

## SECTION 303

### CULVERTS

**303.01 Scope** - This section covers the construction of pipe culverts.

**303.01.01 Definitions** – for the purposes of this section, the following general terms are defined as follows:

- a) Backfilling means the operation of filling the embedment and backfill material.
- b) Backfill Material means fill material used above the embedment material and below the lower of the subgrade or finished grade or the original ground.
- c) Bedding Material means the material used to support the pipe culvert.
- d) Embedment Material means material from the bottom of the bedding to the bottom of the backfill.
- e) Subgrade means the grade upon which the first layer of select granular sub-base or base material is laid.

**303.02 Materials** The Contractor shall supply all material in accordance with SS 145.15 and the following:

- a) Concrete Pipe (CP) - supplied in accordance with CSA A257.
- b) Corrugated Steel Pipe (CSP) - supplied in accordance with SS 320.
- c) Structural Plate Corrugated Steel Pipe (SPCSP) - supplied in accordance with SS 320.
- d) Polyethylene Pipe (PP) – supplied in accordance with SS 317.
- e) PVC Pipe – supplied in accordance with SS 318.03.

#### **303.03 Construction**

**303.03.01 Backfill Material** – construction shall conform to SS 201 Roadway and Drainage Excavation.

**303.03.02 Freezing Temperatures** - When the air temperature is below 0°C, no backfilling is allowed unless otherwise accepted by the Ministry Representative. When acceptance is granted, all backfill materials shall be in a thawed state when placed and compacted. Frozen granular backfill materials will not be permitted. No backfill material will be permitted to be placed directly on frozen substrate.

**303.04 Concrete, Corrugated Steel, Polyethylene and PVC Pipes** (this subsection does not cover SPCSP).

**303.04.01 Layout** – All culverts shall be laid out and constructed in general accordance with the lines, grades, and locations specified in the Drawings, or as directed by the Ministry Representative. Culverts are to be field fit by the Contractor, to reflect actual conditions encountered on-

Site, and approved by the Ministry Representative prior to installation.

Such field fits will normally involve minor changes in location, elevation, grade, skew, depth and/or length resulting from actual local drainage course locations, post-stripping surface elevations, final ditch depths, and other factors.

Some culverts may be designed to control drainage, and are not to be field fit without the approval of the designer and Ministry Representative. Any such culverts will be identified in advance for the Contractor, through a note on the Drawings, in the Special Provisions, or by the Ministry Representative.

**303.04.02 Flow Obstructions** – Any obstacles to flow, such as filter cloth used for siltation control, shall not be placed directly on the end of any culvert. Where practicable, there shall be a minimum spacing of 1 m between the end of the culvert and any obstacles to flow.

Any obstructed culvert shall be cleaned out in accordance with SS 165.10.07.

**303.04.03 Inlet and Outlet Ditches** - Inlet and outlet ditches to culverts shall be constructed to the lines and grades as shown in the design.

**303.04.04 Trenching** - The trench and other preparatory work shall be approved by the Ministry Representative before actual placing starts.

A full trench condition shall be provided wherever possible; a minimum trench depth shall be 50% of the pipe culvert diameter. If, in the opinion of the Ministry Representative, the material in the bottom of the excavation is of such a character as to cause unequal settlement along the length of the culvert, the trench shall be dug below the grade to such depth as ordered, backfilled with gravel or other suitable material, and compacted to ensure a firm and uniform foundation.

**303.04.05 Placing** - Concrete pipe culvert shall be laid beginning at the downstream end with the bell end pointing upstream. Pipe culvert with elliptical reinforcement shall be laid with the minor axis of the reinforcement as marked by the manufacturer in a vertical position.

When jointing concrete pipe culverts the trench shall be in a dry condition and the joints shall be cleaned and wetted before sealing with mortar. The mortar shall consist of one part Portland Cement to two parts fine sand, mixed to the proper consistency. Sealing shall be neatly and thoroughly done, and the interior of the pipe culvert cleaned of all surplus mortar. Joints shall be kept damp

with burlap or earth for at least three days after sealing.

CSP shall be laid beginning at the downstream end. With riveted CSP, the outside laps shall point upstream and the longitudinal joint shall be on the side. There is no directional restriction with helical CSP.

