REPUBLIC OF GHANA

MINISTRY OF ROADS AND HIGHWAYS

MANUAL FOR LOW VOLUME ROADS

APPENDIX C.2: DRAINAGE STRUCTURAL DRAWINGS

2019

MESSAGE FROM THE MINISTER

The mandate of the Ministry of Roads and Highways (MRH) is to provide a reliable and affordable road transport system that facilitates the socioeconomic development of Ghana. Effective and efficient road design, construction and maintenance is a sine-qua-non for achieving this. If high volume roads are the arteries and veins of the country, facilitating the free flow of the nation's socio-economic lifeblood, then low volume roads are the capillaries, extending that flow to the village level. Low volume roads facilitate travel that directly impacts public access to health, education and other essential services in rural areas, as well as the transport of goods that stimulates economic development at both the local and the national level.

The Manual provides a basis for constructing, rehabilitating, or upgrading low volume roads in a manner that draws on international good practice, yet is relevant to the Ghanaian context. As such it constitutes an essential point of reference for students or experienced practitioners with a professional interest in achieving value for money in the provision of such roads in Ghana. The Ministry will continue in such pursuits, in ensuring that the future of rural transport infrastructure remains sound through proper designs, construction and maintenance.

I recommend this Manual and am confident that it will provide the essential information and guidance needed for the sustainable provision of appropriate low volume roads that will meet Ghana's growing need for rural travel and transport.

Hon. Kwasi Amoako-Atta,
Minister of Roads and Highways

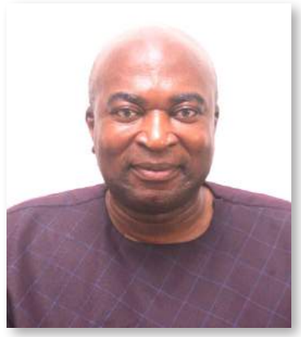
FOREWORD

This Manual has been through a robust process to ensure that it is fit for purpose. It draws on the expertise of both international and national specialists, and takes account of the latest relevant research findings, making every effort to ensure its relevance to the needs of our practitioners. A series of stakeholder workshops resulted in a range of perspectives being taken into account, from both the public and the private sector, and the initial complete draft has been subjected to a peer review. Nevertheless, it is recognised that there is no such thing as "perfect" guidance, so associated mechanisms are in place to ensure that sector performance continues to be monitored, and that further updates and improvements to the Manual can be made where necessary.

When changes to this Manual are made and approved, new versions of the manual incorporating the revision will be issued. All suggestions to improve the manual should be made in writing to the Director of the Department of Feeder Roads. It is my fervent hope that you find this Manual useful and make every effort to make use of it.

Ing. Edmund Offei-Annor,
Chief Director of Ministry of Roads and Highways

PREFACE



This Manual will assist in developing optimal designs that use locally occurring natural resources, encourage the use of labour-based construction methods where appropriate and ensure value for money. It is for use as a point of reference for engineering and allied practitioners alike and serves as an excellent guide for the design of low volume roads.

I am grateful to UK Aid working through DFID, to the Project Management Unit of ReCAP, to the consultants from Civil Design Solutions, and to the technical staff of DFR and MRH for the immense support they have provided in ensuring the coming into fruition of this Manual. It is my fervent hope that it will change the face of low volume road design in Ghana.

Ing. Bernard Badu
Director of the Department of Feeder Roads

ABOUT THIS APPENDIX

Part C of the Ghana Manual for Low Volume Roads addresses drainage-related aspects of the design of Low Volume Roads. These include the calculation of flows in watercourses, discharge rates, the location and design of appropriate drainage structures, associated road side stabilisation measures, and provision for the anticipated effects of climate change. Tailored specifically for conditions in Ghana, it includes worked examples to help the reader understand the detailed application of the methods and practices described.

This Annex to the Manual includes Standard Drawings for typical drainage structures. In the case of pipe culverts, options are included for the use of both unreinforced and reinforced culvert rings.

These drawings are indicative only, and are subject to review, adjustment and approval by the responsible Engineer in order to suit prevailing conditions and requirements.

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Reinforced Pipe Culverts (RPC)

Box Culverts (BC)

Relief Culverts (RC)

Vented Ford (VF)

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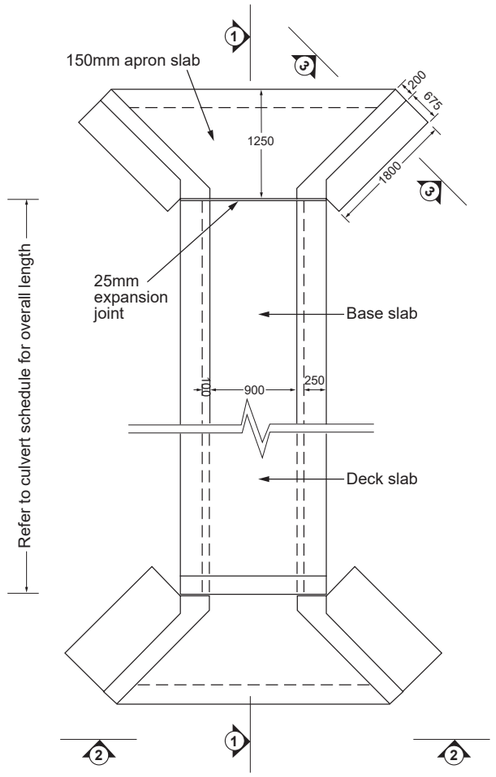
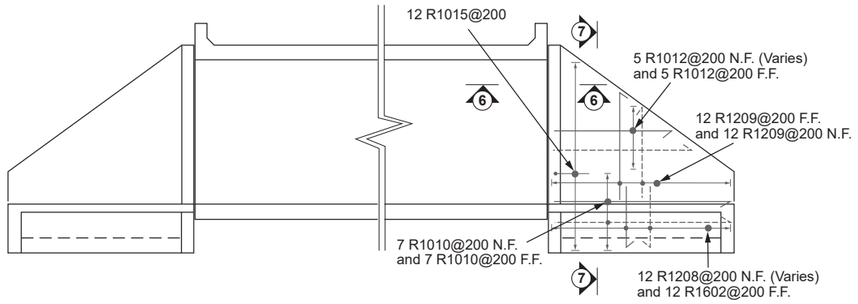
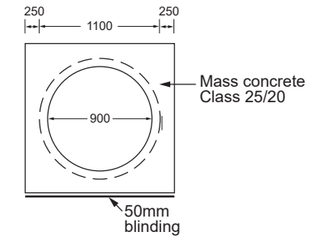


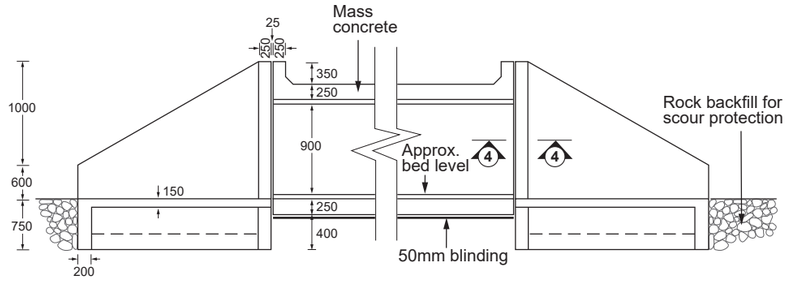
Plan showing part of base and deck



Sectional elevation



Detail of concrete surround for 900Ø pipe drain crossing



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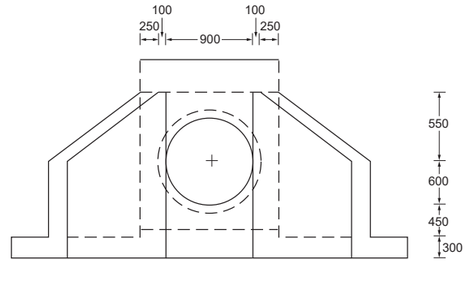

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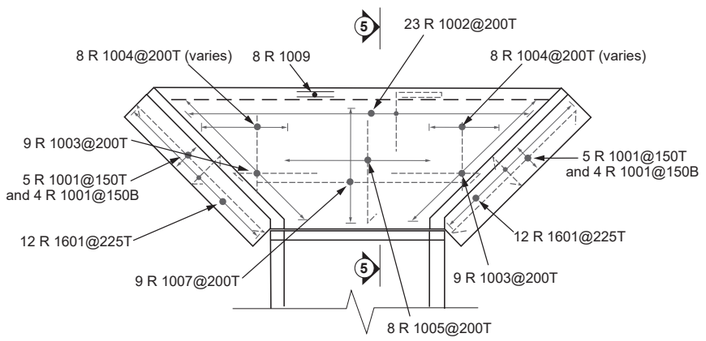
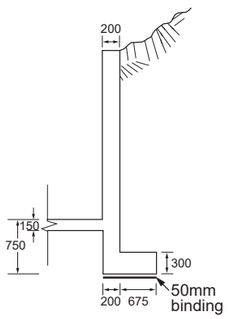


Apron and wing wall reinforcment details



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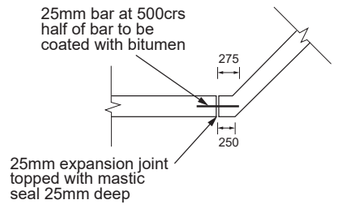

