO BE 20 MPa. IN 28 DAYS.
4. REINFORCING STEEL TO BE INTERMEDIATE GRADE Fy = 300 MPa.
5. ALL LAPS TO BE 36 BAR DIAMETERS.
6. USE M.H. TYPE 5A WITH PIPE UP TO & INCLUDING 600mm DIA.
7. CONCRETE SHALL BE SULPHATE RESISTANT WHERE SPECIFIED.
8. JOINTS BETWEEN PRECAST SECTIONS TO BE SEALED WITH APPROVED BITUMINOUS GASKET.



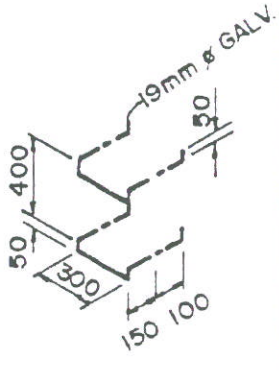
SECTION A-A



BASE SLAB DETAIL



SECTION B-B



STEP DETAIL

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Alberta

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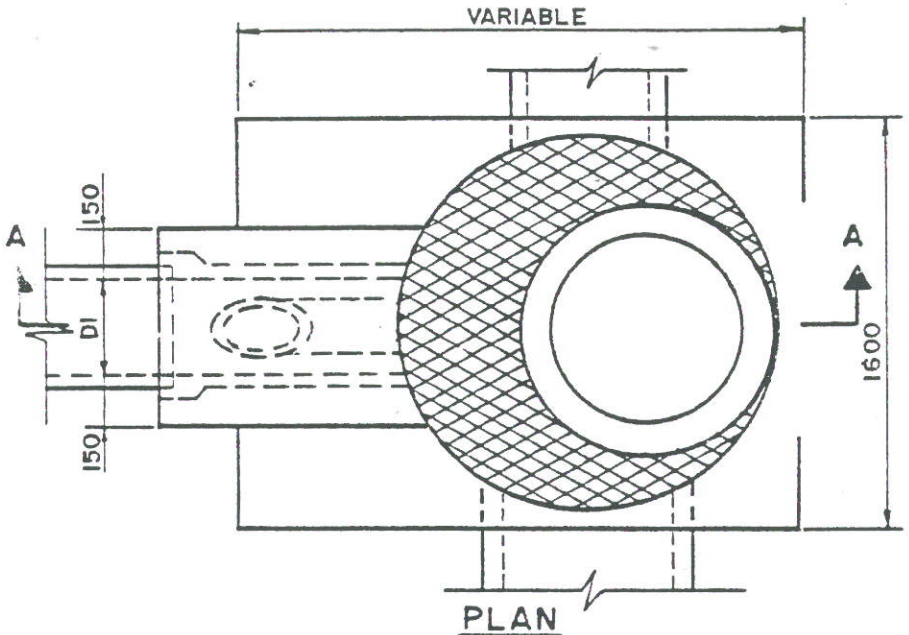
STANDARD XXIV-C101

STANDARD MANHOLE
TYPE 5A

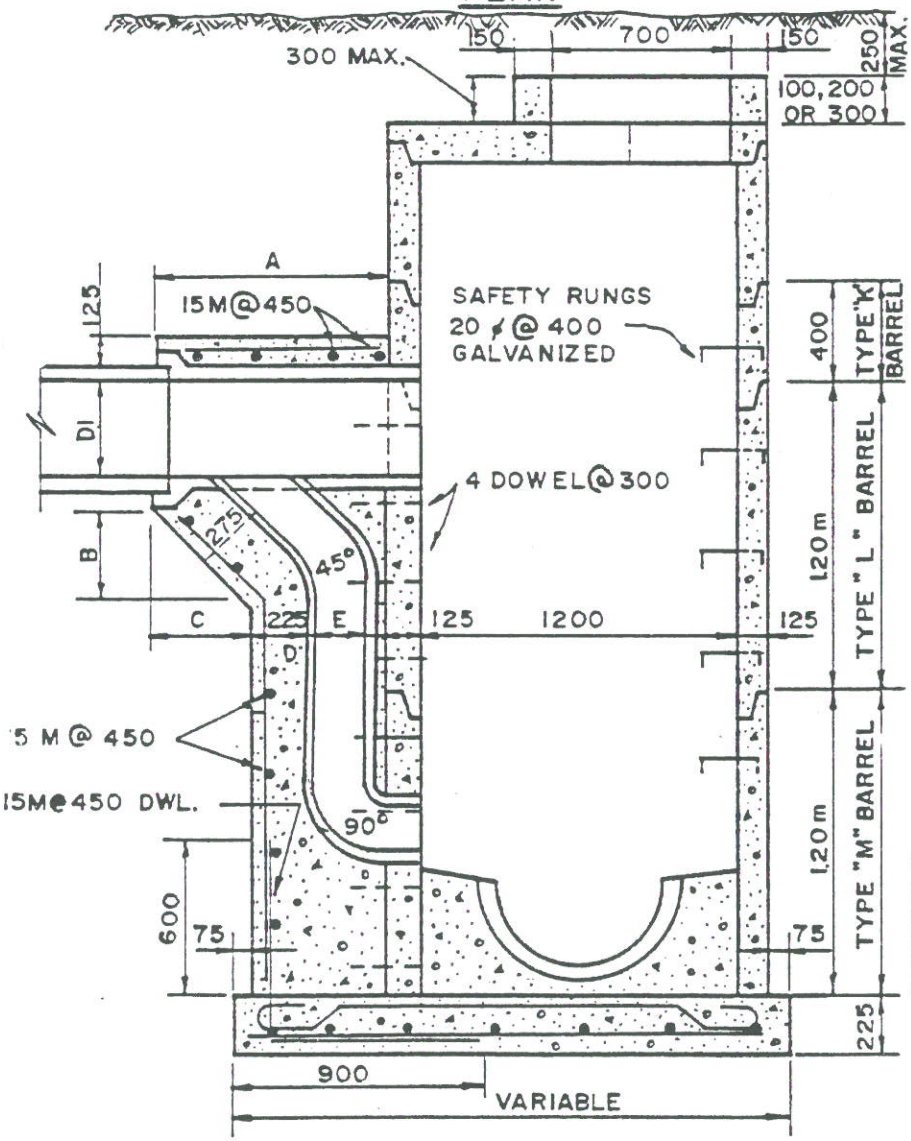
11/80

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE



PLAN

PIPE SIZE IN mm		A	B	C	D
INFLOW (DI)	EXT. DROP (E)				
250 TO 450	200	900	400	400	75
525 TO 750	250	1025	425	425	125
900 TO 1200	450	550	600	600	150



SECTION A-A

NOTE:

1. USE DEFORMED BARS THROUGHOUT.
2. COVER FOR REINFORCING STEEL BE 50 EXCEPT FOR BOTTOM ROW OF BARS IN BASE SLAB WHERE 75 COVER IS USED.
3. CONCRETE STRENGTH TO BE 20 MPa IN 28 DAYS.
4. REINFORCING STEEL TO BE INTERMEDIATE GRADE FY = 300 MPa.
5. ALL LAPS TO BE 30 DIAMETER BAR.
6. JOINTS BETWEEN PRECAST SECTIONS TO BE SEALED WITH APPROVED BITUMINOUS GASKET.
7. CONCRETE SHALL BE SULPHATE RESISTANT WHERE SPECIFIED.

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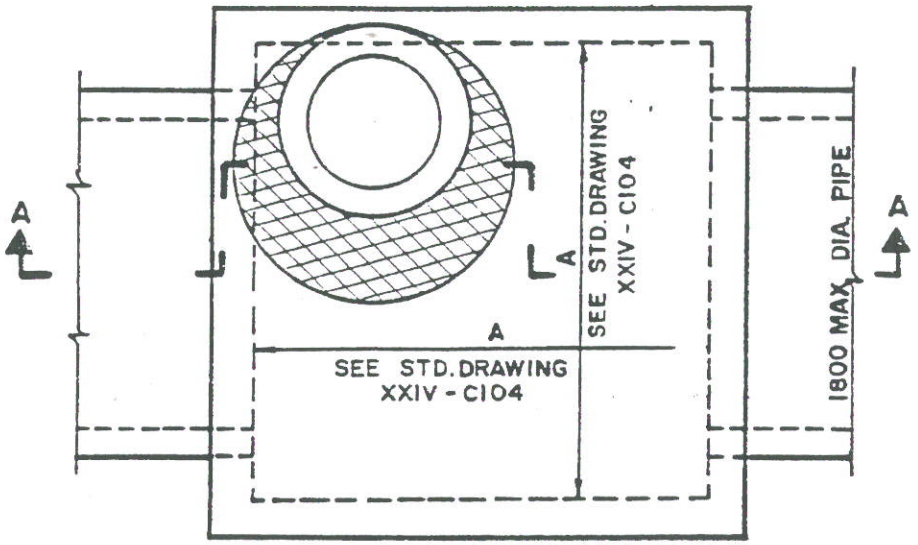
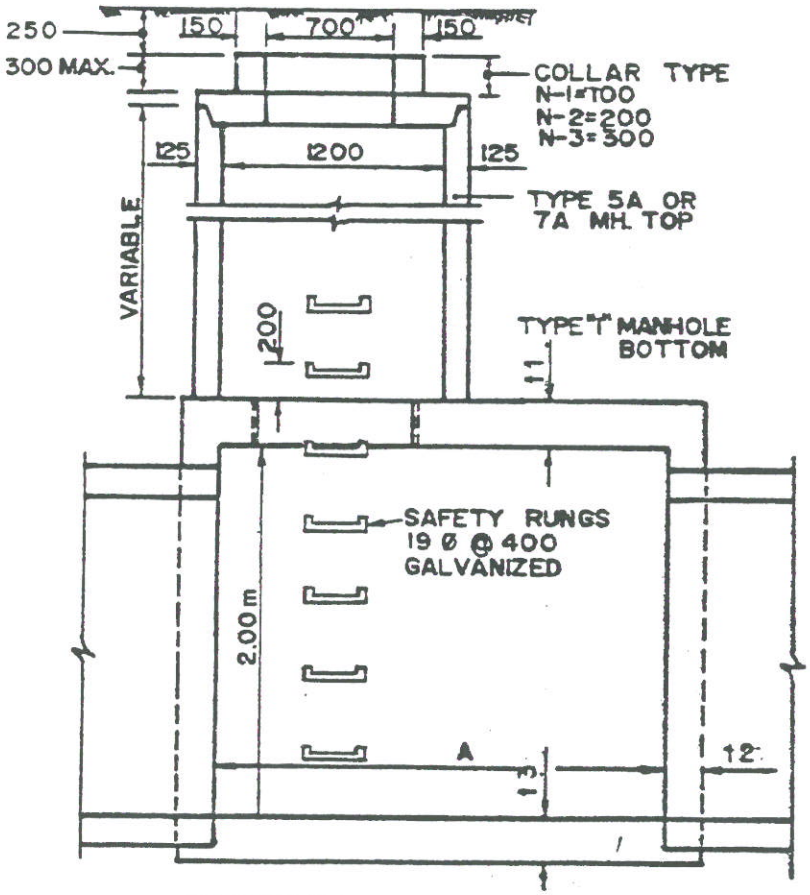
STANDARD XXIV-C102