**303.04.06 Backfilling** - Embedment Material shall consist of mineral aggregate and shall meet the gradation specified in Table 303-A.

Bedding material shall extend a minimum of 150 mm below the culvert invert. The top of the bedding, upon which the pipe culvert is to be laid, shall be shaped so that at least 25% of the circumference of the pipe culvert is in contact with the prepared bedding for the whole of its length.

Embedment material for embankment installation shall extend a minimum of two-thirds of the span or 0.9 m beyond the culvert span on each side, whichever is greater. Embedment material for trench installation shall extend a minimum of 0.3 m on either side.

Embedment material shall be placed in layers not exceeding 150 mm in depth when compacted. Embedment material shall be compacted to a minimum 95% (100% within 300 mm of subgrade elevation) of the laboratory density as determined in accordance with ASTM D 698. Backfilling shall be done symmetrically. The differential height of backfilling material on either side of the culvert shall not exceed 300 mm.

The material within 450 mm directly above the crown of the pipe culvert shall be laid and compacted as one lift. For a culvert with crown within 300 mm of subgrade, installation methods shall be approved by the Ministry Representative.

**TABLE 303-A: EMBEDMENT MATERIAL GRADATION REQUIREMENTS FOR CONCRETE, CORRUGATED STEEL, POLYETHYLENE AND PVC PIPE CULVERTS**

SIEVE SIZE (mm)	PERCENTAGE PASSING
31.5	100
25	60-100
19	15-100
2.36	10-100
0.075	0-5

**303.05 Structural Plate Corrugated Steel Pipe/Pipe-Arch Culverts (SPCSP)**

**303.05.01 Excavation** – shall conform to SS 407 Foundation Excavation. If a coarse boulder material or solid rock is encountered when preparing the bed of the SPCSP, the material shall be excavated to a minimum depth of 300 mm below the SPCSP invert and backfilled with granular material having a maximum size of 75 mm.

**303.05.02 Assembling** - All bolted plates shall be in contact for the full width and length of the seam lap. The bolts in the valley of each longitudinal seam shall be nearer to the visible edge of the plate than the bolts in the crest. The torque on the bolts prior to backfilling shall be between 200 and 340 Nm, or as directed by Ministry Representative. A minimum of 5% randomly selected bolts shall be tested in each longitudinal and circumferential connection. The installation shall not be accepted if 10% or more of tested bolts do not meet the specified torque requirements.

Rotation of the pipe culvert and/or spiralling of the longitudinal seams shall not be permitted. The upward or downward crown deflection shall not exceed 2% of the rise.

**303.05.03 Backfilling** –Backfilling shall extend to the limits as noted on the drawings. For multiple SPCSP structures, structural backfill shall be provided between adjacent SPCSP structures.

The diameter or the span and rise of SPCSP shall not vary from the manufactured dimensions by more than 5% during backfilling operations.

The embedment material shall be free draining, well graded, granular material approved by the Ministry Representative.

The top surface of the bedding upon which the pipe culvert is to be laid shall be constructed to the true grade and alignment as shown in the Drawings.

The embedment material shall be placed and compacted in lifts not exceeding 200 mm compacted thickness, with each lift to a minimum of 95% of Standard Proctor Density prior to addition of the next lift. The bedding layer of a 200 mm thickness in direct contact with the invert shall be shaped to the pipe culvert curved invert and shall be left uncompacted.

Backfilling shall be done symmetrically. The differential height of backfilling material on either side of the SPCSP at any transverse section shall not exceed 400 mm.

The embedment material within 300 mm of the pipe culvert walls shall be free of stones exceeding 75 mm size. Heavy equipment shall not be allowed within 1 m of the pipe culvert walls.

End dumped or loose pushed material shall not be piled closer than 3 m from the pipe culvert. Hauling equipment shall not be operated over the pipe culvert until backfilling

operations have completed a suitable cover approved by the Ministry Representative.

**303.06 Culvert Endwalls** – shall be constructed in accordance with the details shown on the Drawings. For concrete end walls, construction and materials for concrete and reinforcement shall conform to SS 211 and SS 412 and excavation shall conform to the requirements of SS 407.