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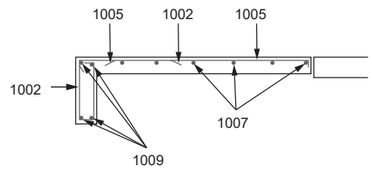

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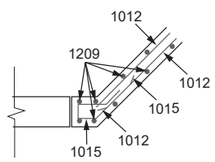

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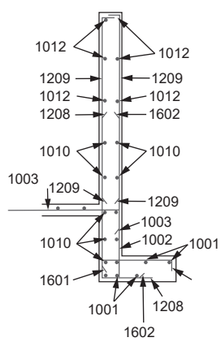

Section 7-7

REPUBLIC OF GHANA

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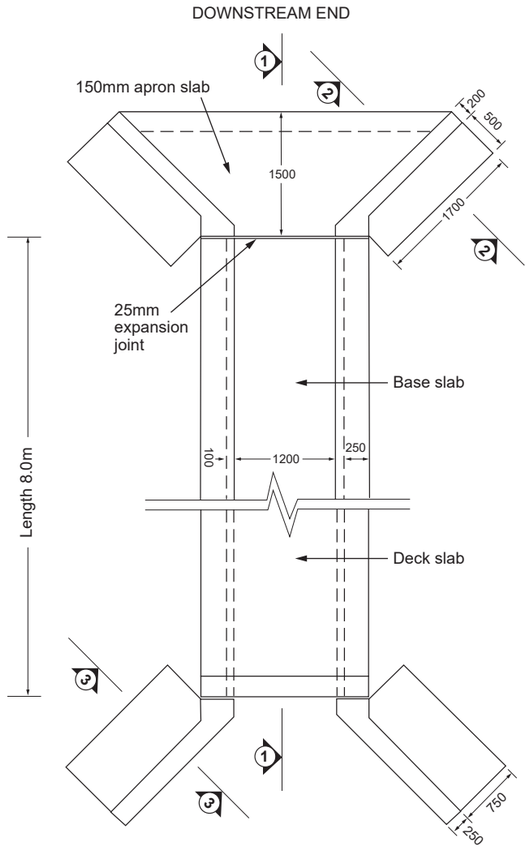
LOW VOLUME ROADS
for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

NOTES

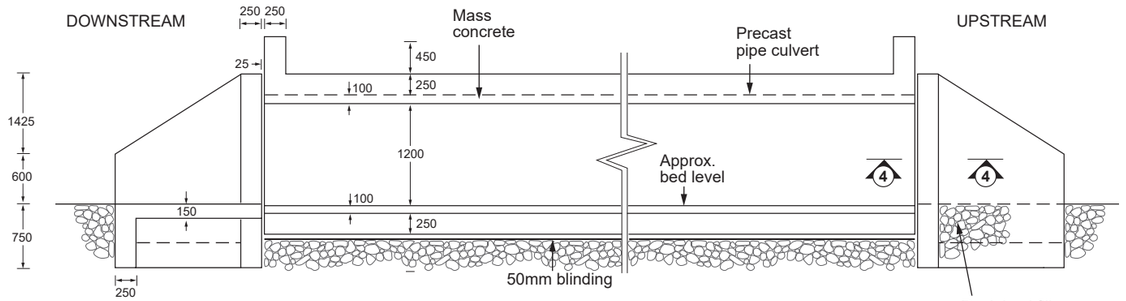
1. This drawing must be read in conjunction with all relevant structural drawings.
2. All dimensions are in mm unless otherwise stated.
3. Concrete class shall be 25/20.
4. Dowels shall be 20mm Ø at 500mm crs. half of bar to be coated with bitumen.
5. The construction of reinforced concrete work shall be in accordance with Engineers specification.
6. Reinforcing bars shall be mild steel - minimum strength 250N/mm^2, unless otherwise stated.
7. Concrete cover to all reinforcement bars shall be 40mm minimum.
8. The rock back fill shall be 150 - 750mm and is to be placed in accordance with engineers specification.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

Standard Drawing UPC 2: Single Unreinforced Pipe Culvert (1200 mm) General Arrangement



Plan showing part of base and deck



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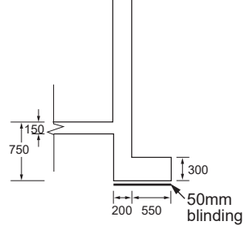

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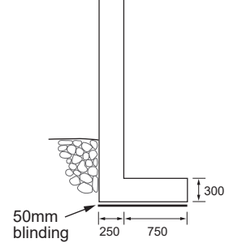

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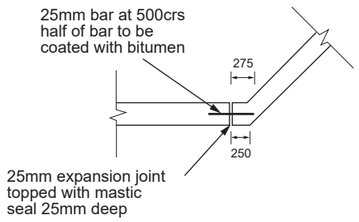

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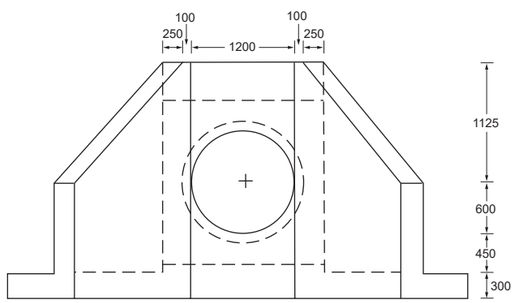
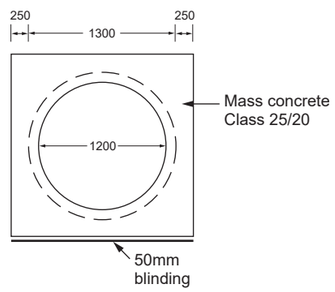


Sectional Elevation



Detail of concrete surround for 1200Ø pipe drain crossing
(Approx. Length 8m)

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MINISTRY OF ROADS AND HIGHWAYS

LOW VOLUME ROADS
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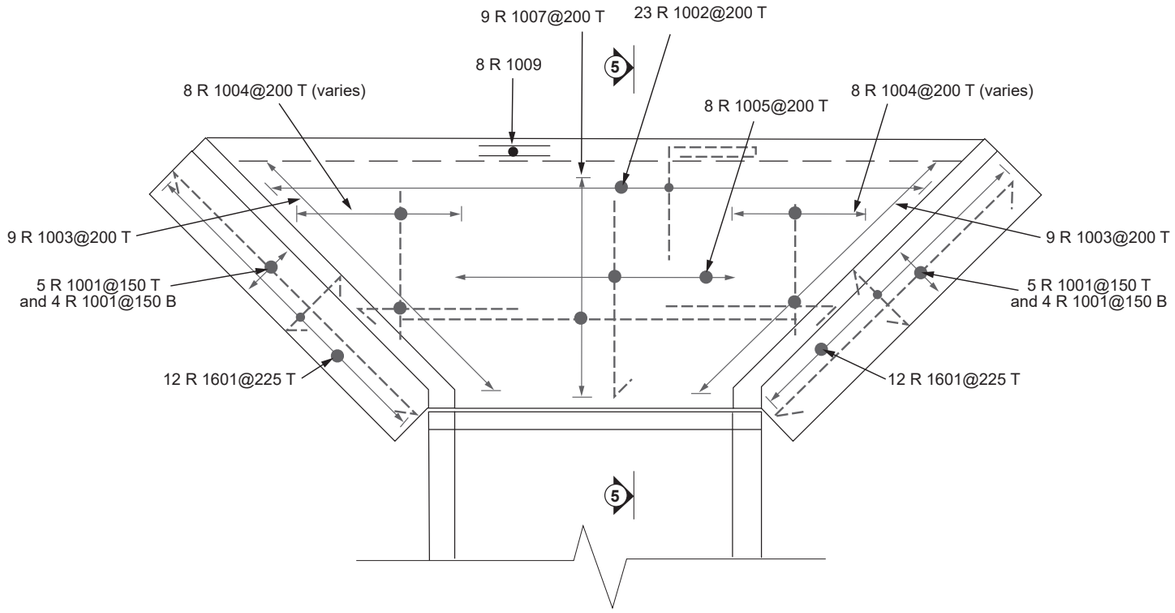
NOTES

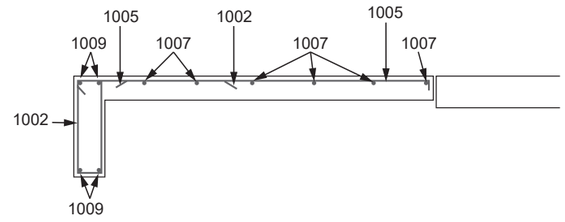
1. All dimensions are in mm unless otherwise stated.
2. Concrete class shall be 22.5/20.
3. All exposed corners and arise to have 25mm x 25mm chamfer unless stated otherwise.
4. The construction of reinforced concrete work shall be in accordance with Engineers specification.
5. The rock backfill shall be 300-1000mm and is to placed inaccordance with Engineers specification.
6. Dowels shall be 20mm Ø at 500mm crs half of bar to be coated with bitumen.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

Standard Drawing UPC 3: Single Unreinforced Pipe Culvert (1200 mm) Reinforcement



Reinforced apron slab



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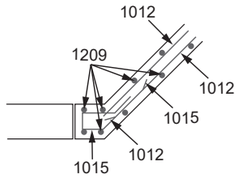

