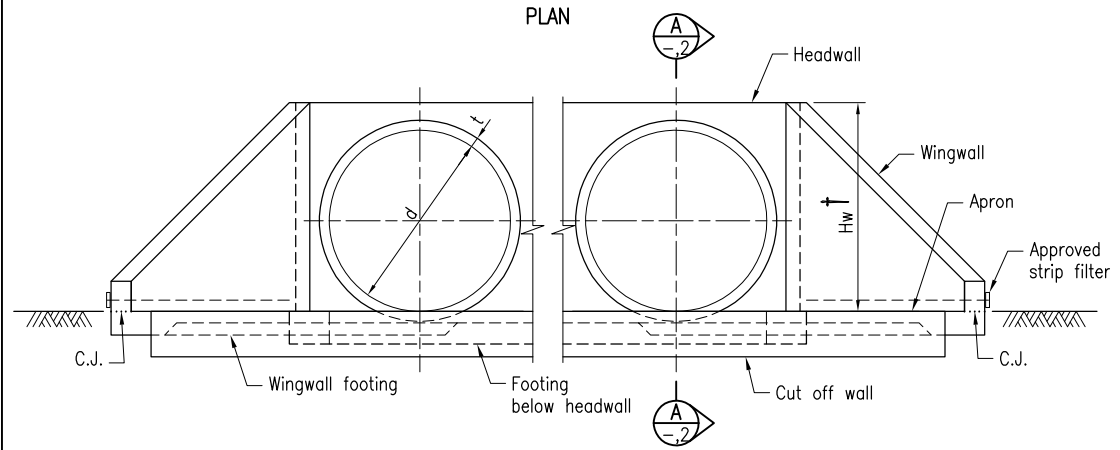
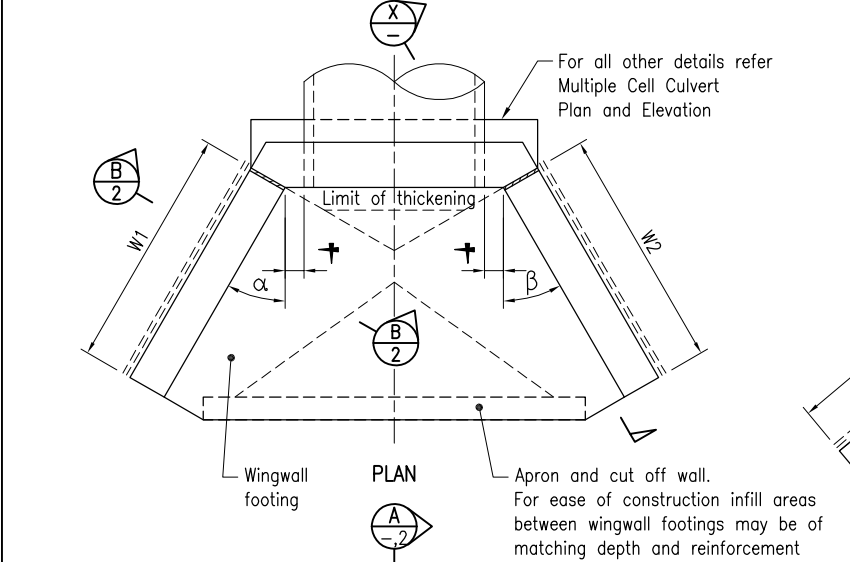