DROP MANHOLE SLAB TOP

11/80



PLAN



SECTIONAL ELEVATION A-A

NOTES:

1. JOINTS BETWEEN PRECAST SECTIONS TO BE SEALED WITH APPROVED BITUMINOUS GASKET.
2. FOR REINFORCING SEE STANDARD DRAWING XXIV-C103A & -C104.

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STANDARD XXIV-C103

STANDARD MANHOLE TYPE I SPECIAL

04/83.

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Alberta

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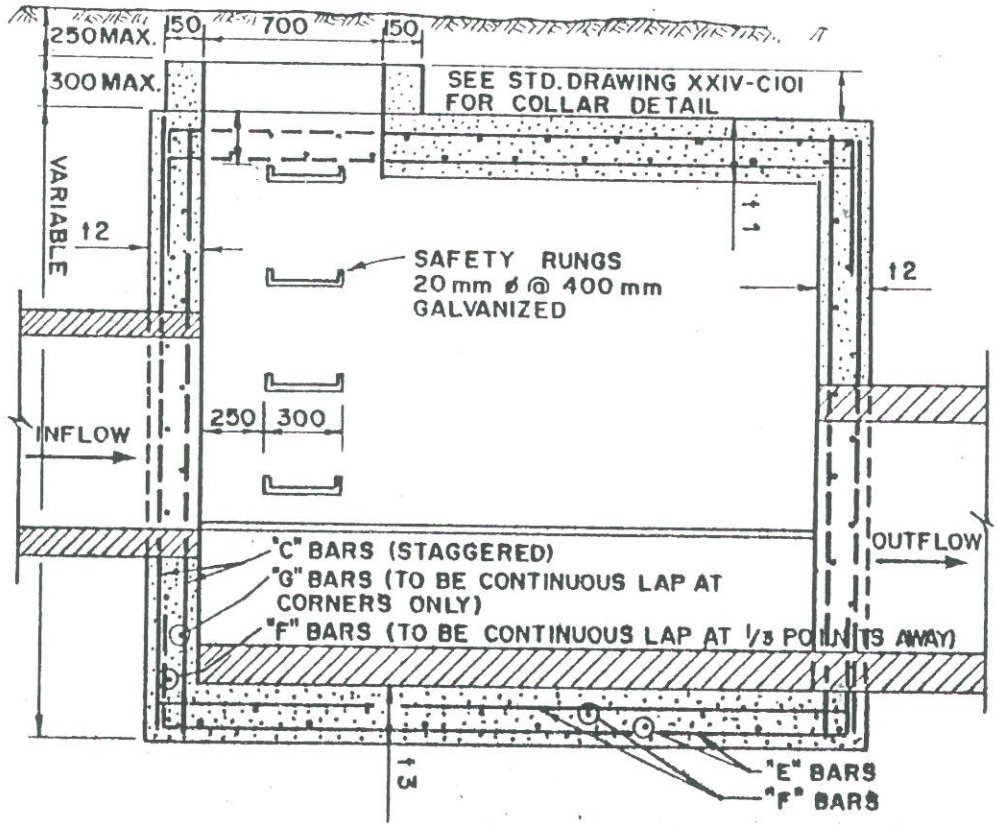
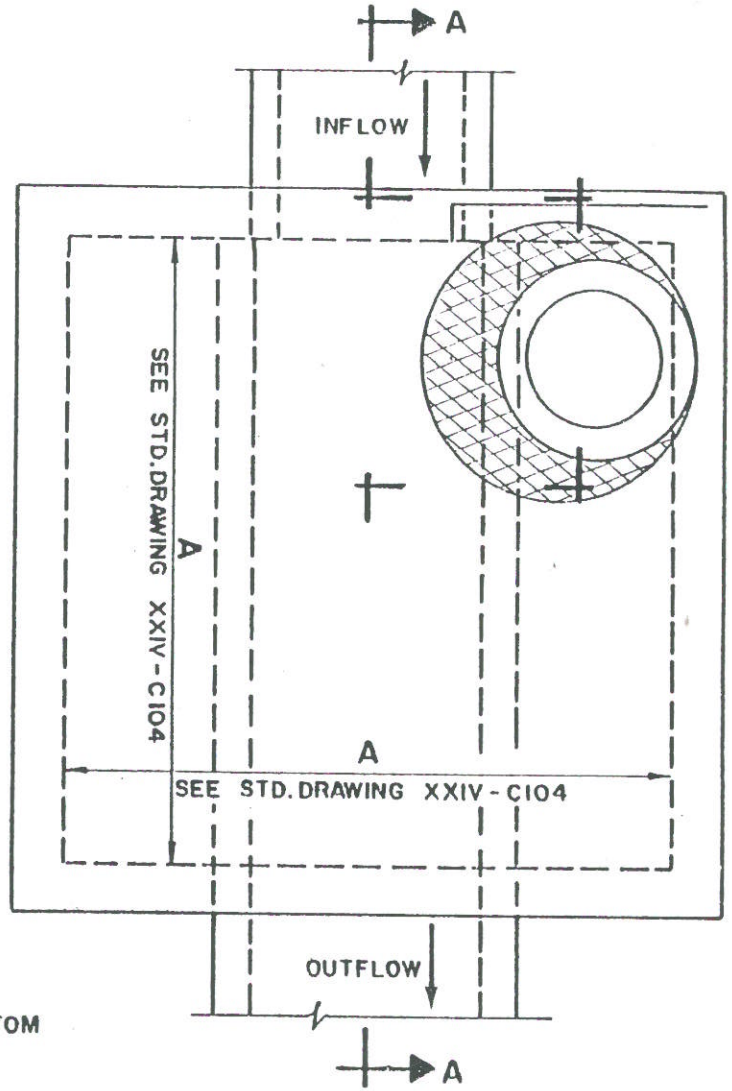
STANDARD XXIV-C103A

STANDARD MANHOLE TYPE 1 SPECIAL



SECTIONAL ELEVATION A-A



PLAN

NOTES:

1 – USE DEFORMED BARS THROUGHOUT.

2 – COVER FOR REINFORCING STEEL SHALL BE 50 mm EXCEPT FOR BOTTOM ROW OF BARS IN BASE SLAB WHERE 80 mm COVER SHALL BE USED.

3 – CONCRETE STRENGTH TO BE 20 MPa IN 28 DAYS.

4 – REINFORCING STEEL TO BE INTERMEDIATE GRADE F_y = 300 MPa.

5 – ALL LAPS TO BE 30 BAR DIAMETER.

6 – PLACE 15 M BARS AT 45° TO MAIN REINFORCING STEEL ON CORNER OF OPENING IN TOP SLAB.

7 – CONCRETE SHALL BE SULPHATE RESISTANT WHERE SPECIFIED.

8 – JOINTS BETWEEN PRECAST SECTIONS TO BE SEALED WITH APPROVED BITUMINOUS GASKET.