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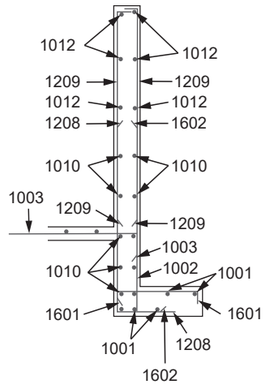

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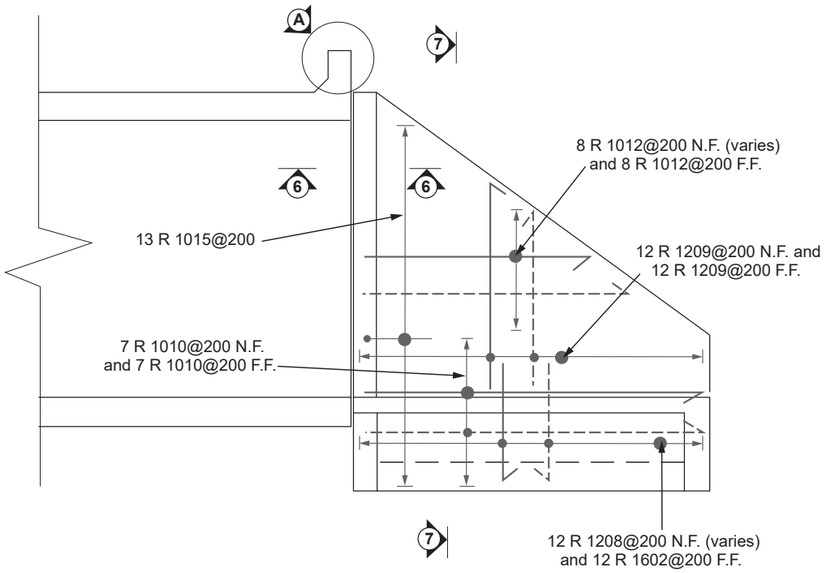
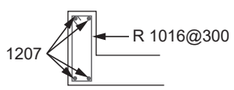


Sectional Elevation



Deck edge detail A

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NOTES

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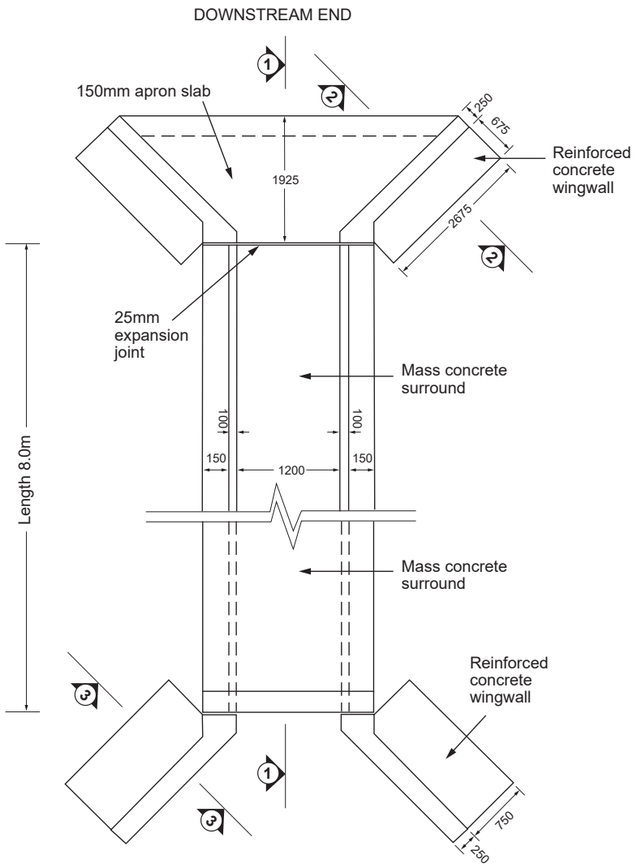
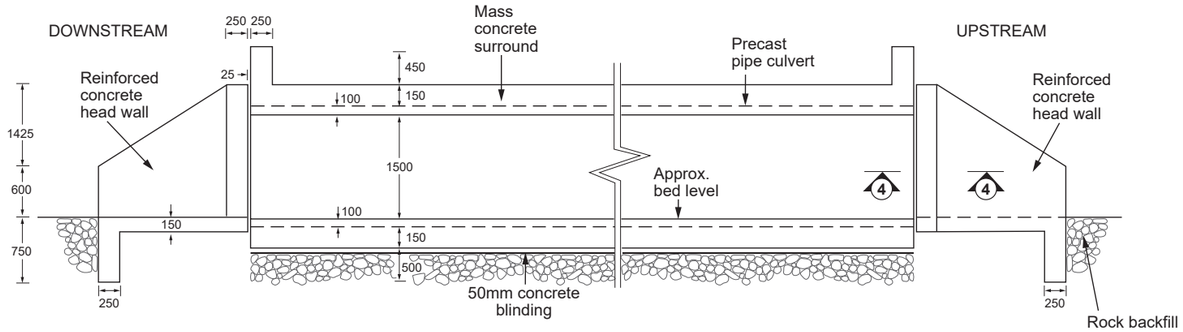
3. All exposed corners and arise to have 25mm x 25mm chamfer unless stated otherwise.
4. The construction of reinforced concrete work shall be in accordance with Engineers specification.
5. The rock backfill shall be 300-1000mm and is to placed inaccordance with Engineers specification.
6. Dowels shall be 20mm Ø at 500mm crs half of bar to be coated with bitumen.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

Standard Drawing UPC 4: Single Unreinforced Pipe Culvert (1500 mm) General Arrangement



Plan showing mass concrete surround



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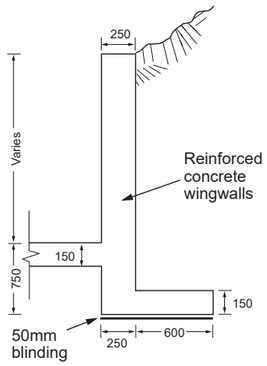

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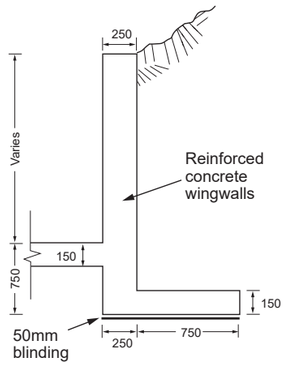

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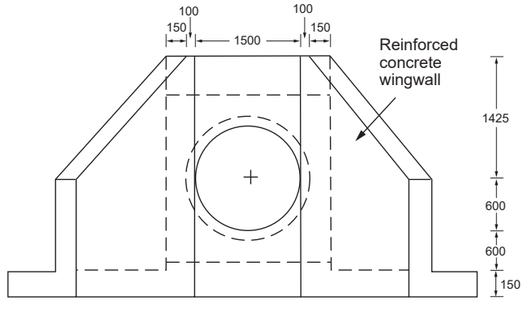
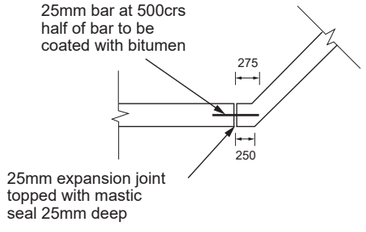


Sectional Elevation



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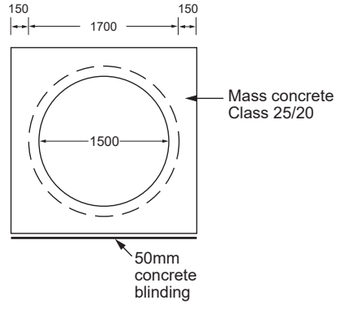

Detail of concrete surround for 1500Ø pipe drain at road crossing (junctions)