If specified on the Drawings, the Contractor may provide an alternative endwall product from the Ministry's Recognized Products List.

### **303.07 MEASUREMENT**

**303.07.01 Pipe Culverts** - Pipe culverts will be measured by the METRE along its invert length as installed.

**303.07.02 Concrete Endwalls** - Concrete end walls will be measured by the CUBIC METRE.

### **303.08 PAYMENT**

**303.08.01 Pipe Culverts** - Payment for excavation, pipe culvert assembling, placing, and backfilling shall be at the

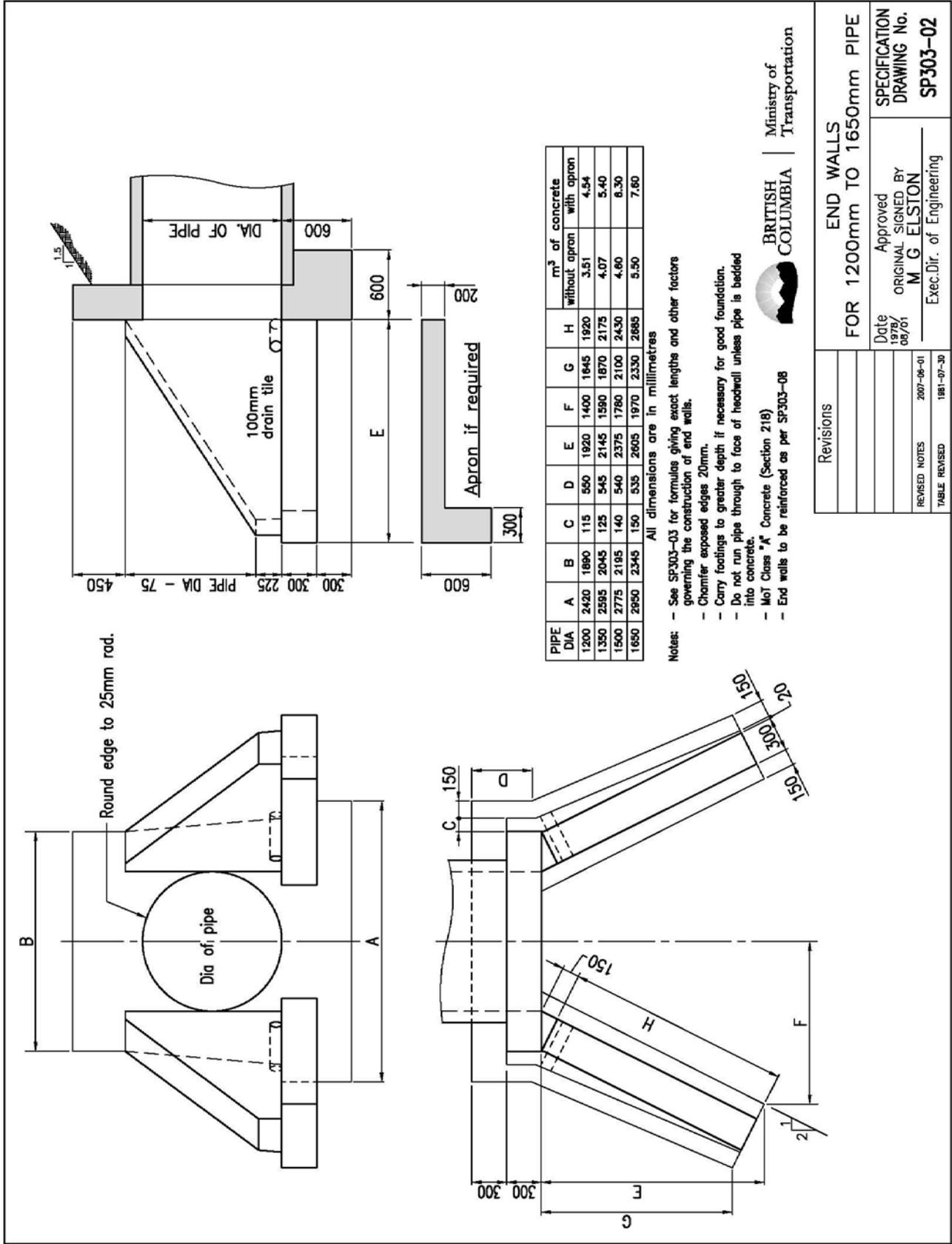
Contract Unit or Lump Sum Price bid for each of these items of work, or at the Contract Unit Price bid per metre of pipe culvert.