04/83

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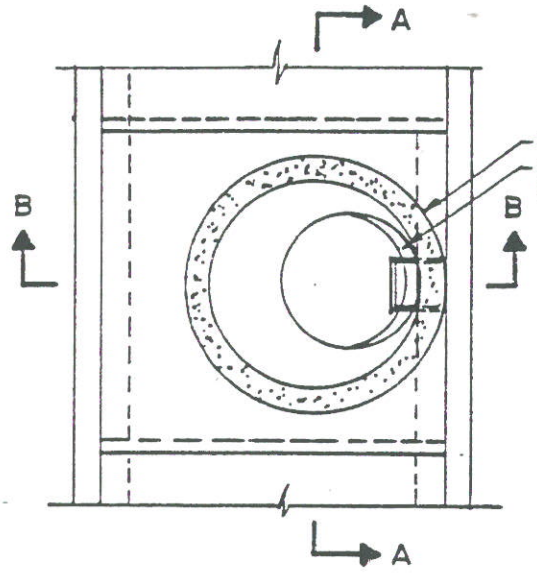
MANHOLE TYPE I SPECIAL DATA

A	Bottom Slab				Walls				Top Slab			
Inside Dimension (m)	t_3	D Bars Horizontal U. Face	E Bars Horizontal L. Face	Lap X_2	t_2	C Bars Vertical Both Face	F Bars Horizontal O. Face	G Bars Horizontal I. Face	t_1	A Bars Horizontal U. Face	B Bars Horizontal L. Face	Lap X_1
1.2x1.2	225	15M@350	15M@350	450	200	10M@300	15M@450	10M@430	200	15M@150	15M@150	650
1.5x1.5	225	15M@300	15M@300	525	200	10M@300	15M@350	10M@325	225	15M@150	15M@150	650
1.8x1.8	225	15M@225	15M@225	525	200	10M@300	15M@250	15M@460	250	20M@190	20M@190	650
2.1x2.1	225	15M@225	15M@225	525	200	10M@300	20M@250	15M@375	250	20M@165	20M@165	650
2.4x2.4	225	15M@200	15M@200	550	200	10M@300	20M@200	15M@250	250	20M@165	20M@165	650
2.7x2.7	225	15M@175	15M@175	550	225	10M@300	20M@200	15M@250	250	20M@150	20M@150	650

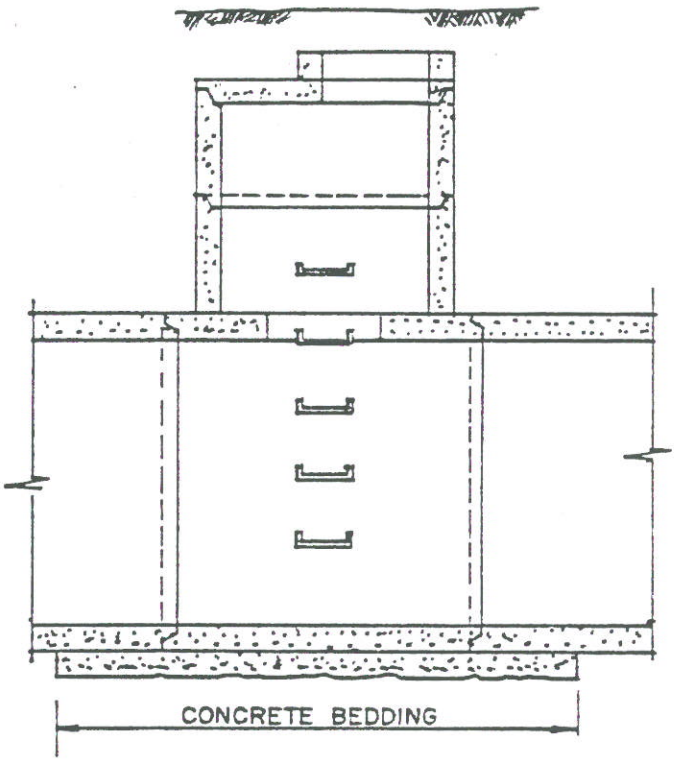
STANDARD XXIV-C 104

STANDARD MANHOLE TYPE I SPECIAL DATA SHEET

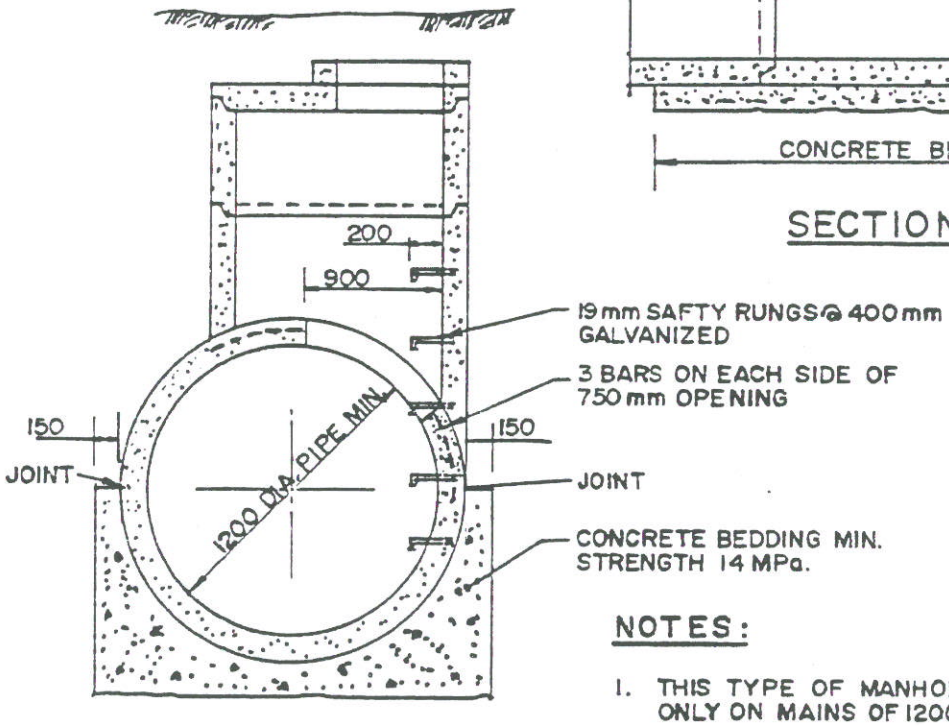
11/80



PLAN



SECTION - A-A



SECTION B-B

NOTES:

1. THIS TYPE OF MANHOLE IS TO BE BUILT ONLY ON MAINS OF 1200 mm Ø OR LARGER.
2. THIS TYPE OF MANHOLE IS TO BE USED ONLY WHERE THERE IS NO CHANGE IN DIRECTION OF FLOW. I.E. A 'STRAIGHT-THROUGH' FLOW.
3. T-RISER SUPPLIED AS A PRECAST SECTION.
4. JOINTS BETWEEN PRECAST SECTIONS TO BE SEALED WITH APPROVED BITUMINOUS GASKET.

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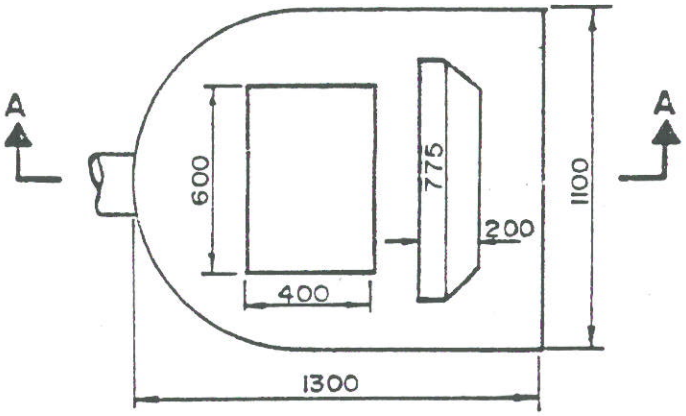
STANDARD XXIV - C105

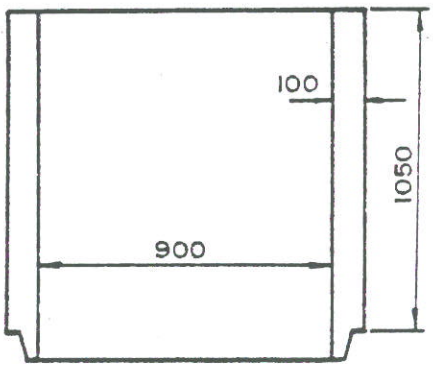
T-RISER MANHOLE

11/80

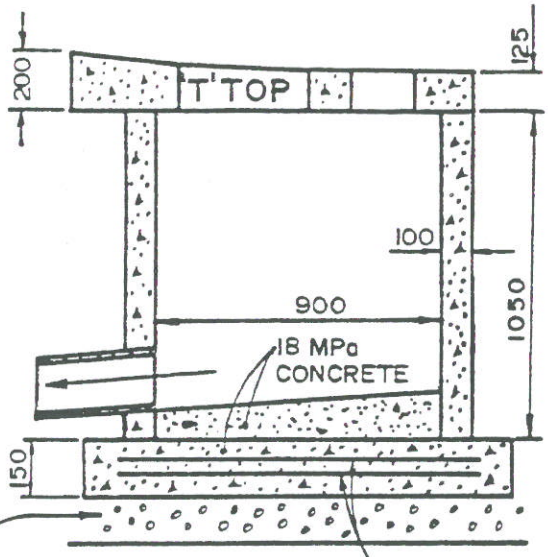
NOTE:
USE TYPE "C" C-B-FRAME GRATE AND SIDE INLET WITH "T" SLAB