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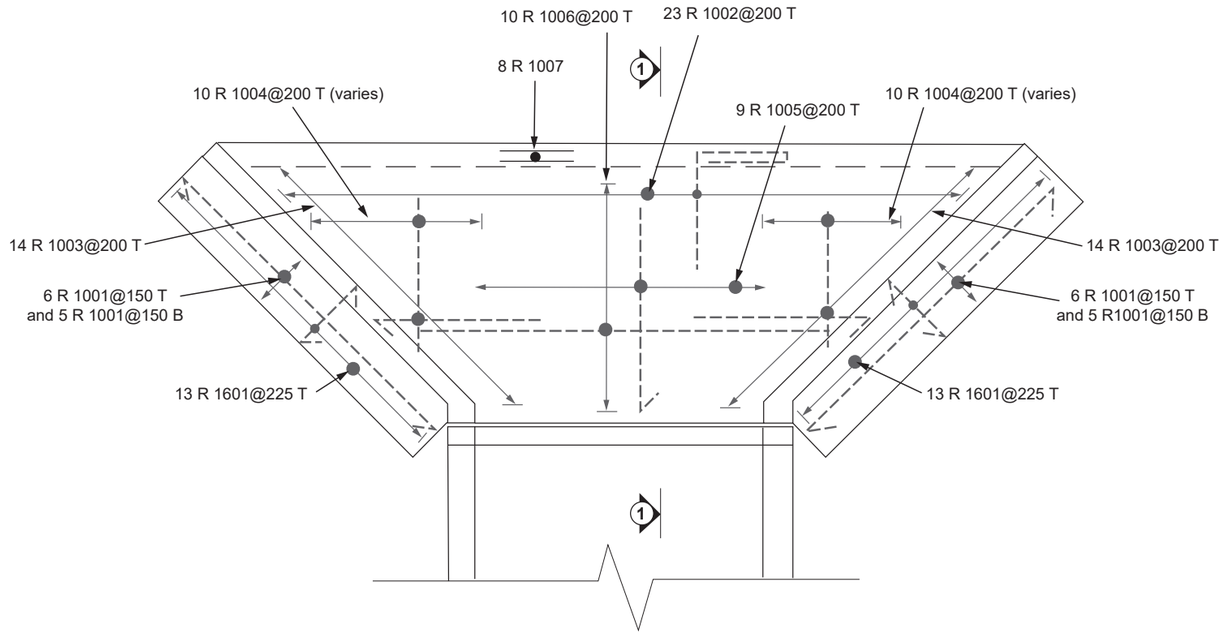
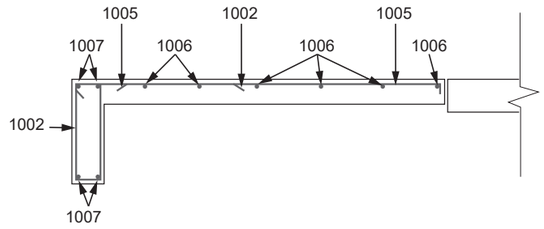
4. The construction of reinforced concrete work shall be in accordance with Engineers specification.
5. The rock backfill shall be 300-1000mm and is to placed inaccordance with Engineers specification.
6. Dowels shall be 20mm Ø at 500mm crs half of bar to be coated with bitumen.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

Standard Drawing UPC 5: Single Unreinforced Pipe Culvert (1500 mm) Reinforcement



Reinforced apron slab



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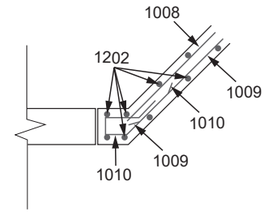

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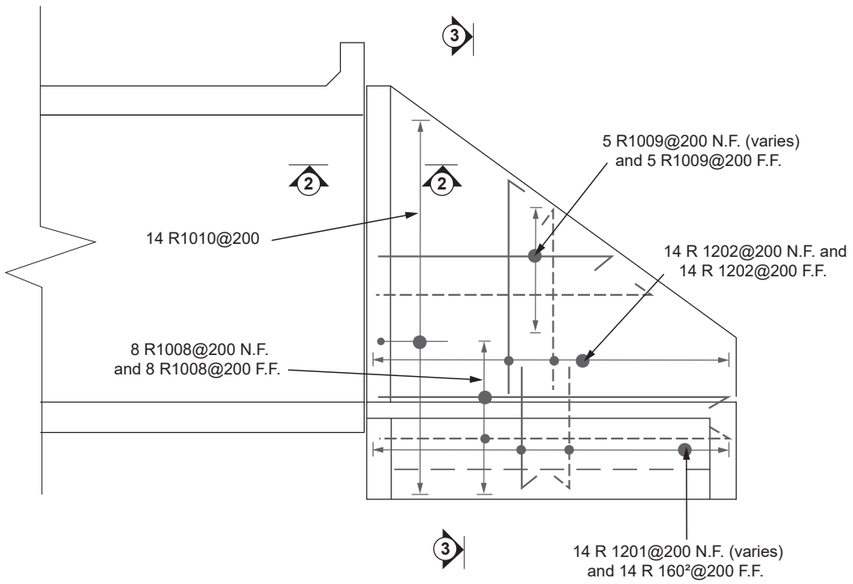
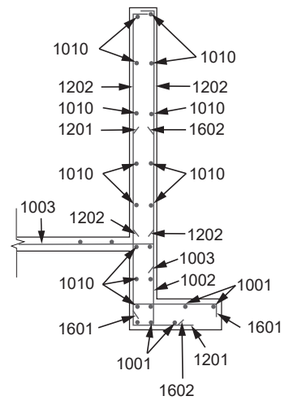


Wing wall details
(4Nº thus.)



Section 3-3

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NOTES

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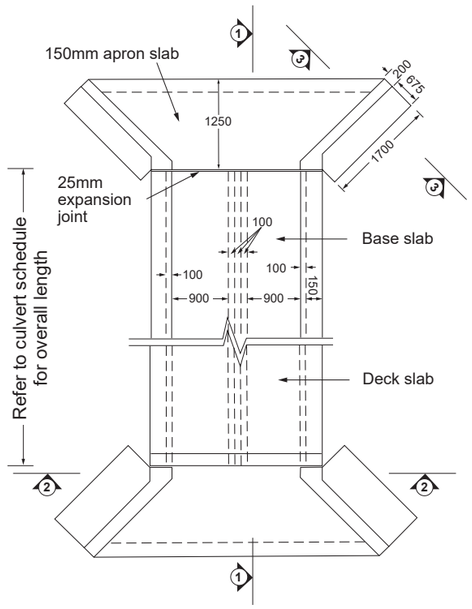
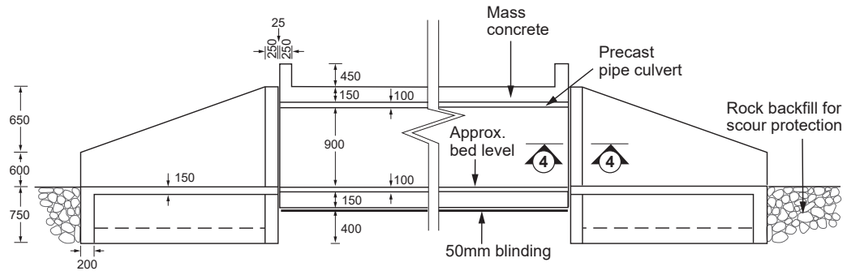
2. All dimensions are in mm unless otherwise stated.
3. Concrete class shall be 22.5/20.
4. Reinforcing bars shall be mild steel - minimum strength 250N/mm, unless otherwise stated.
5. Concrete cover to all reinforcement bars shall be 40mm minimum.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

Standard Drawing UPC 6: Double Unreinforced Pipe Culvert (900 mm) General Arrangement



Plan showing part of base and deck



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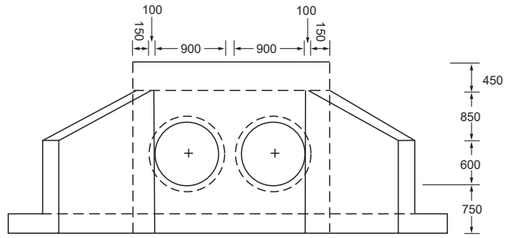

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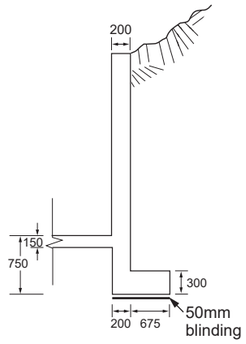

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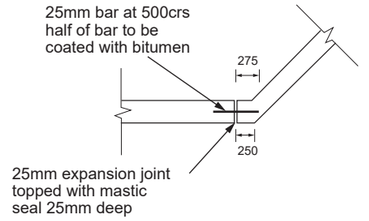
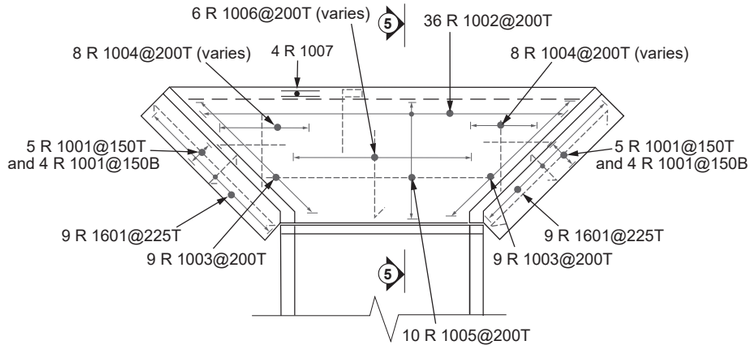
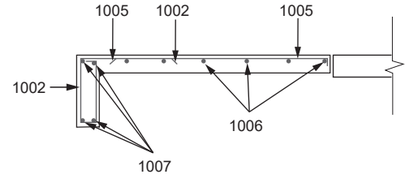


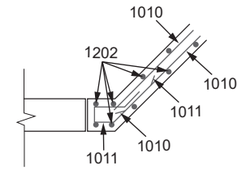
Section 4-4



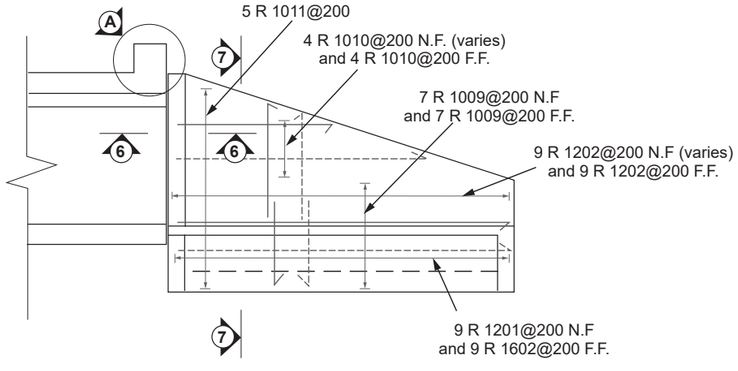
Apron slab details (2Nº thus)