**303.08.02 Concrete Endwalls** - Payment for CONCRETE END WALLS will be at the Contract Unit or Lump Sum Price bid per size of endwall required. The Contract Unit Price shall include provision of everything necessary; precast or cast-in-place endwall, formwork, reinforcement, air entrained concrete, placing and tamping, stripping and cleaning, curing and any other work necessary in connection therewith, including excavation and backfilling, but excluding riprap.

**303.08.03 Full Compensation** - The price(s) bid shall be full compensation for the cost of furnishing all labour, materials, equipment, tools and incidentals necessary to complete the work as specified in the Contract.

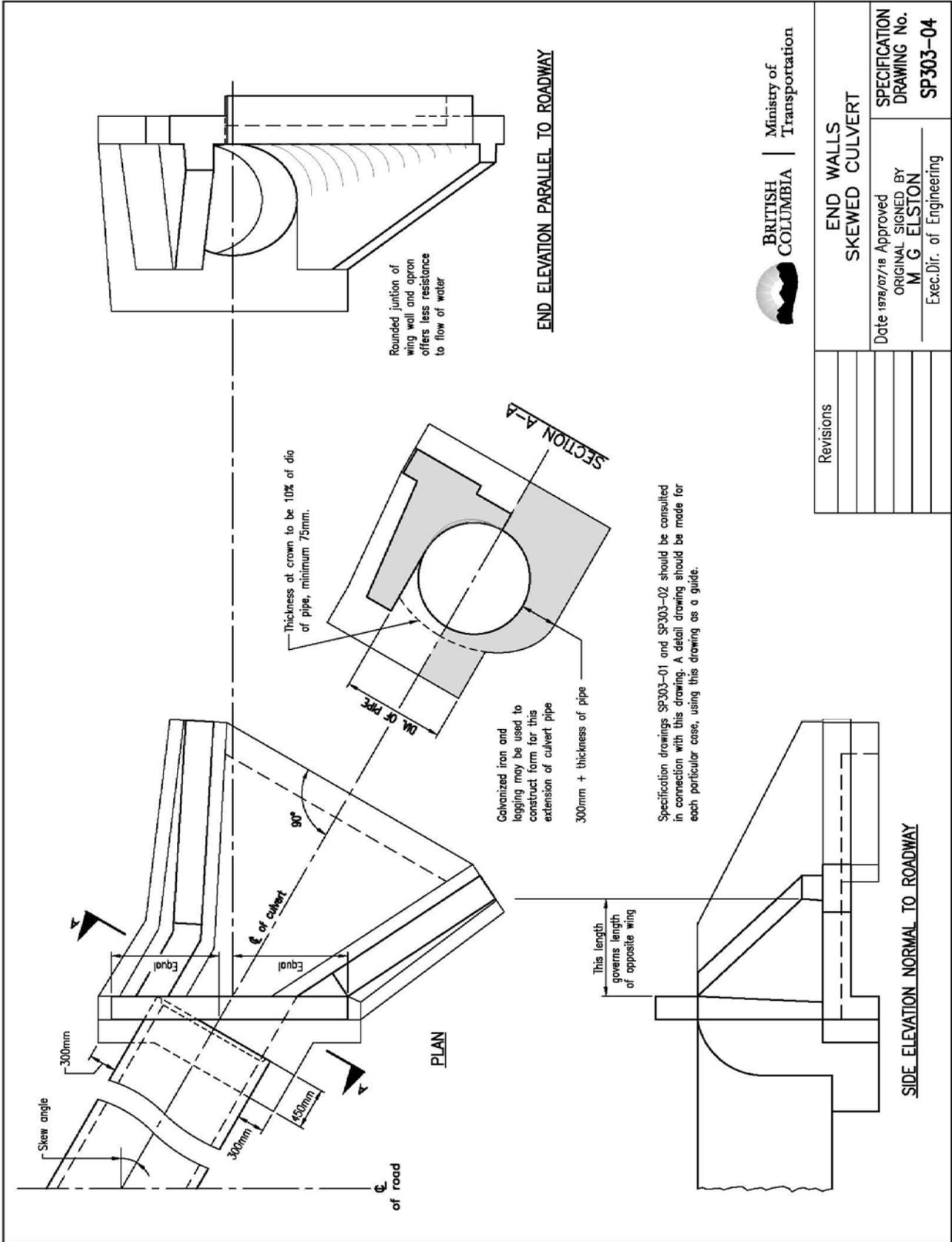
**303.08.04 Type A Excavation** - Excavation of Type A material encountered in the trench or endwall excavation will be paid at the Contract Unit Price for Type A, or where such an Item is not included in the Contract, at a negotiated price or on a Force Account Basis.