PLAN

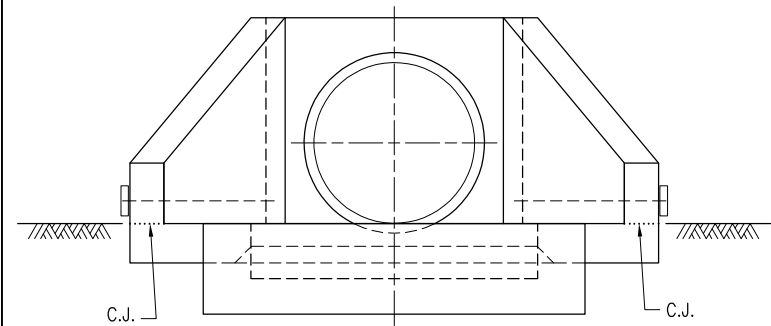


ELEVATION

**MULTIPLE CELL CULVERT**

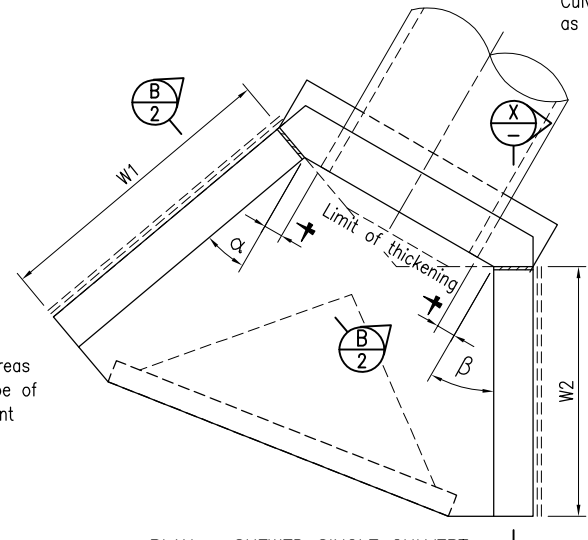


PLAN



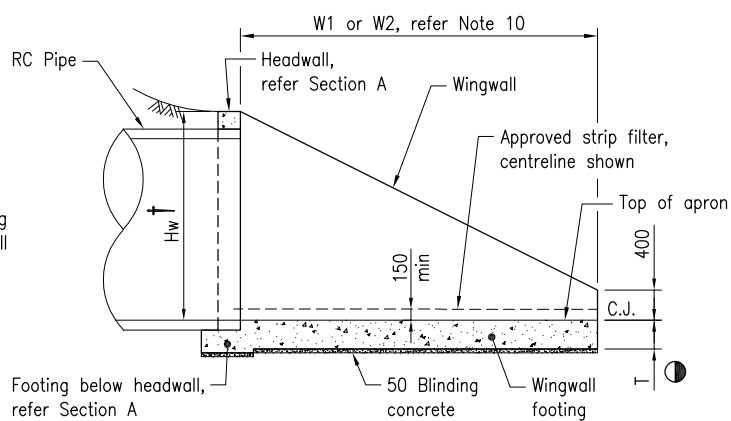
ELEVATION

**SINGLE CELL CULVERT**

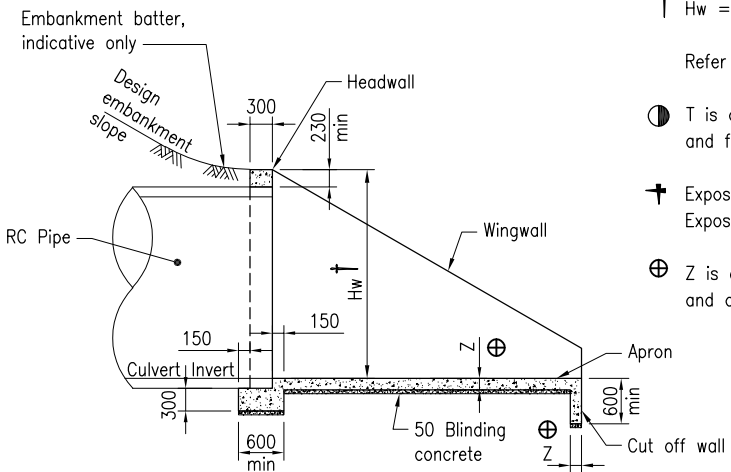


PLAN - SKEWED SINGLE CULVERT

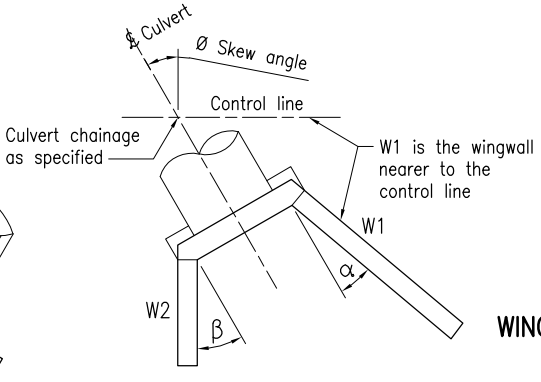
**GENERAL ARRANGEMENT - SKEWED CULVERTS**