PLAN
'T' TOP



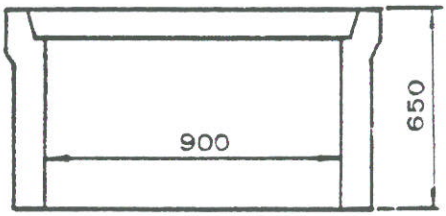
'C' BARREL



150mm CRUSHED GRAVEL

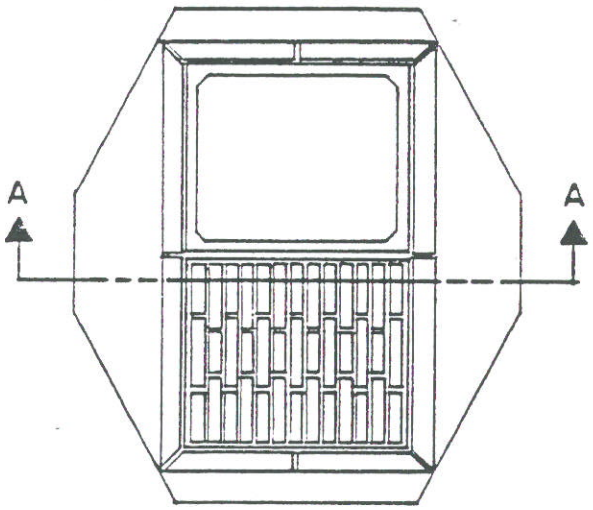
DOUBLE LAYER OF
150 x 150 MW 25.8 x MW 25.8

SECTION A-A
'A' BARREL

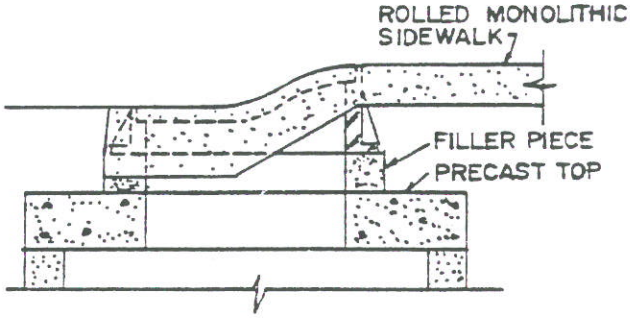


'D' BARREL

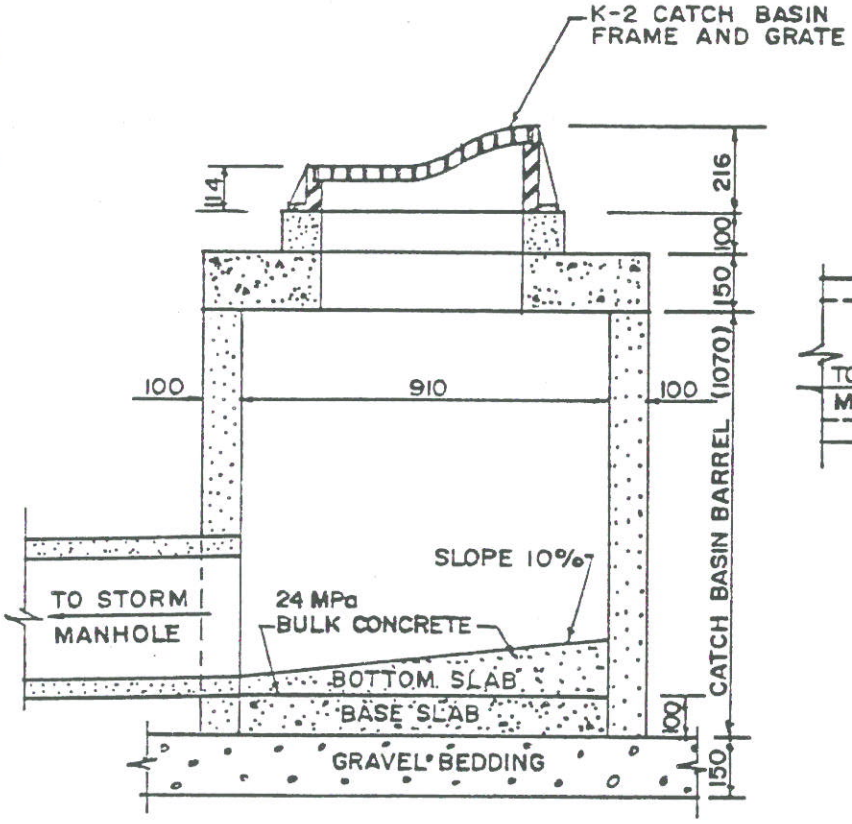
Underwood McLellan Ltd. Consulting Engineers and Planners Alberta	the umg group	STANDARD XXIV - C106 PRECAST CURB DRAIN CATCH BASIN TYPE T.S. 11/80



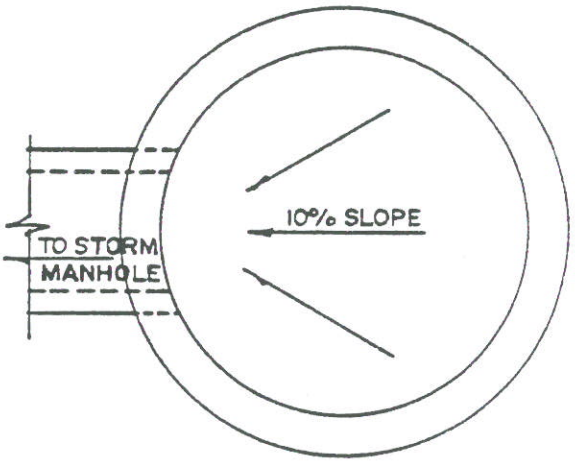
PLAN



CATCH BASIN & SIDEWALK



SECTION A-A



PLAN OF BOTTOM SLAB

NOTE :
PRECAST CATCH BASIN BARRELS TO CONFORM TO A.S.T.M. C-478 (LATEST EDITION)

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STANDARD XXIV-C107

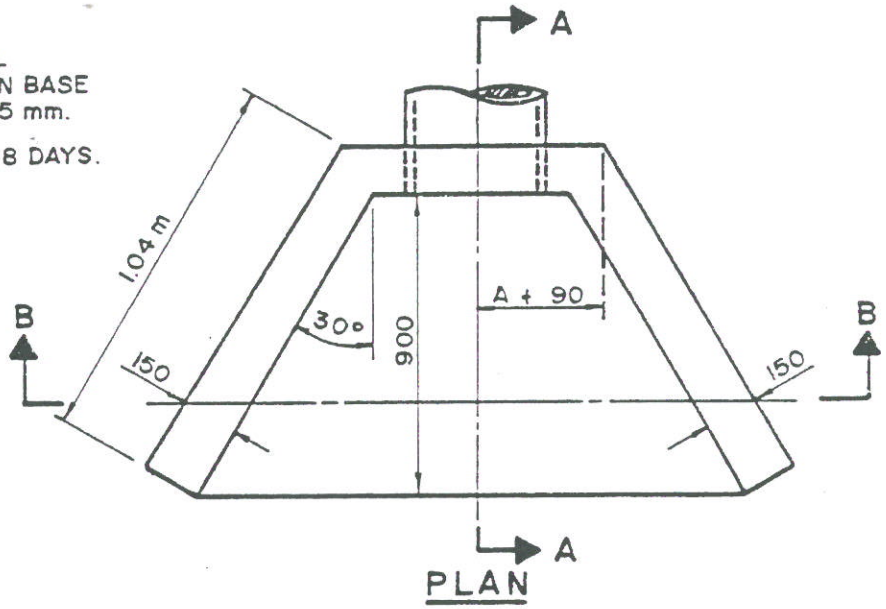
STORM CATCH BASIN TYPE K-2 ASSEMBLY

11/80

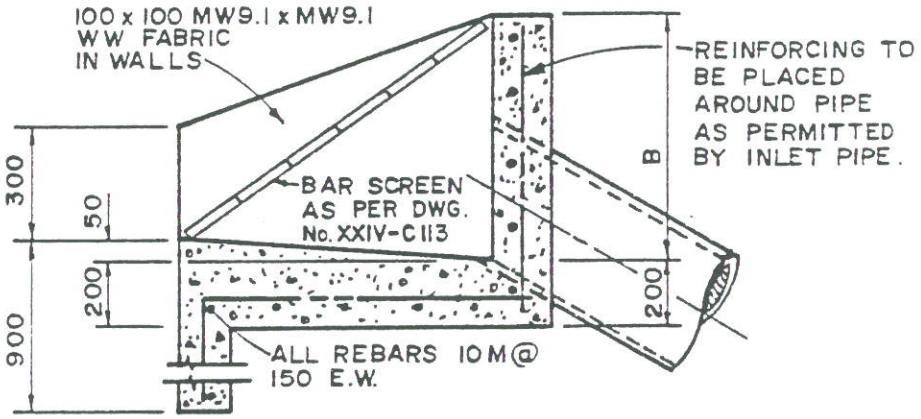
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN

NOTES :

1. COVER FOR REINFORCING STEEL SHALL BE 50 mm MIN. EXCEPT IN BASE SLAB WHERE MIN. SHALL BE 75 mm.
2. CONCRETE TO BE 20 MPa @ 28 DAYS.
3. LAP ALL HORIZONTAL BARS 250 mm INTO WING WALLS.