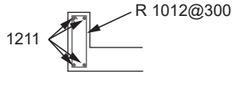
Section 5-5



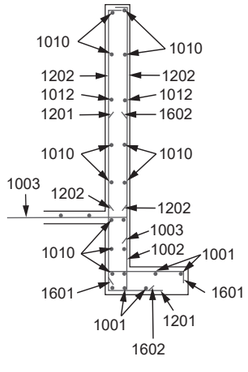
Section 6-6



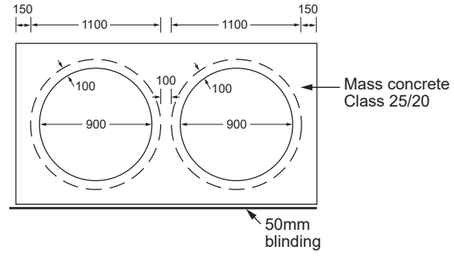
Wingwall details (4Nº thus)



Deck edge detail A



Section 7-7



Detail of concrete surround for 2x900Ø pipe drain crossing

REPUBLIC OF GHANA

MINISTRY OF ROADS AND HIGHWAYS

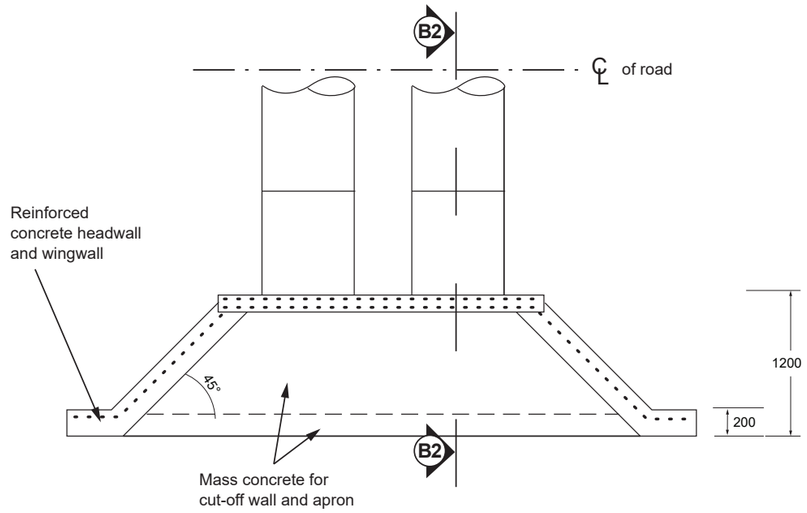
LOW VOLUME ROADS
for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

NOTES

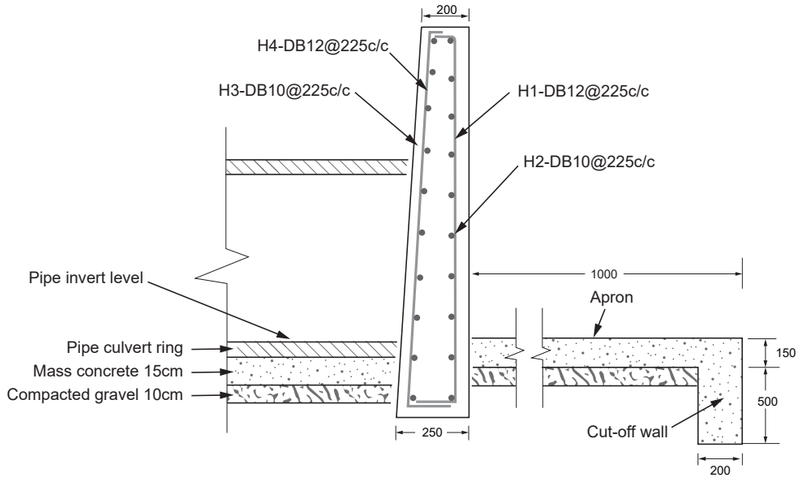
1. This drawing must be read in conjunction with all relevant structural drawings.
2. All dimensions are in mm unless otherwise stated.
3. Concrete class shall be 25/20.
4. Dowels shall be 20mm Ø at 500mm crs. half of bar to be coated with bitumen.
5. The construction of reinforced concrete work shall be in accordance with Engineers specification.
6. Reinforcing bars shall be mild steel - minimum strength 250N/mm^2, unless otherwise stated.
7. Concrete cover to all reinforcement bars shall be 40mm minimum.
8. The rock back fill shall be 150 - 750mm and is to be placed in accordance with engineers specification.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

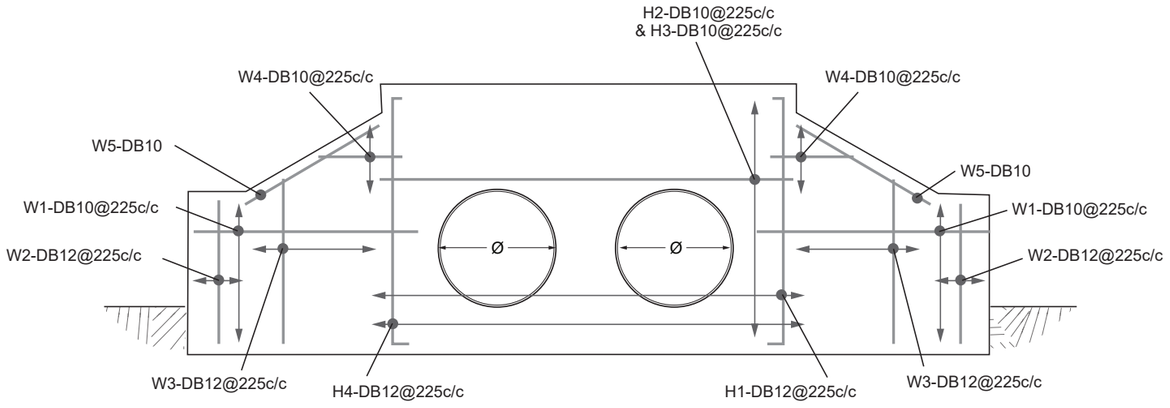
Standard Drawing UPC 7: Double Unreinforced Pipe Culvert (900 mm) Reinforcement



Reinforcement details for head wall and wing wall



Section B2-B2: Reinforcment details for head wall



Head wall & wing wall rienforcement details

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
600	720	Varies	800	200 (top) 250 (base)	300	450	Approved gravel
900	1080	Varies	1100	200 (top) 250 (base)	300	600	Approved gravel

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

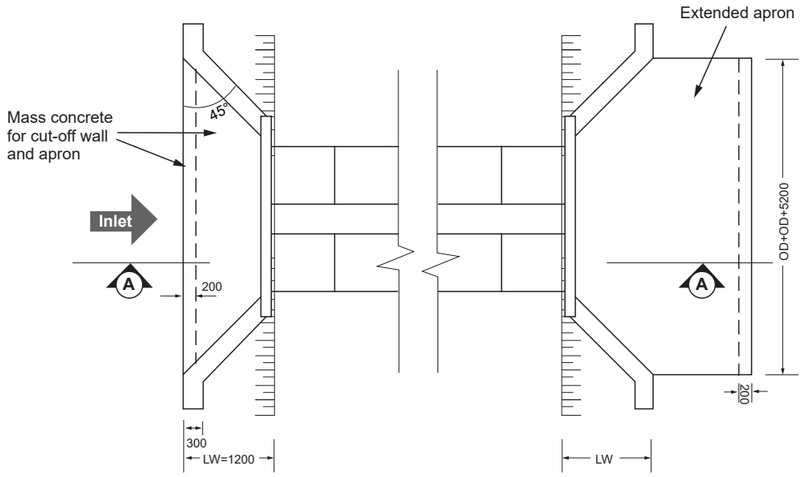
8: The Engineer shall specify the length (L) of the culvert structure.