**SECTION X** ELEVATION AT WINGWALL - CONCRETE DETAILS



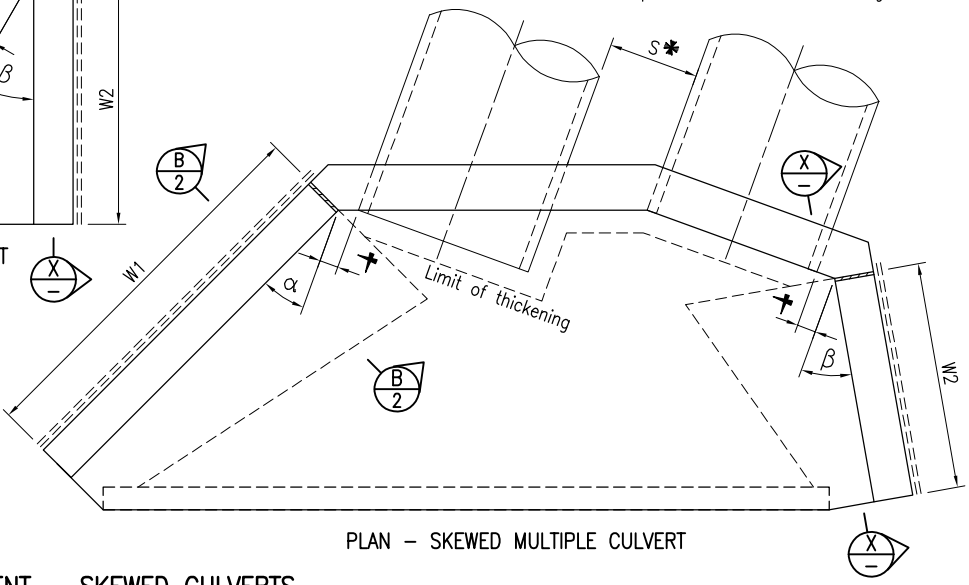
**SECTION A** HEADWALL AND APRON - CONCRETE DETAILS



**WINGWALL ANGLES**

Skew angle $\theta$	Wingwall angle	
	$\alpha$	$\beta$
0 - 10	30	30
11 - 20	25	30
21 - 30	20	30
31 - 45	15	30

\* Spacing for multiple pipes "S" is as specified on Standard Drawing 1359.



PLAN - SKEWED MULTIPLE CULVERT

The purpose of this Standard Drawing is to provide typical standard details that shall be used within the limitations specified in the drawing and accordance with the following:

- The use of the standard details shall be assessed by the project designer in respect of specific project geometric, appropriate foundation and scour conditions.
- If the field investigation undertaken by the Project Engineer determines that the foundation bearing capacity is not adequate, the Project Engineer shall engage a RPEQ Geotechnical engineer to develop a specific project solution to ensure the adequate bearing capacity. These design solutions shall be reviewed and accepted by E&T Structures and Geotechnical sections.
- When there is uncertainty regarding the application of the standard details on this drawing for a specific project, advice shall be sought from E&T Structures.
- The details specific to the project shall be shown on the project specific drawings.

**NOTES:**

- PIPE CULVERT END STRUCTURES** shall be in accordance with MRTS03. The purpose of this drawing is to detail wingwalls, headwall and apron for culverts with pipe diameter 750 to 2400. Refer Standard Drawing 1305 for details of headwall and apron for culverts with pipe diameter 375 to 675. Refer Standard Drawing 1359 for details of culvert installation and earthworks. This standard drawing does not provide details of fish passage requirements. Where project specific environmental assessment determines that waterway barrier works are required, additional details shall be developed and included in the project drawings.
- Required minimum foundation bearing capacity is 150 kPa ( $\phi_g R_{u,g}$  to AS 5100.3).
- PIPE DIAMETERS** greater than 2400 require a special design.
- Where **CULVERT APRONS** are longer than 20m, the project specific design shall be developed with a transverse contraction joint, with direction of flow, at every 20m length. Typical contraction joint details provided in this standard drawing are to be used.
- WINGWALLS** for skewed culverts with angle greater than 45 require a special design.
- CONCRETE** shall be in accordance with MRTS70. Design life 100 years. Exposure classification and cover to reinforcement shall be in accordance with AS 5100. Minimum concrete strength and cover to reinforcement shall be as shown in table below.