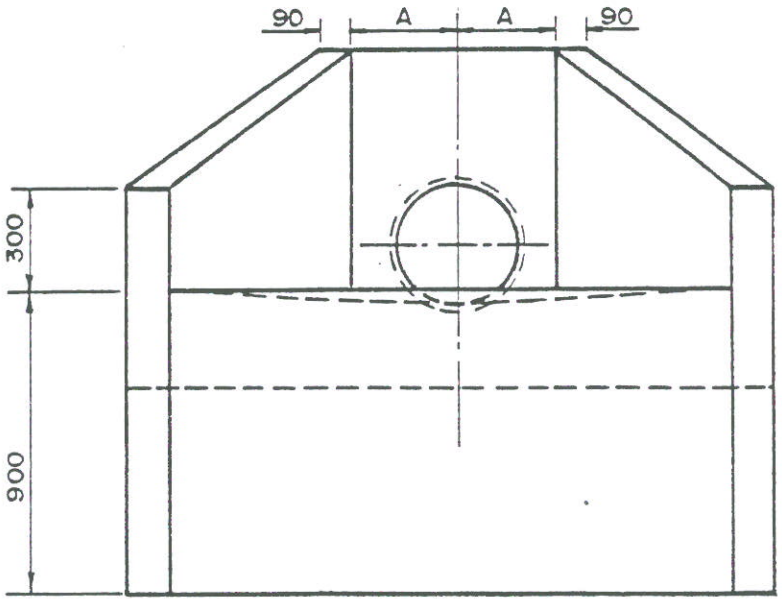


PLAN



SECTION A-A

PIPE DIA. (mm)	A	B
180-300	250	865
375	300	915
450	375	1065
525	375	1120
600	490	1220



SECTION B-B

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Alberta

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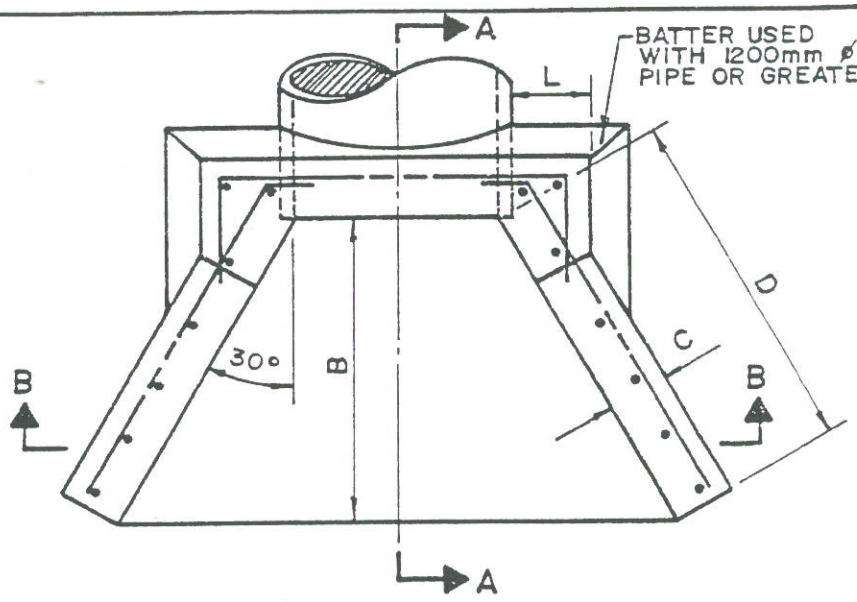
STANDARD XXIV-CIII

STANDARD STORM INLET STRUCTURE

11/80

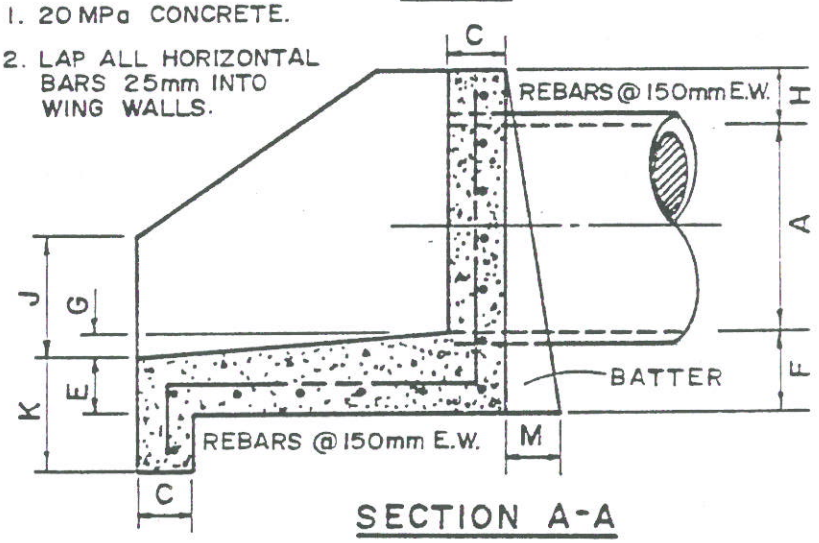
PIPE DIA.mm A	B	C	D	E	F	G	H	J	K	L	M	REINFORC. WING WALLS	REINFORC. REMAINDER
450/SMALLER	900	150	1055	150	200	50	200	300	225	250	NIL	102 x 102 MW9.1 x MW9.1	10M @ 150
600	1050	150	1270	150	200	50	200	300	225	250	NIL		10M @ 150
900	1200	200	1410	200	275	75	225	300	275	275	NIL		15M @ 150
1050	1350	200	1620	200	275	75	225	300	275	275	NIL		15M @ 150
1200	1500	250	1760	225	300	75	250	300	300	300	NIL		15M @ 150
1200	1650	250	1975	300	400	100	250	600	400	300	200		15M @ 150
1350	1800	275	2115	300	400	100	300	600	400	400	250		
1500	1950	300	2325	300	400	100	300	700	400	400	300		



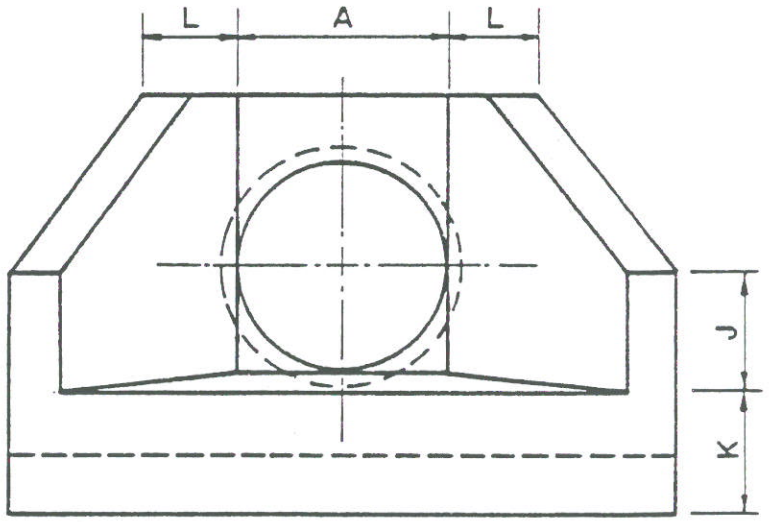
PLAN

NOTES:

1. 20 MPa CONCRETE.
2. LAP ALL HORIZONTAL BARS 25mm INTO WING WALLS.