Revisions		END WALLS FOR 1200mm TO 1650mm PIPE	
Date	Approved	SPECIFICATION	
1978/ 08/01	ORIGINAL SIGNED BY	DRAWING No.	
	M. G. ELSTON	SP303-02	
REVISED NOTES	2007-06-01	Exec.Dir. of Engineering	
TABLE REVISED	1981-07-30		



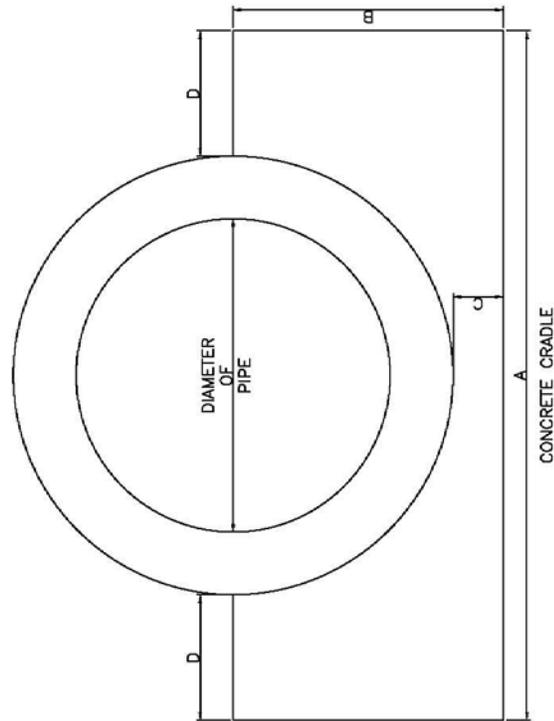


Notes:  
 Lower part of cradle to be a stiff mix of concrete, lay pipe to established line and grade.  
 Follow immediately with concrete of a workable consistency to the required height.  
 Cradles of these dimensions are for concrete pipes only.