Exposure classification	minimum B2	C1	C2
Minimum concrete strength	S40/20	S50/20	S55/20
Minimum Cover UN0	60	70	80

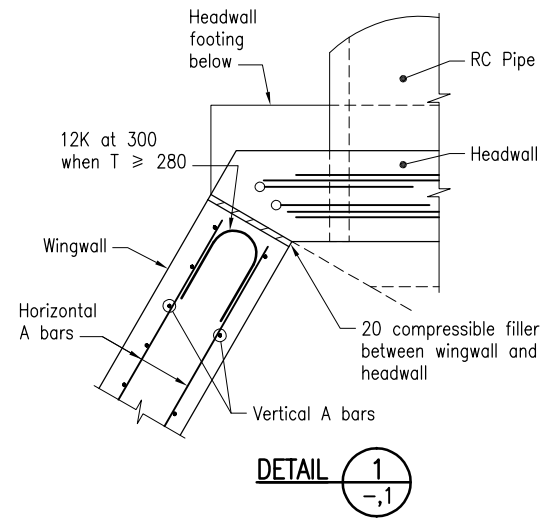
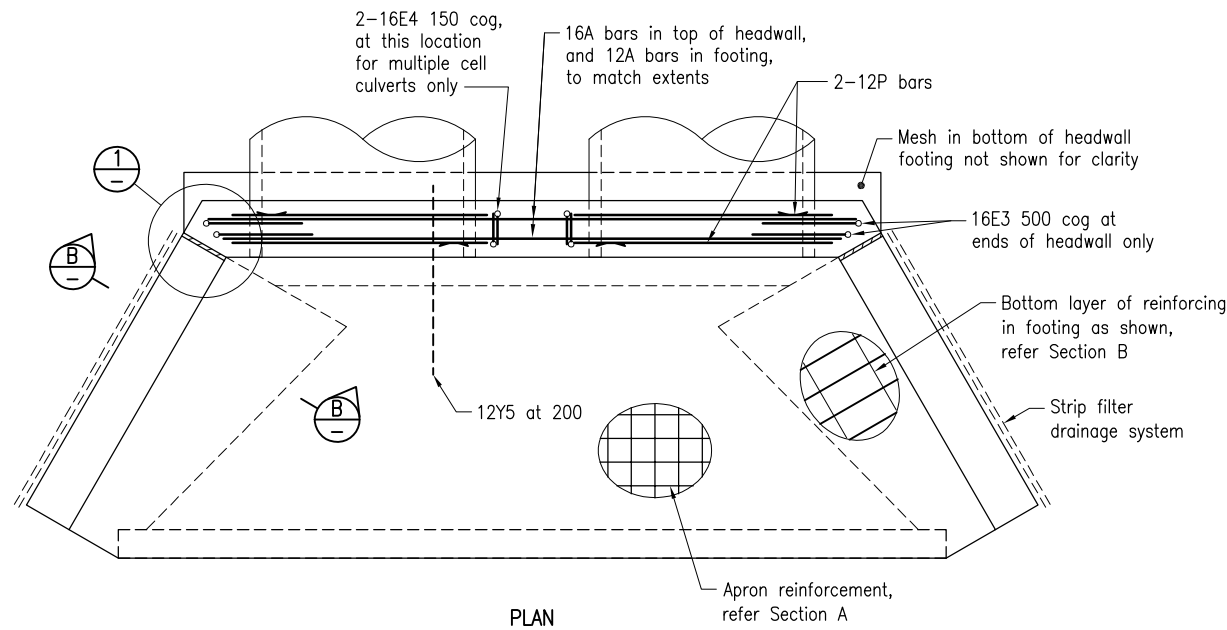
- REINFORCING STEEL** shall be read in conjunction with Standard Drawings 1043 and 1044, and shall be in accordance with MRTS71 and AS/NZS 4671. Deformed bars Grade D500N. Round bars Grade R250N. Mesh Grade D500L. Reinforcement shall be hot dip galvanised to AS/NZS 4680 where shown.
- TACK WELDING** to reinforcement for location purposes to AS/NZS 1554.3. Welding consumables to be controlled hydrogen type: G49X to AS/NZS ISO 14341-B or T49X to AS/NZS ISO 17632-B.
- WINGWALL DRAINAGE** shall be provided behind wingwalls to prevent hydrostatic pressure being applied to the wingwall. A strip filter shall be used at each wingwall to drain out at the low end of the wingwall as shown.
- PROJECT-SPECIFIC INFORMATION** to be shown on the drawings: Exposure classification; Culvert chainage; Skew angle; Base and apron setout and extents; Headwall and wingwall extents (W1, W2,  $\alpha$ ,  $\beta$ ); Requirements for fish passage.
- DIMENSIONS** are in millimetres.