SECTION A-A



SECTION B-B

Underwood McLellan Ltd.
Consulting Engineers and Planners
Alberta

the uma group

STANDARD XXIV-C112

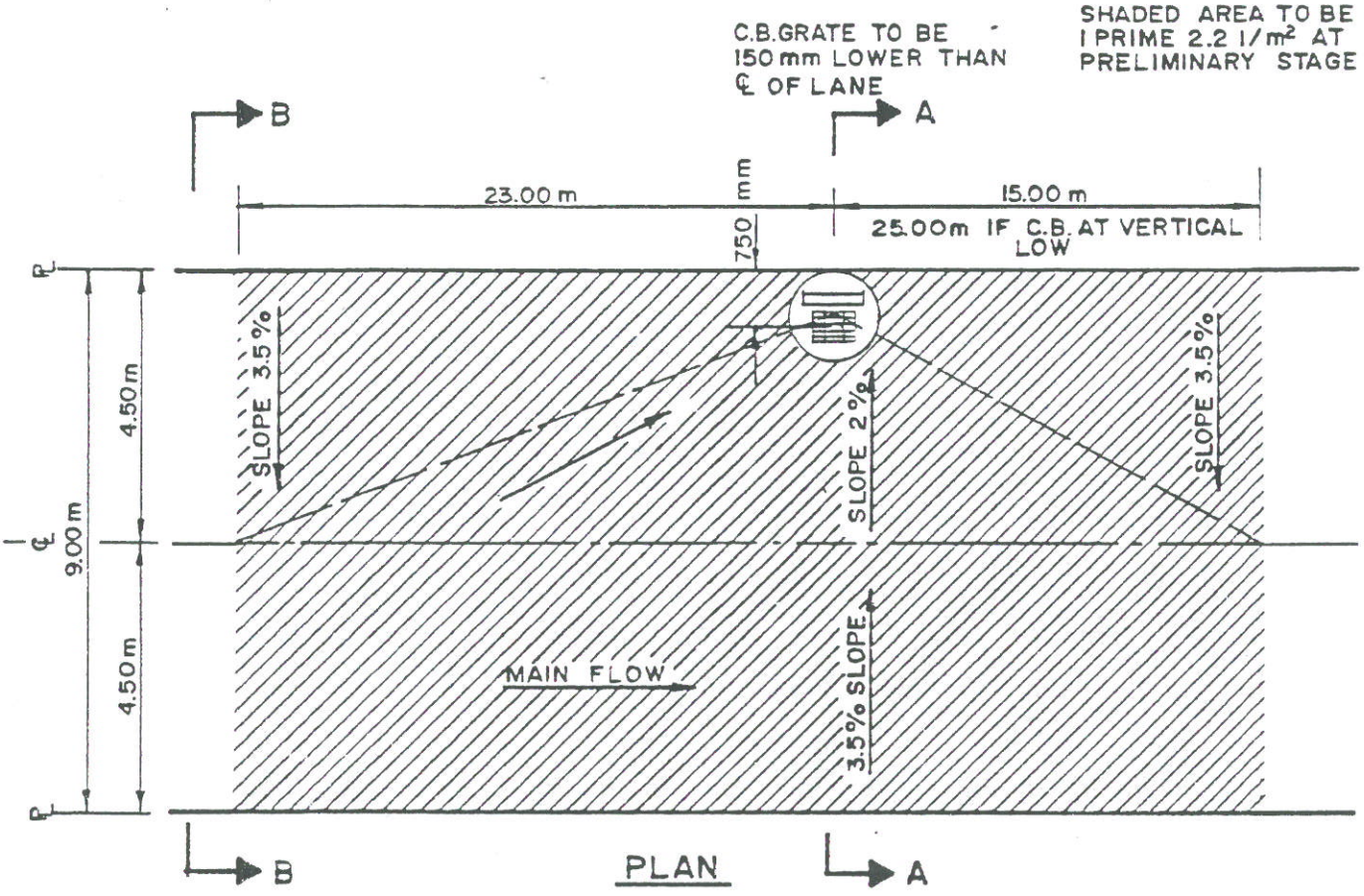
STANDARD STORM OUTLET STRUCTURE

11/80

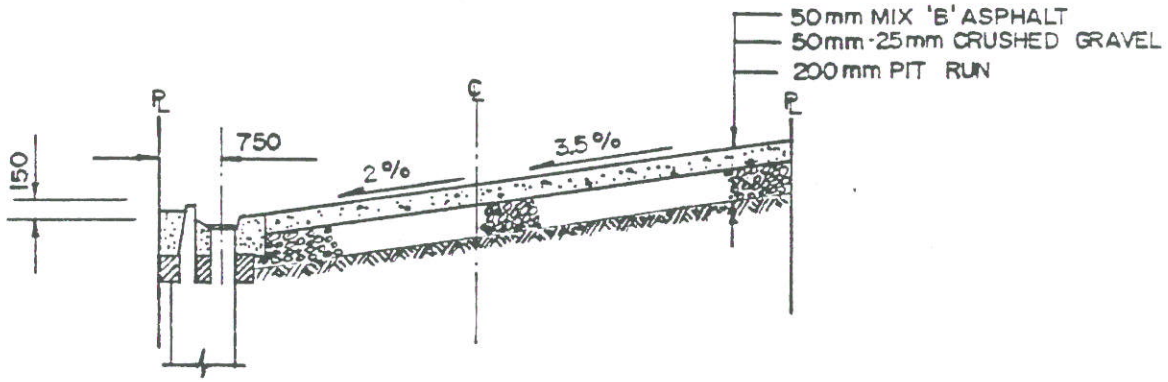
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE

NOTE:

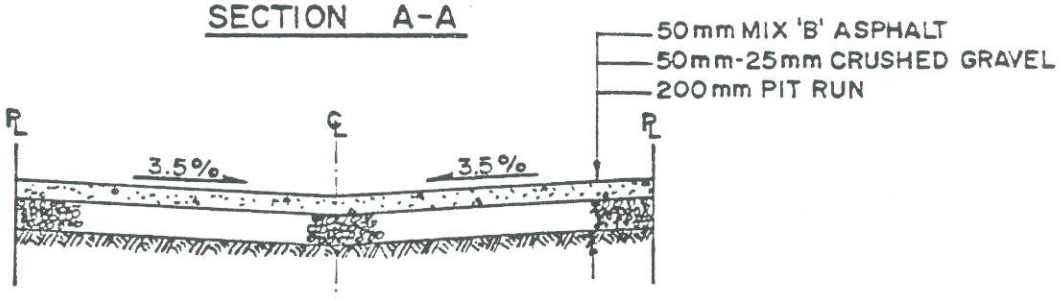
SHADED AREA TO BE S.S I PRIME 2.2 l/m² AT PRELIMINARY STAGE