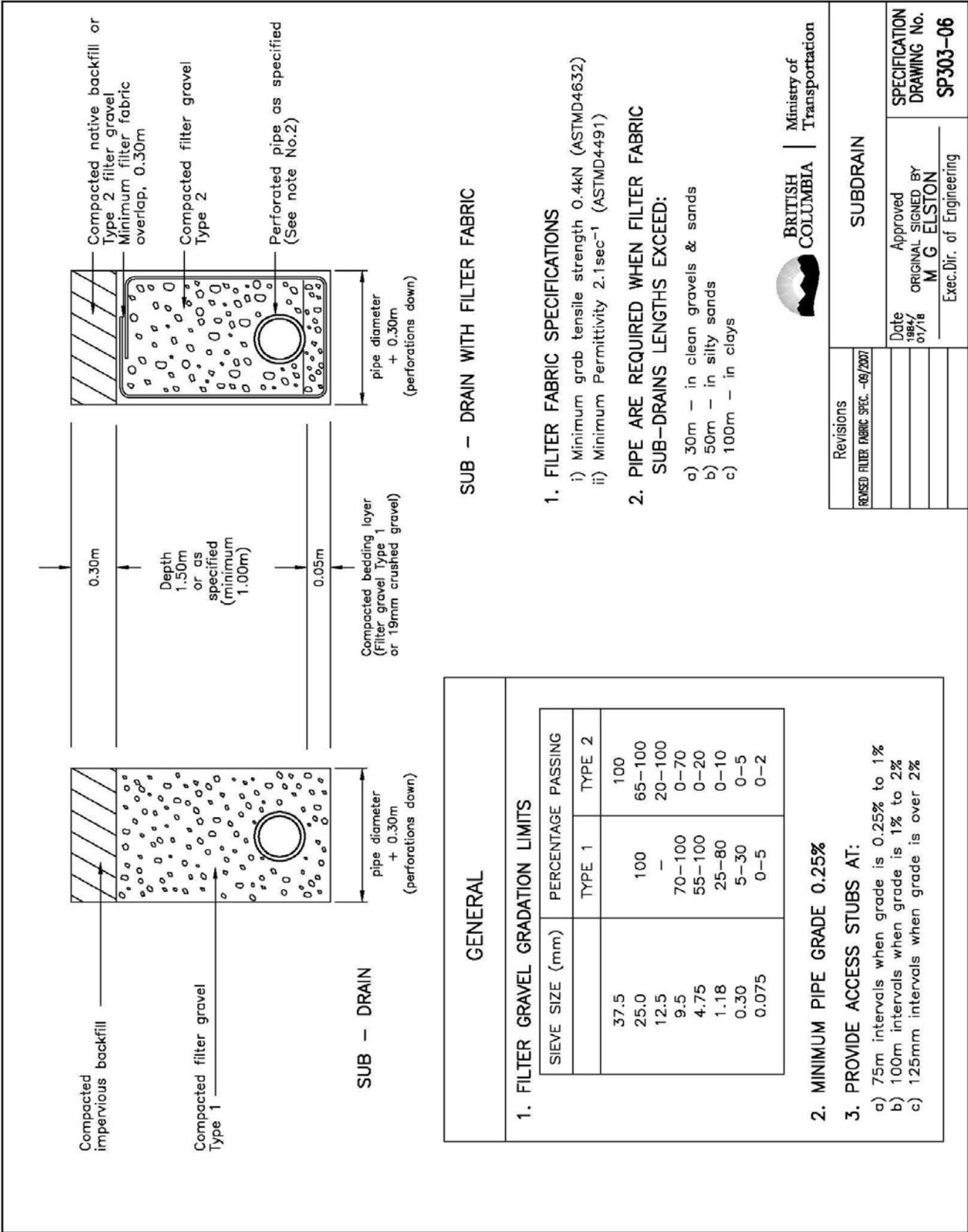
Use concrete cradles under the following conditions.  
 High fill.  
 Steep culvert grade.  
 Rock formations.

M.O.H. Class "A" Concrete (Section 218)

PIPE DIMENSIONS		CONCRETE CRADLES					m <sup>3</sup> per m
Inside Diameter mm	Wall Thickness mm	A mm	B mm	C mm	D mm		
600	95	1400	500	100	300	0.45	
750	108	1580	605	115	300	0.58	
900	121	1755	695	115	300	0.69	
1050	133	1935	795	130	300	0.84	
1200	146	2110	895	140	300	0.99	
1350	159	2290	995	150	300	1.16	
1500	172	2470	1100	165	300	1.35	
1650	184	2645	1200	180	300	1.53	
1800	197	2825	1300	190	300	1.73	



Revisions	CONCRETE CRADLE FOR CULVERT PIPE	Approved ORIGINAL SIGNED BY <b>M. G. ELSTON</b> Exec. Dir. of Engineering	SPECIFICATION DRAWING No. <b>SP303-05</b>
TABLE REVISED 1981-07-30			
Date 1978/07/18			



**SUB - DRAIN WITH FILTER FABRIC**

**1. FILTER FABRIC SPECIFICATIONS**

- i) Minimum grab tensile strength 0.4kN (ASTMD4632)
- ii) Minimum Permittivity 2.1sec<sup>-1</sup> (ASTMD4491)

**2. PIPE ARE REQUIRED WHEN FILTER FABRIC SUB-DRAINS LENGTHS EXCEED:**

- a) 30m - in clean gravels & sands
- b) 50m - in silty sands
- c) 100m - in clays