- ASSOCIATED DEPARTMENTAL DOCUMENTS:**  
Design Criteria for Bridges and Other Structures; Road Drainage Manual (RDM)
- REFERENCED DOCUMENTS:**  
Departmental Standard Drawings:  
1043 Reinforcing Steel - Standard Bar Shapes  
1044 Reinforcing Steel - Lap Lengths  
1305 Pipe Culverts - Headwall and Apron for Pipe Diameter 375 to 675  
1359 Culverts - Installation, Bedding and Filling/Backfilling Against/Over Culverts
- Departmental Specifications:  
MRTS03 Drainage, Retaining Structures and Protective Treatments  
MRTS70 Concrete; MRTS71 Reinforcing Steel

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<b>PIPE CULVERTS</b>				
<b>WINGWALLS, HEADWALL AND APRON FOR PIPE DIAMETER 750 TO 2400</b>		Not to Scale	<b>1304</b>	Date 3/2020
<b>DRAWING 1 OF 2</b>				

**NOTES:**

1. Refer Drawing 1 for all notes.
2. Refer Drawing 1 for concrete profile and general arrangement

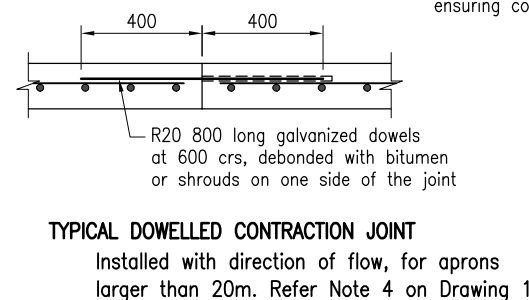
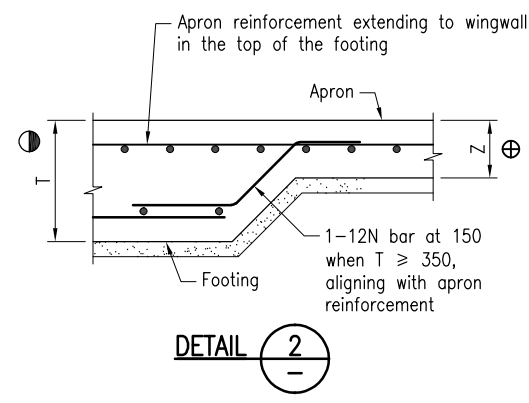
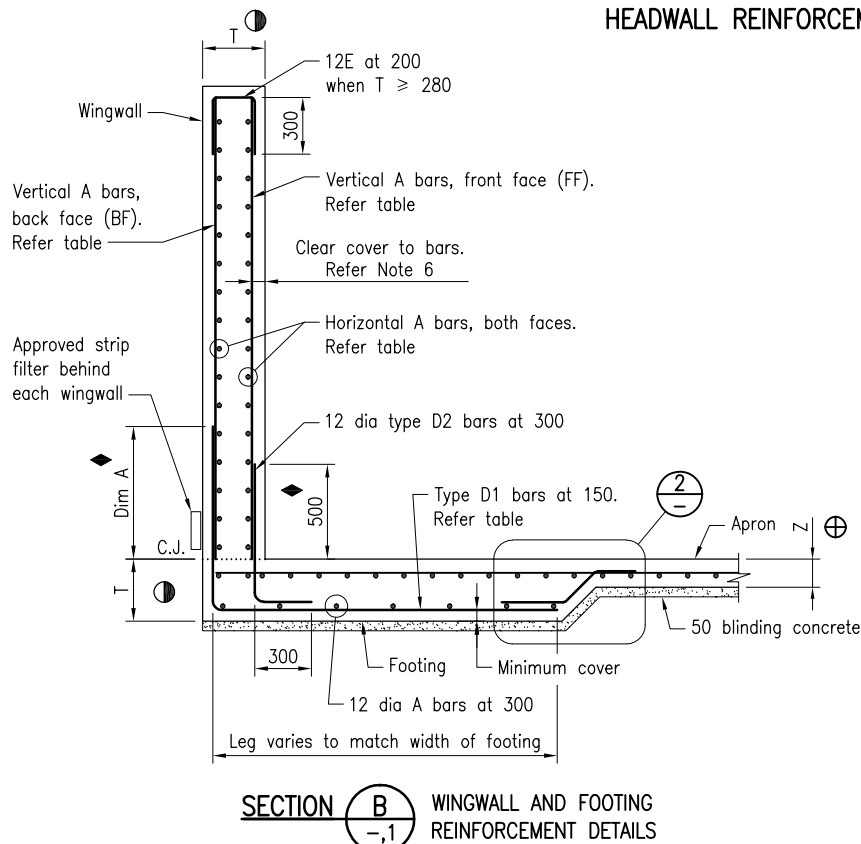
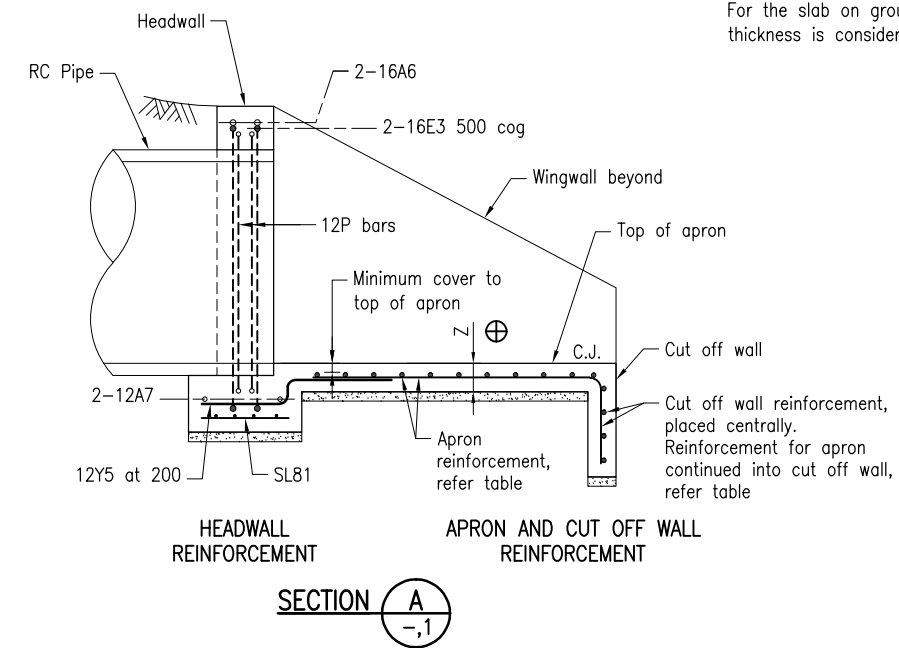
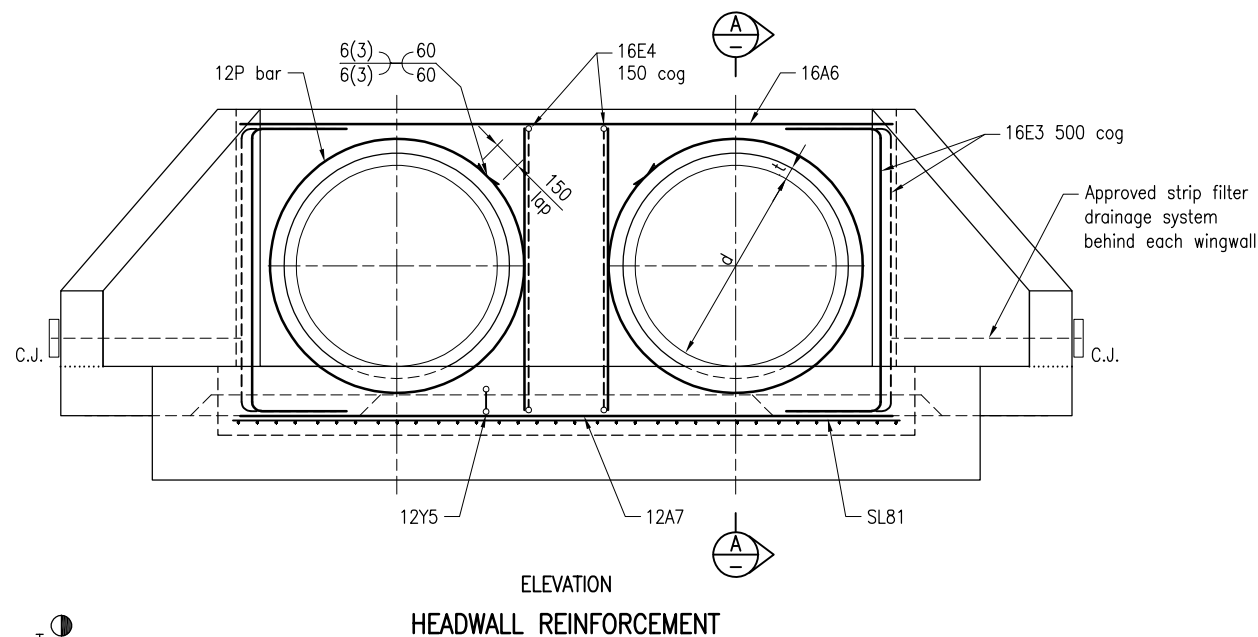