9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

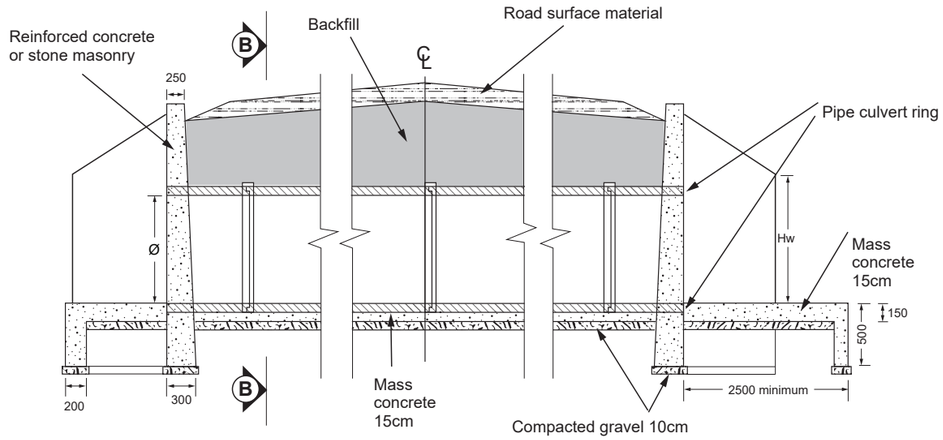
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

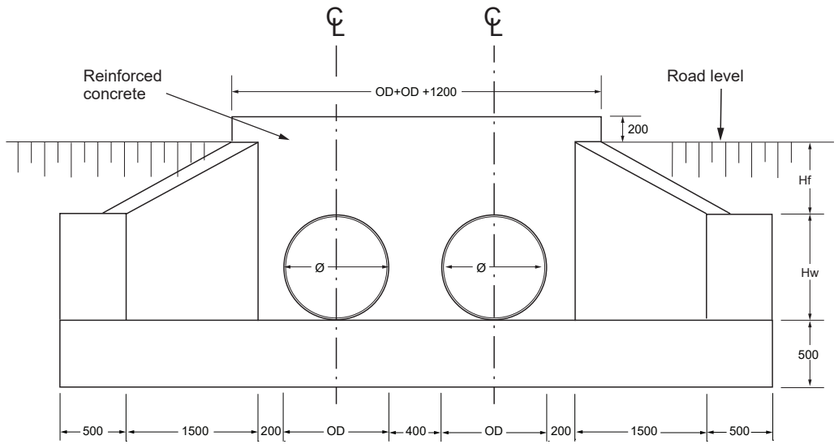
Standard Drawing UPC 8: Double Unreinforced Pipe Culvert (2 x 1500 mm) General Arrangement



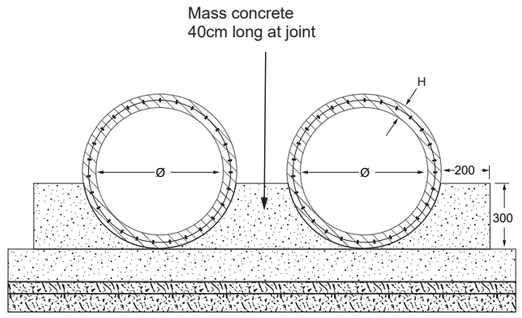
Plan view of culvert installation, headwall & wingwall



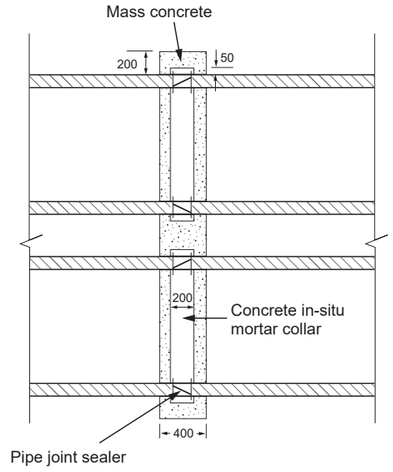
Section A-A longitudinal section of culvert structure



End elevation showing headwall and wing walls



Section B-B cross section of culvert pipe installation



Detail of pipe joint

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
1200	1440	Varies	1400	250 (top) 300 (base)	300	700	Approved gravel
1500	1800	Varies	1700	250 (top) 300 (base)	300	800	Approved gravel

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MINISTRY OF ROADS AND HIGHWAYS

LOW VOLUME ROADS
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Department of Urban Roads

NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

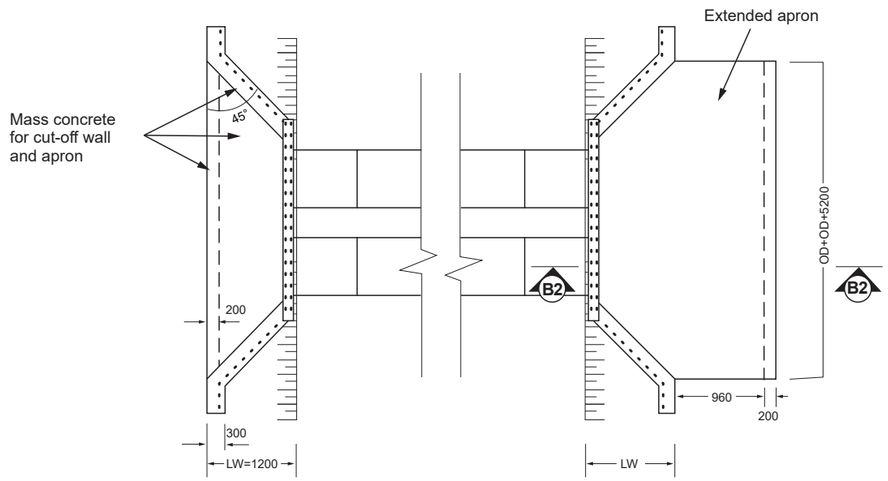
8: The Engineer shall specify the length (L) of the culvert structure.

9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

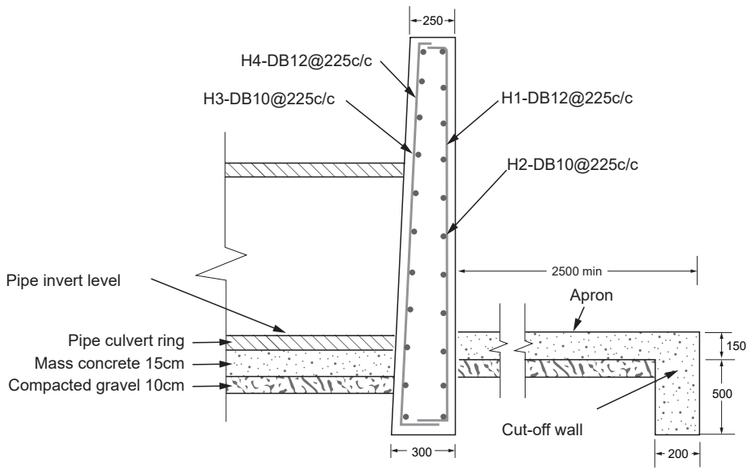
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

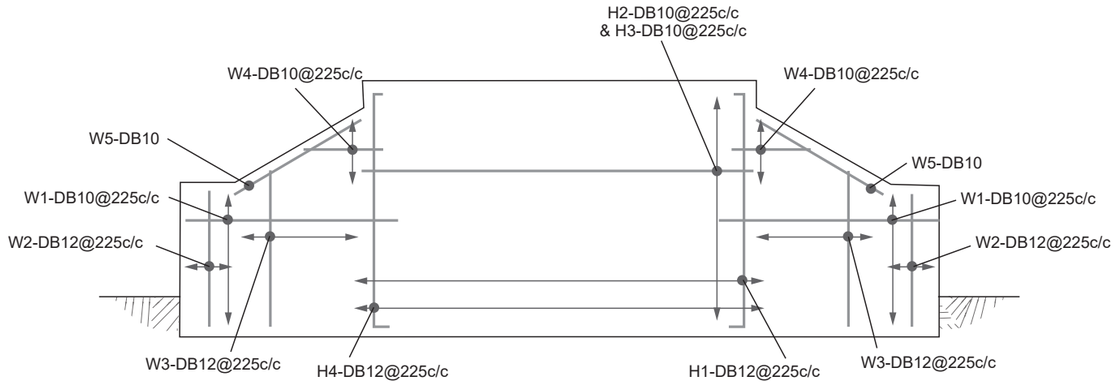
Standard Drawing UPC 9: Double Unreinforced Pipe Culvert (2 x 1500 mm) Reinforcement



Reinforcement details for headwall & wingwall



Section B2-B2: Reinforcment details for head wall



Head wall & wing wall reinforcement details

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
1200	1440	Varies	1400	250 (top) 300 (base)	300	700	Approved gravel
1500	1800	Varies	1700	250 (top) 300 (base)	300	800	Approved gravel

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor.
1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

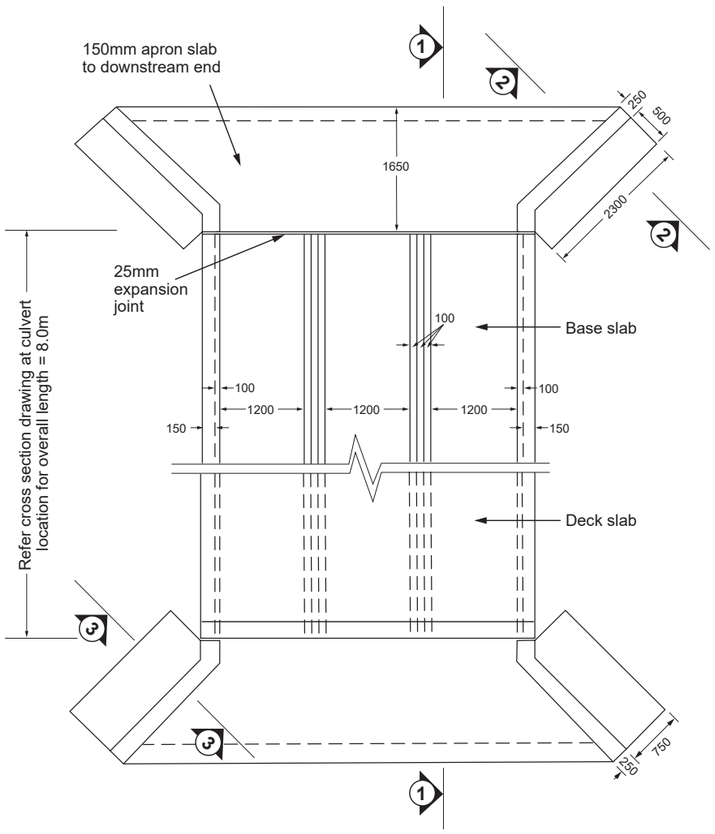
8: The Engineer shall specify the length (L) of the culvert structure.