PLAN



SECTION A-A



SECTION B-B

Underwood McLellan Ltd.
Consulting Engineers and Planners
Alberta

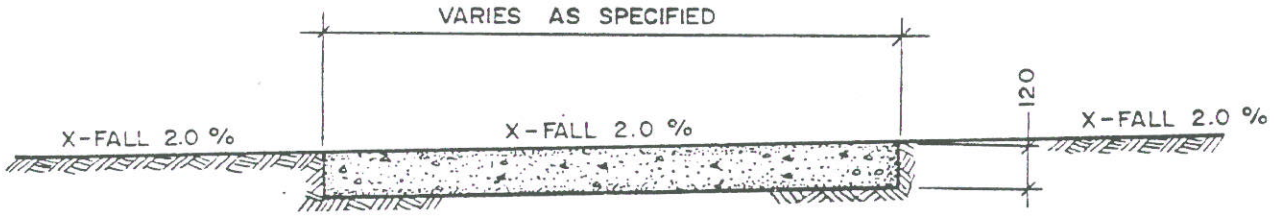
the uma group

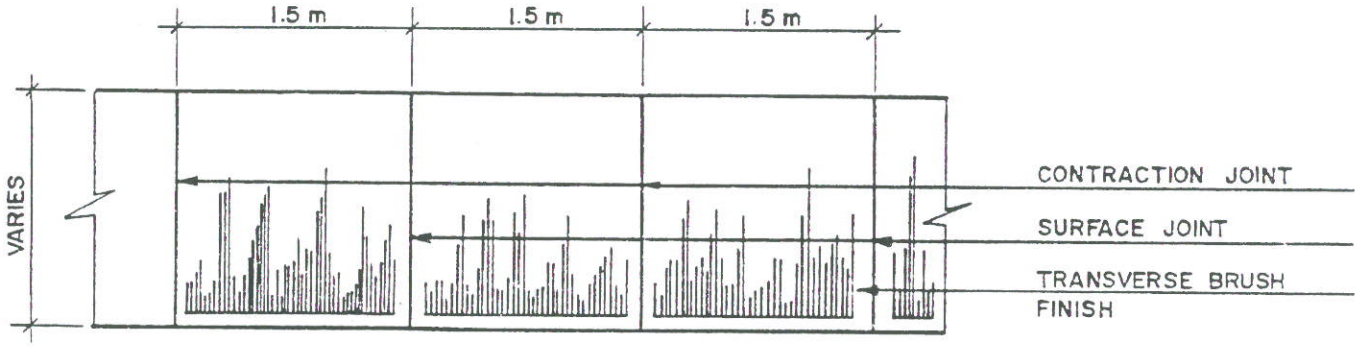
STANDARD XXIV-C115

TYPICAL CATCH BASIN INSTALLATION IN DISHED TYPE LANE

11/80

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN





Underwood McLellan Ltd.
Consulting Engineers and Planners
Alberta

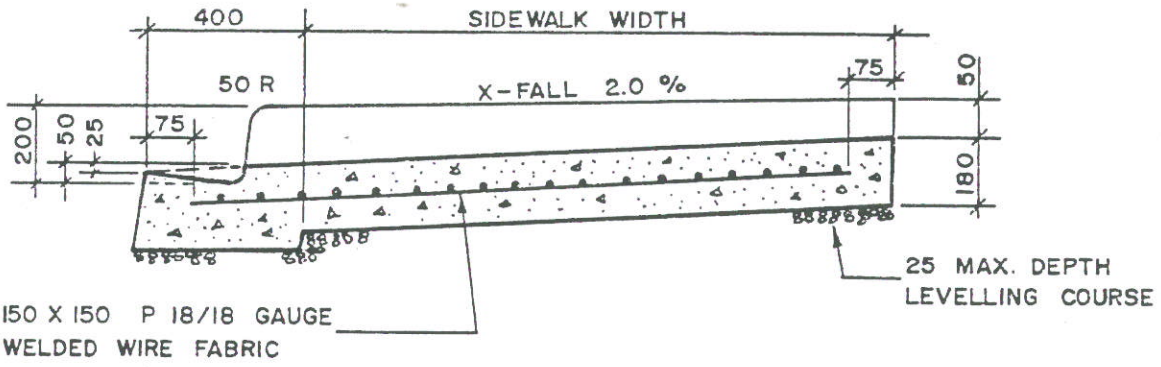
the umg group

STANDARD XXVII-06

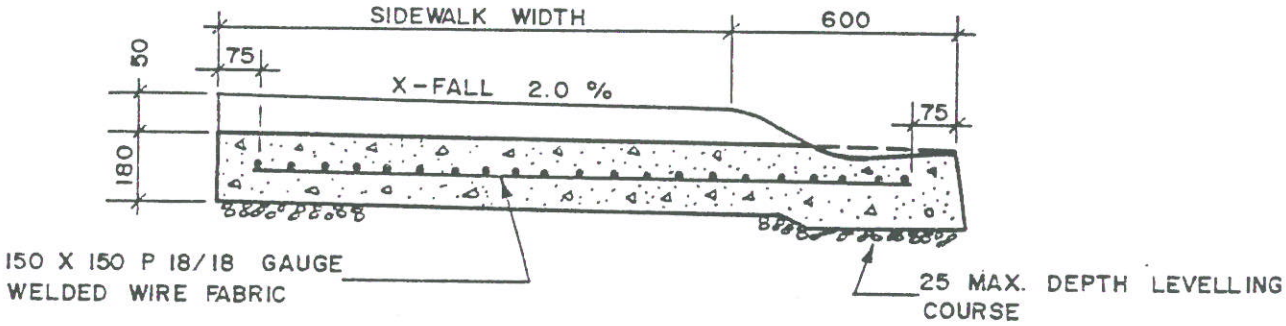
SEPARATE SIDEWALK

02/80

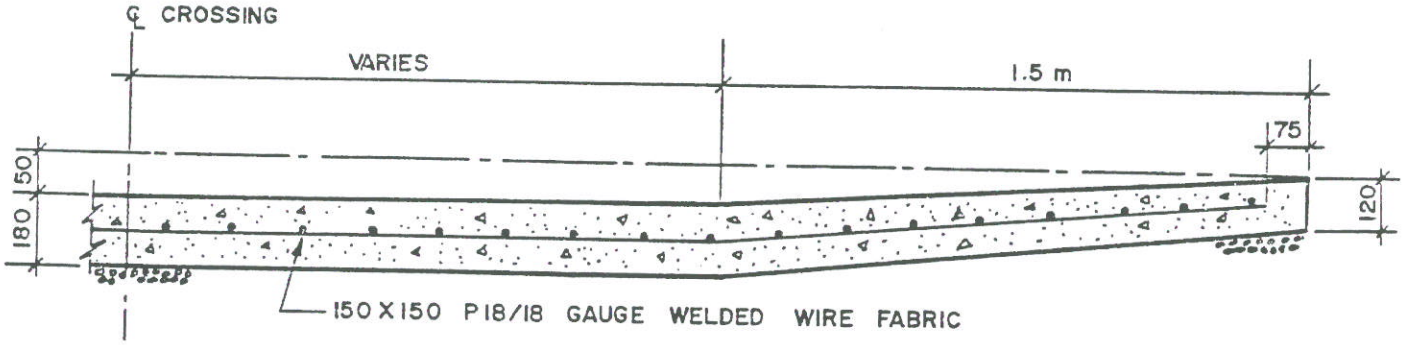
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN



SECTION AT ℄ FOR 150 MONOLITHIC STANDARD CURB & GUTTER



SECTION AT ℄ FOR MONOLITHIC ROLLED CURB & GUTTER



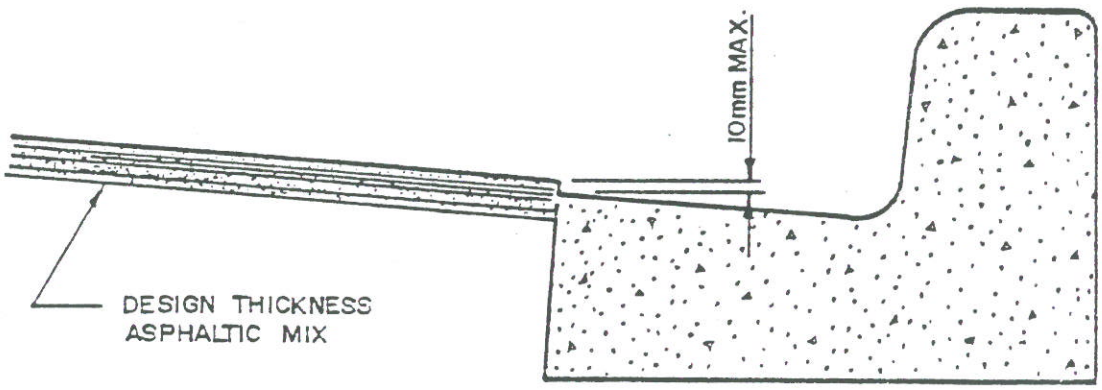
DETAIL FOR BACK OF WALK FOR 150 MONOLITHIC STANDARD CURB & GUTTER

Underwood McLellan Ltd. Consulting Engineers and Planners Alberta	the umq group	STANDARD XXVII-08 MONOLITHIC LANE & COMMERCIAL CROSSINGS 02/80

NOTE:

THE FINISHED ASPHALT SURFACE SHALL VARY FROM 3 mm MIN. TO 10 mm MAX. ABOVE LIP OF GUTTER.

THE SUBGRADE OR BASE COURSE SHALL BE CONSTRUCTED TO A GRADE LINE SO THAT ONLY THE DESIGN THICKNESS OF ASPHALTIC MIX WILL BE REQUIRED.



Underwood McLellan Ltd.
Consulting Engineers and Planners
Alberta

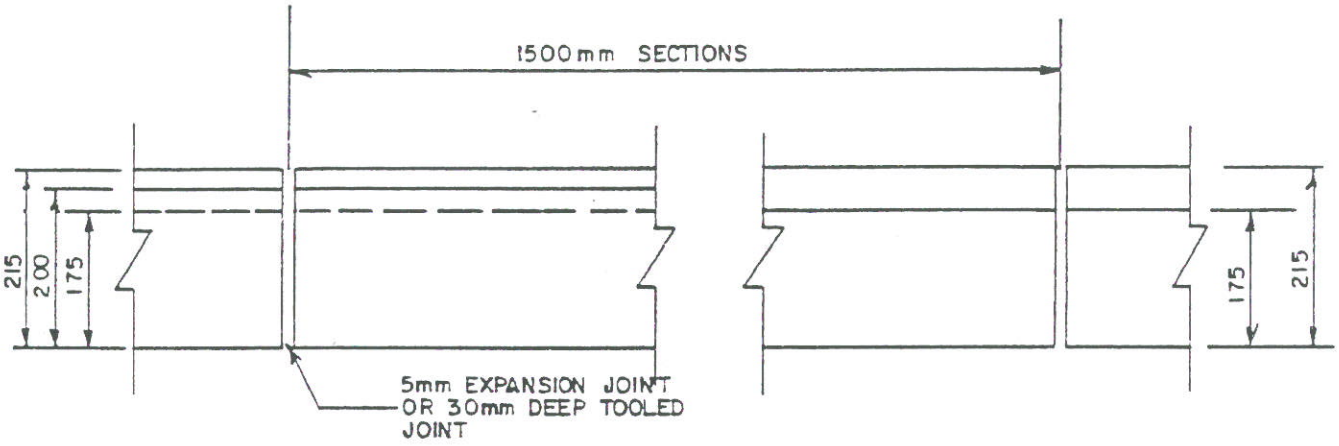
the umg group

STANDARD XXVII-C101

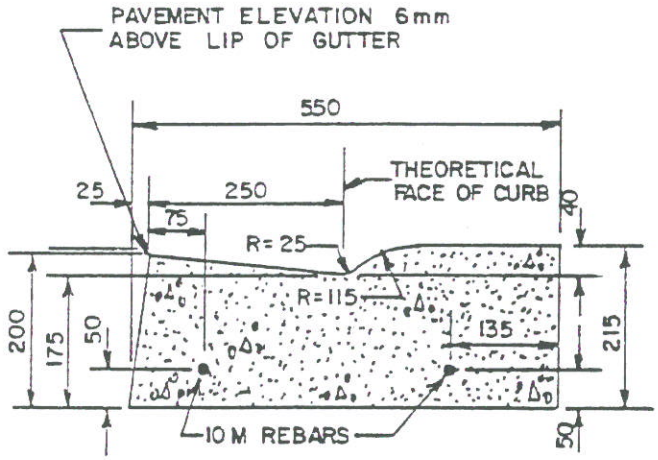
ASPHALT FINISHING DETAIL

11/80

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN

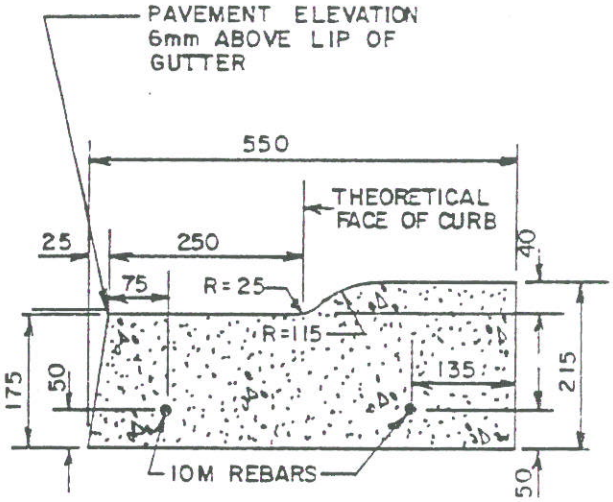


ELEVATION



SECTION

NORMAL CROWN ROAD OR LOW SIDE OF ROAD ON SUPERELEVATION



SECTION

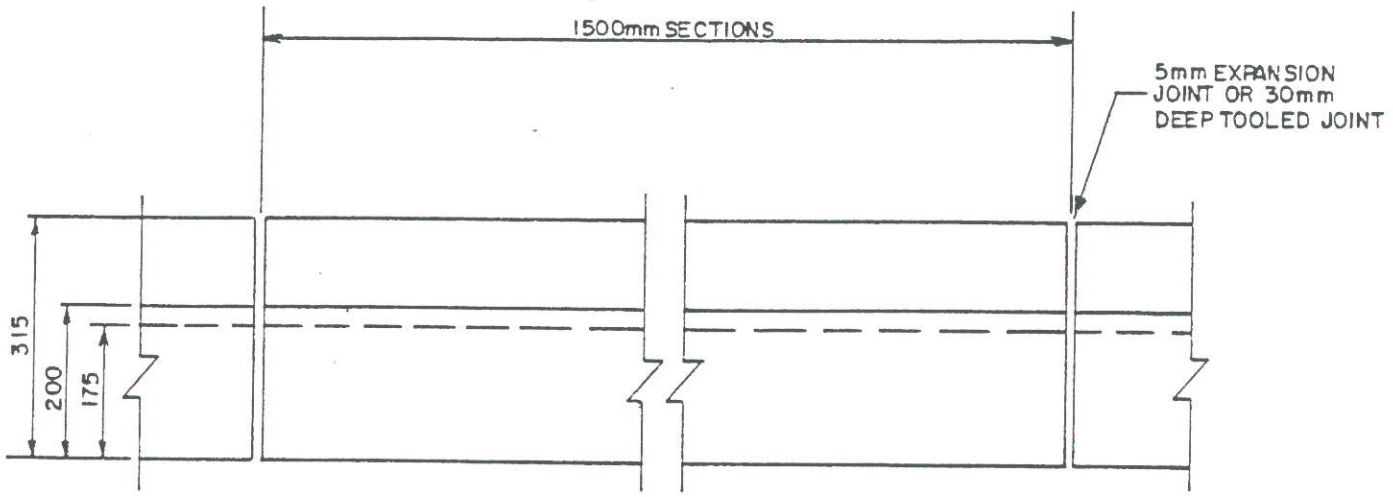
REVERSE GUTTER

NOTE:

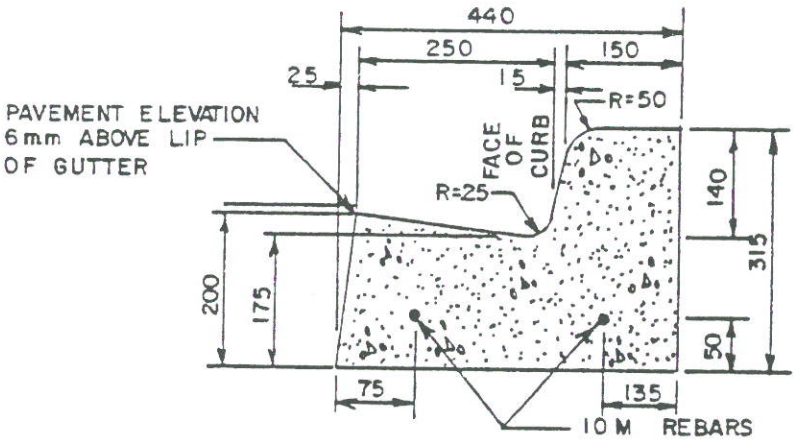
10M REBAR TO BE INSTALLED WITH ALL CURB UNLESS DIRECTED OTHERWISE BY CONTRACT SPECIFICATIONS.
GUTTER SECTION TO BE 300mm IF SPECIFIED.

Underwood McLellan Ltd.	the group	STANDARD XXVII-C103 LOW PROFILE ROLLED CURB 250mm GUTTER CROSSING 07/8 2

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN



ELEVATION



SECTION

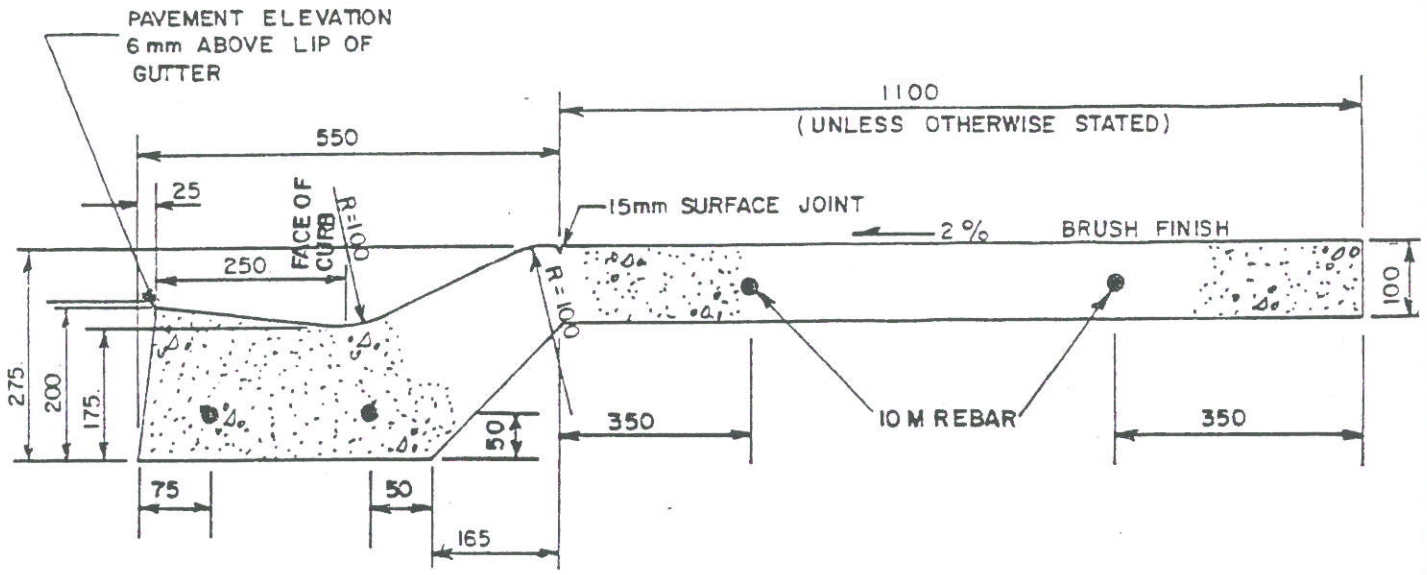
NORMAL CROWN ROAD OR LOW SIDE OF ROAD ON SUPERELEVATION

NOTE:

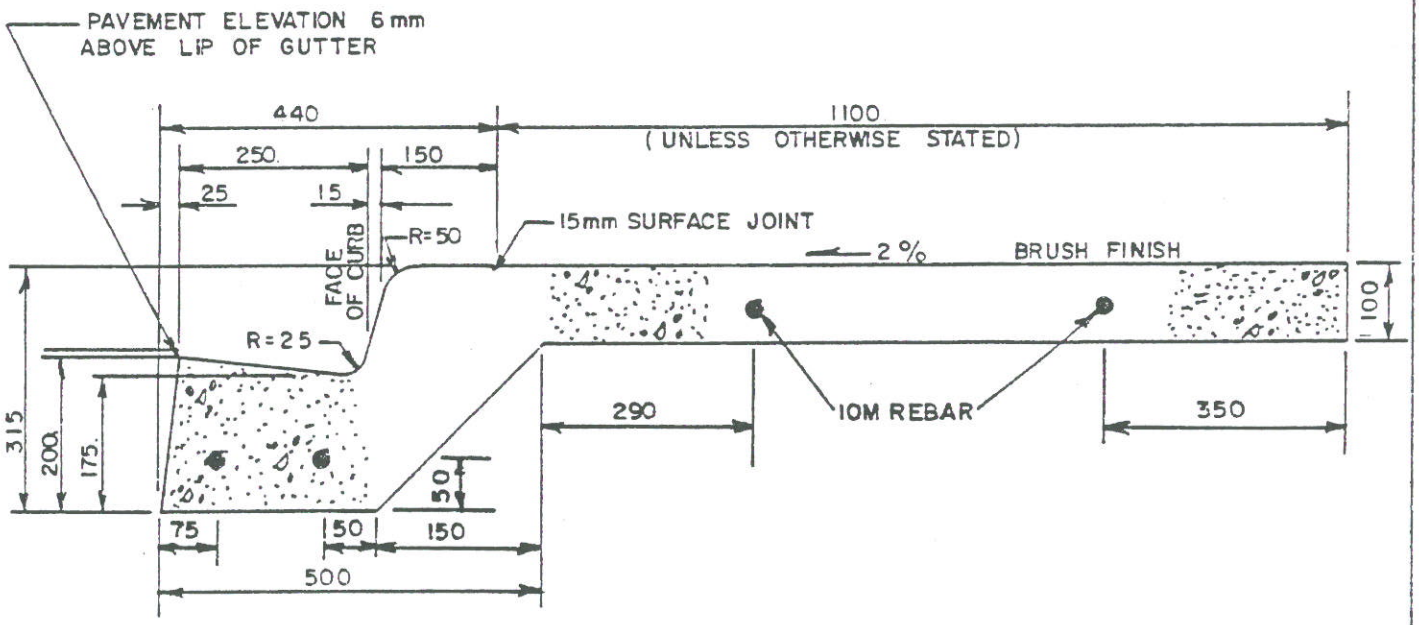
10M REBAR TO BE INSTALLED WITH ALL CURB UNLESS DIRECTED OTHERWISE BY CONTRACT SPECIFICATIONS.
GUTTER SECTION TO BE 300mm IF SPECIFIED.

Underwood McLellan Ltd.	the UMA group	STANDARD XXVII-C104 STANDARD CURB WITH 250mm GUTTER 07/82

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN



LOW PROFILE ROLLED



STANDARD

NOTE:

GUTTER SECTION TO BE 300mm IF SPECIFIED.
10M REBAR TO BE INSTALLED WITH ALL CURB UNLESS DIRECTED OTHERWISE BY CONTRACT SPECIFICATIONS.

Underwood McLellan Ltd	the UMA group	STANDARD XXVII-C111
		MONOLITHIC SIDEWALKS
		04/83