**APRON AND CUT OFF WALL THICKNESSES AND MINIMUM REINFORCEMENT REQUIREMENTS**

Exposure classification	Apron and Cut off wall #	
	Thickness Z ⊕	Reinforcement
B2	150	N12 at 150 both ways
C1	175	N12 at 150 both ways
C2	190	N12 at 125 both ways

⊕ where Z is a constant thickness for aprons and cut off walls.

# Apron minimum reinforcement for shrinkage and temperature effects is designed considering the full restraint condition to AS 5100. For the slab on ground condition, only the top half of the apron thickness is considered for calculation of this reinforcement.



**WINGWALL DIMENSIONS AND MINIMUM REINFORCEMENT REQUIREMENTS**

up to Hw †	T for Exposure classification			Vertical A bars BF		Vertical A bars FF		Horizontal A bars FF and BF						D1 bars	
	B2	C1	C2	Dia	Spacing	Dia	Spacing	B2		C1		C2		Dia	Dim A
	Dia	Spacing	Dia					Spacing	Dia	Spacing	Dia	Spacing			
1000	220	240	260	12	150	12	300	12	150		125			12	500
1500	220	240	260						150	12	125	12	100		
2000	260	270	280						125		100				
2500	330	340	350						100	16	150	16	125		
3000	380	390	400	16				16	150	16	125	16	700		

† where Hw = Internal pipe diameter d + pipe thickness t + 230 min

◆ where type D1 and D2 bars exceed the wall height, curtail the bars to match the wall height, ensuring cover requirements are met

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PIPE CULVERTS				
WINGWALLS, HEADWALL AND APRON FOR PIPE DIAMETER 750 TO 2400		Not to Scale	1304	Date 3/2020
DRAWING 2 OF 2				