9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

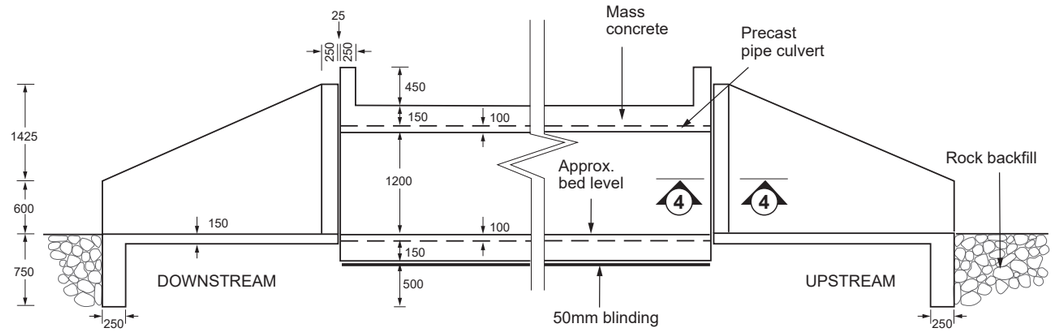
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

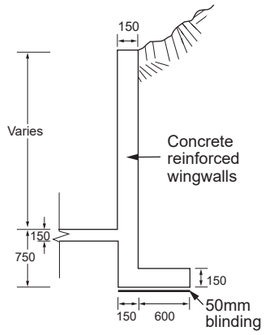
Standard Drawing UPC 10: Triple Unreinforced Pipe Culvert (3 x 1200 mm) General Arrangement



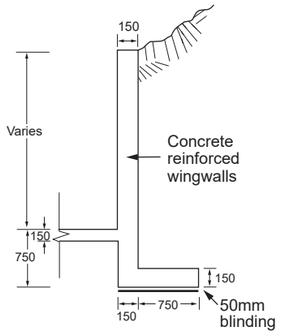
Plan showing mass concrete surround



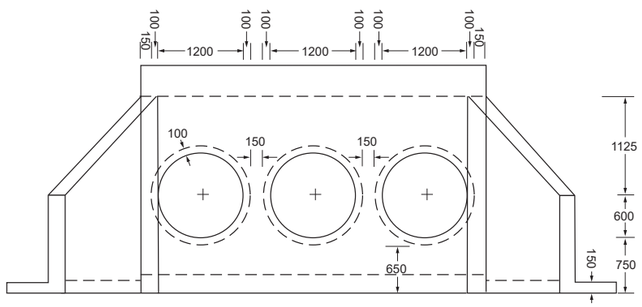
Section 1-1



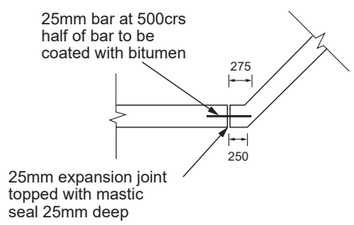
Section 2-2



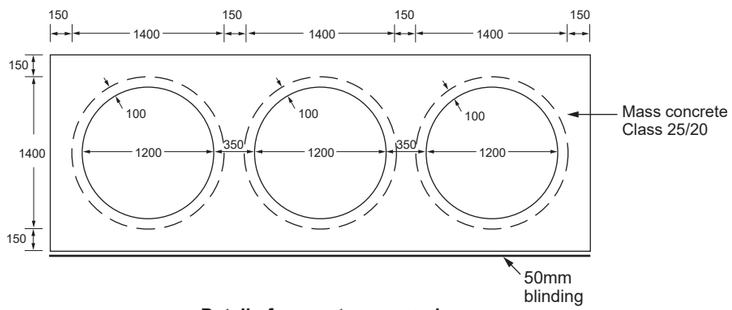
Section 3-3



Sectional elevation



Section 4-4



Detail of concrete surround
for 3x1500Ø pipe drain crossing

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for
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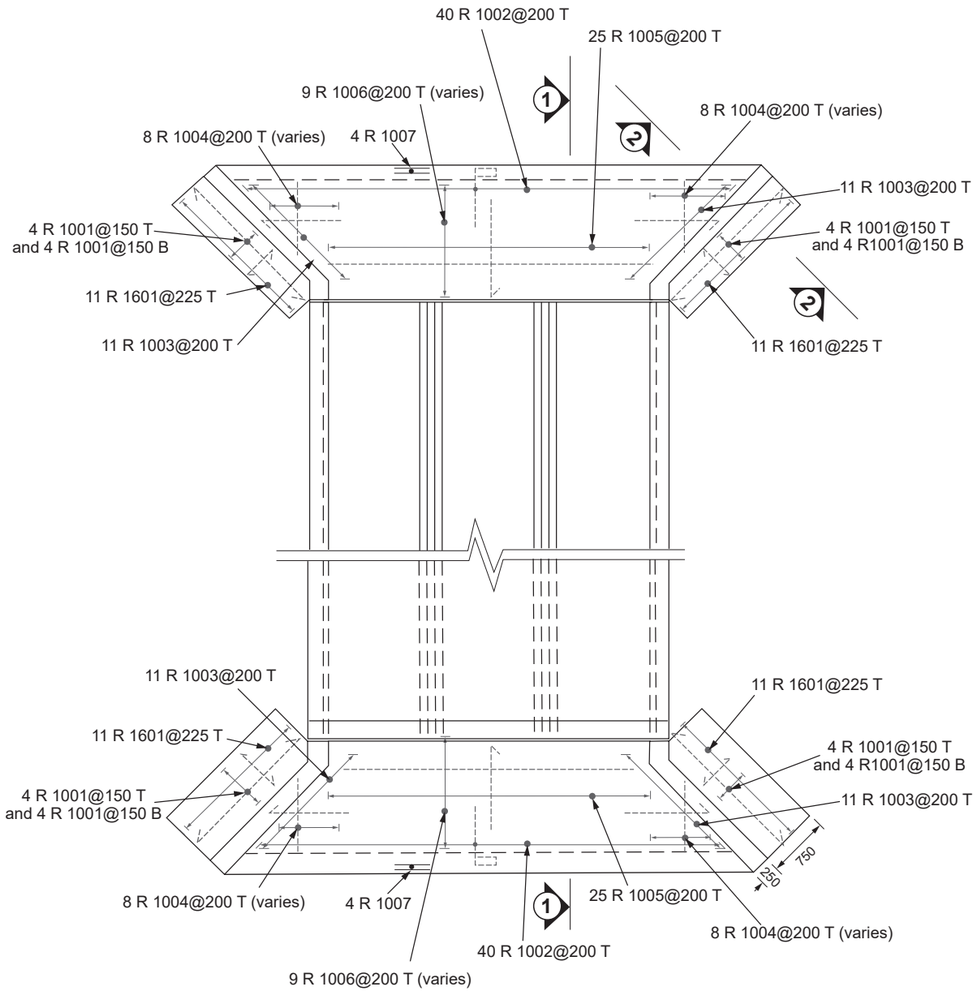
Department of Feeder Roads
Department of Urban Roads

NOTES

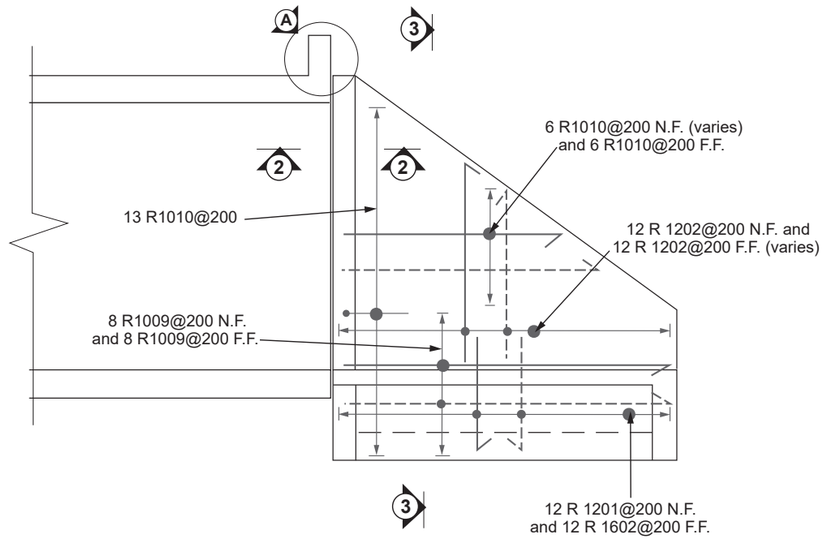
1. All dimensions are in mm unless otherwise stated.
2. Concrete class shall be 25/20.
3. All exposed corners and arise to have 25mm x 25mm chamfer unless otherwise stated.
4. The rock back fill shall be 300 - 1000mm and is to be placed in accordance with engineers specification.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

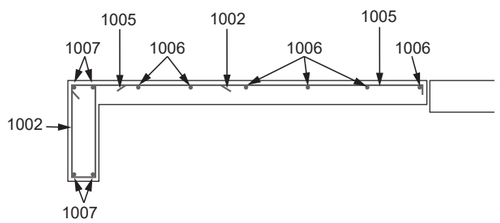
Standard Drawing UPC 11: Triple Unreinforced Pipe Culvert (3 x 1200 mm) Reinforcement



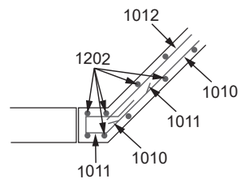
Apron slab details



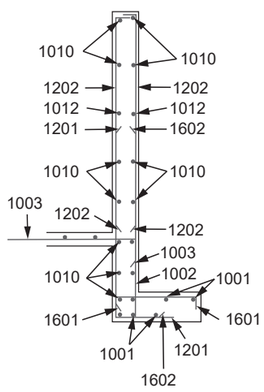
Wing wall details
(4N° thus.)