**GENERAL**

**1. FILTER GRAVEL GRADATION LIMITS**

SIEVE SIZE (mm)	PERCENTAGE PASSING	
	TYPE 1	TYPE 2
37.5	100	100
25.0	—	65-100
12.5	—	20-100
9.5	70-100	0-70
4.75	55-100	0-20
1.18	25-80	0-10
0.30	5-30	0-5
0.075	0-5	0-2

**2. MINIMUM PIPE GRADE 0.25%**

**3. PROVIDE ACCESS STUBS AT:**

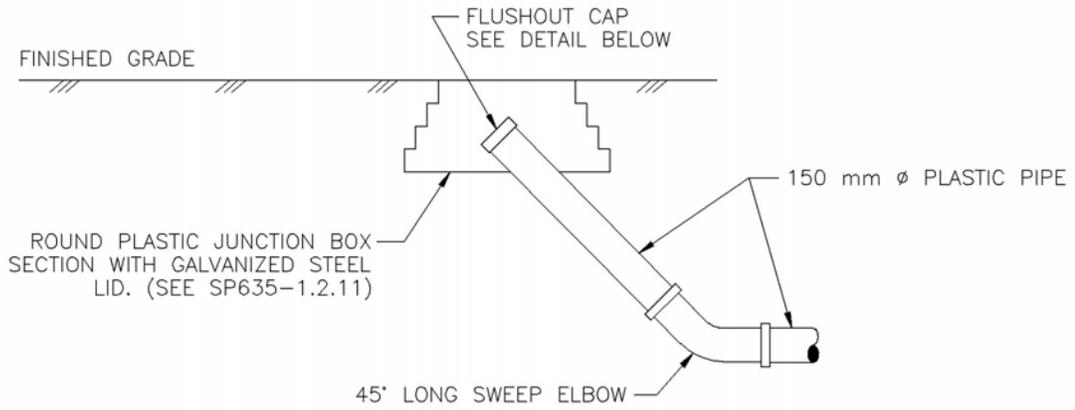
- a) 75m intervals when grade is 0.25% to 1%
- b) 100m intervals when grade is 1% to 2%
- c) 125m intervals when grade is over 2%



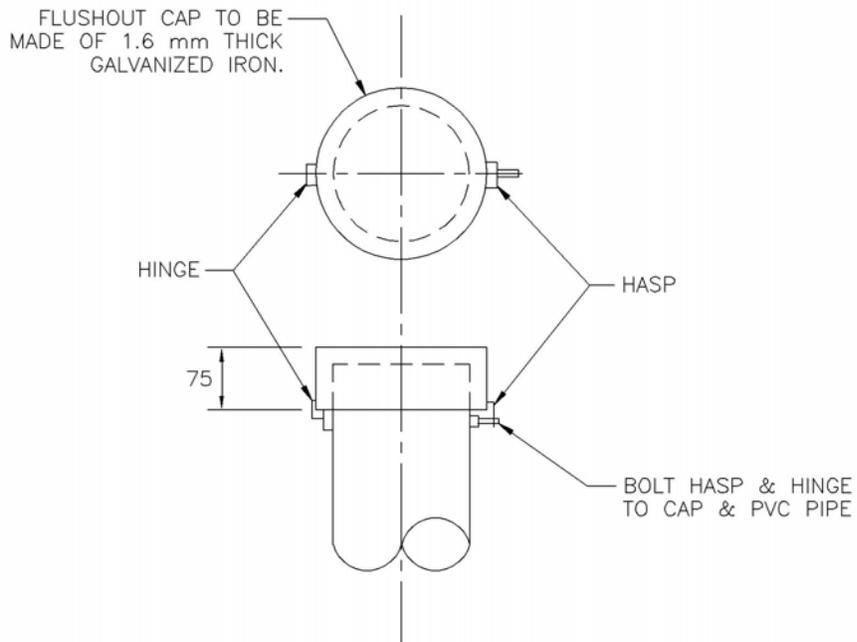
Revisions	SUBDRAIN	
REVISED FILTER FABRIC SPEC. -06/2007	Date 1984/01/16	Approved ORIGINAL SIGNED BY M G ELSTON
		Exec.Dir. of Engineering
		SPECIFICATION DRAWING No. SP303-06

SUBDRAIN FLUSHOUT

SP303-07



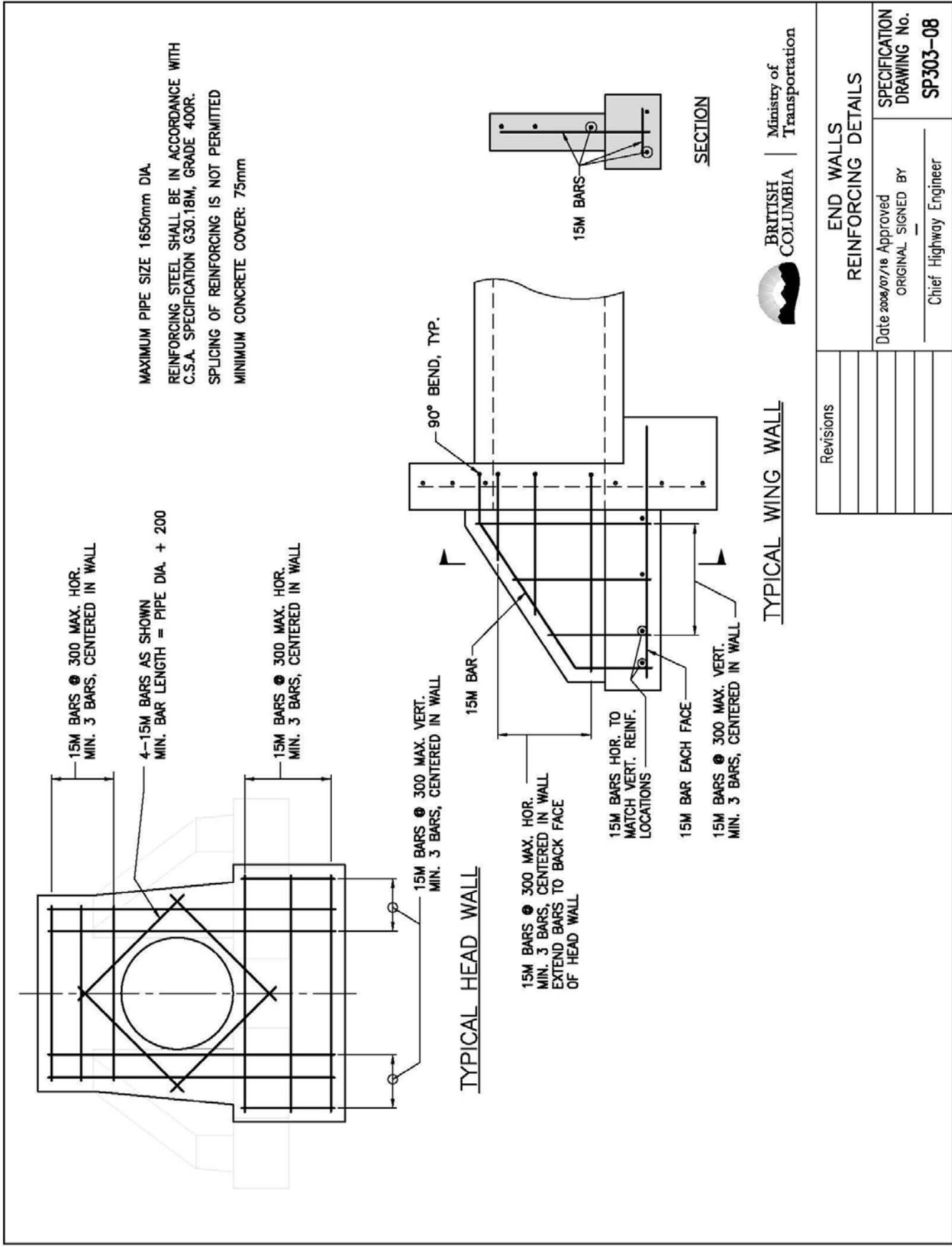
FLUSHOUT AND COVER DETAIL



FLUSHOUT CAP DETAIL

NOT TO SCALE

ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED



Revisions	END WALLS REINFORCING DETAILS	SPECIFICATION DRAWING No. <b>SP303-08</b>
	Date 2008/07/18 Approved	
	ORIGINAL SIGNED BY	
	Chief Highway Engineer	

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