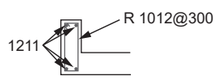
Section 1-1



Section 2-2



Section 3-3



Deck edge detail A

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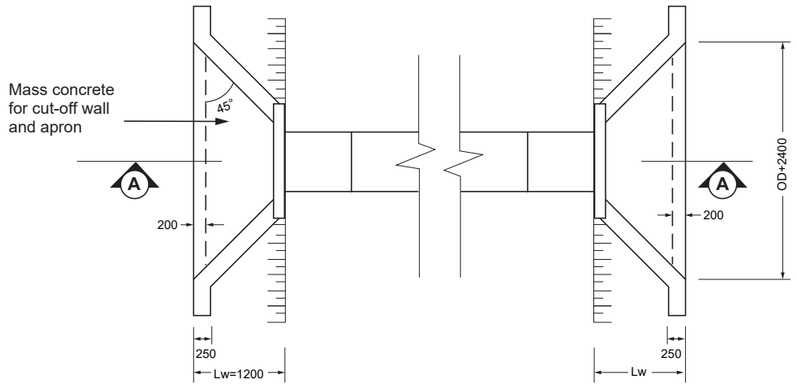
NOTES

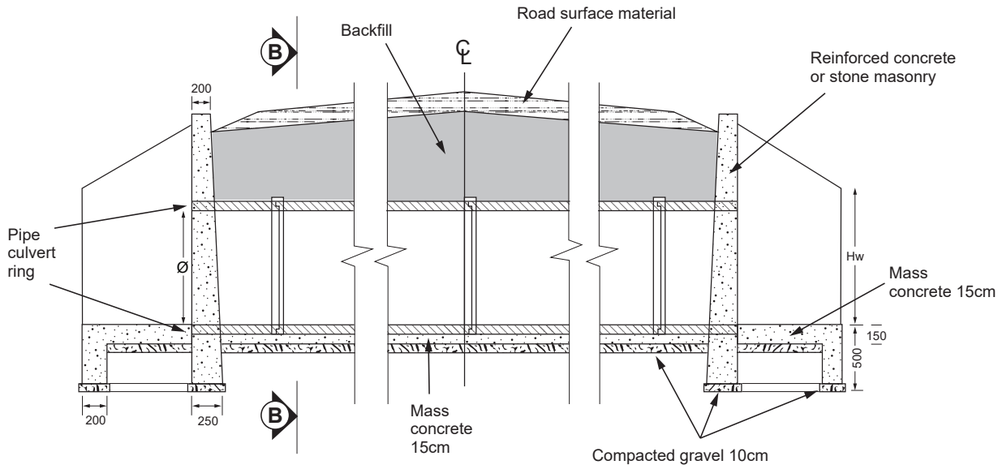
1. This drawing must be read in conjunction with all relevant structural drawings.
2. All dimensions are in mm unless otherwise stated.
3. Concrete class shall be 25/20.
4. Reinforcing bars shall be mild steel - minimum strength 250N/mm^2, unless otherwise stated.
4. Concrete cover to all reinforcement bars shall be 40mm minimum.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

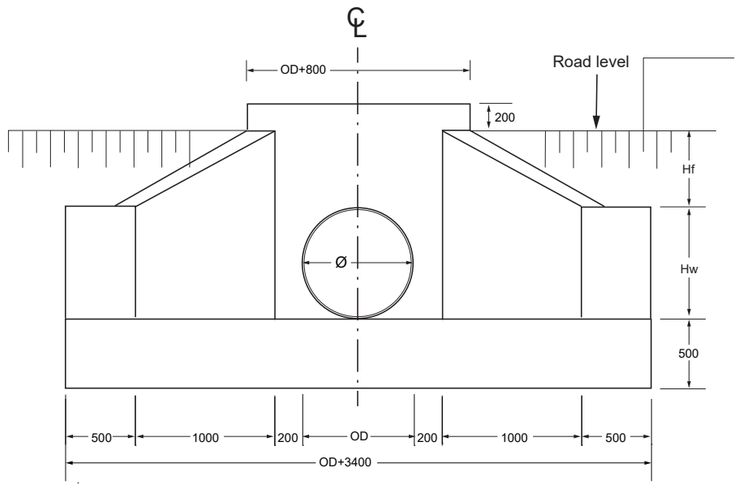
Standard Drawing RPC 1: Single Reinforced Pipe Culvert (600 mm and 900 mm) General Arrangement



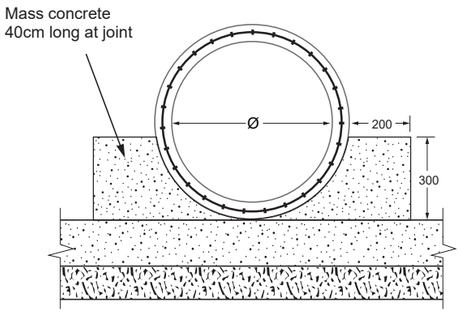
Plan view of culvert installation, headwall & wingwall



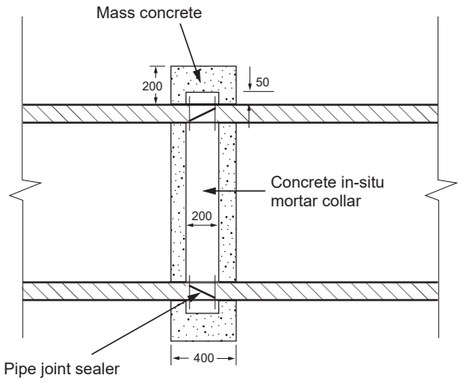
Section A-A longitudinal section of culvert structure



End elevation showing headwall and wing walls



Section B-B cross section of culvert pipe installation



Detail of pipe joint

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
600	720	Varies	800	200 (top) 250 (base)	300	450	Approved gravel
900	1080	Varies	1100	200 (top) 250 (base)	300	600	Approved gravel

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Pipe joint sealer shall be. cement mortar.

6: OD = Outside Diameter = Inside Dia +2*H.

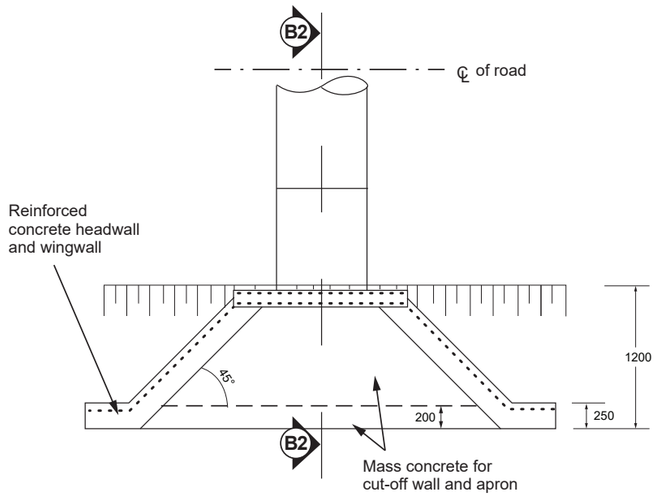
7: The Engineer shall specify the length (L) of the culvert structure.

8. Provide 20mm x 20mm chamfer to all exposed concrete edges.

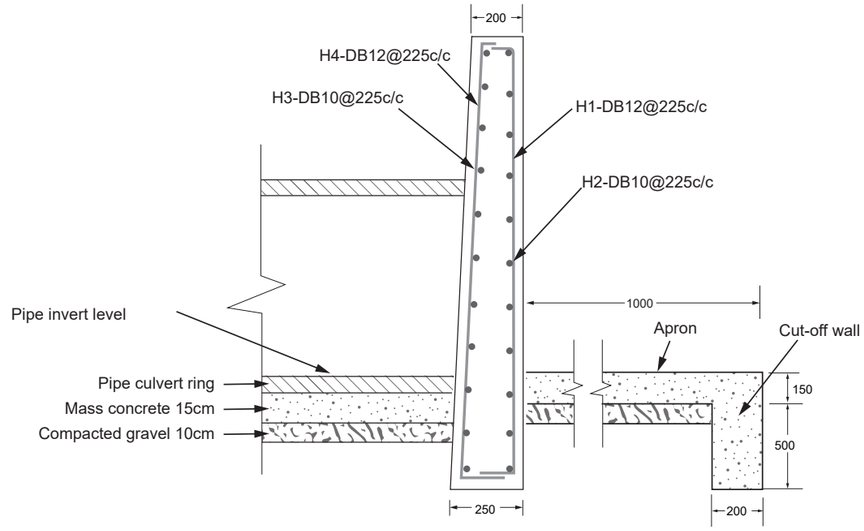
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

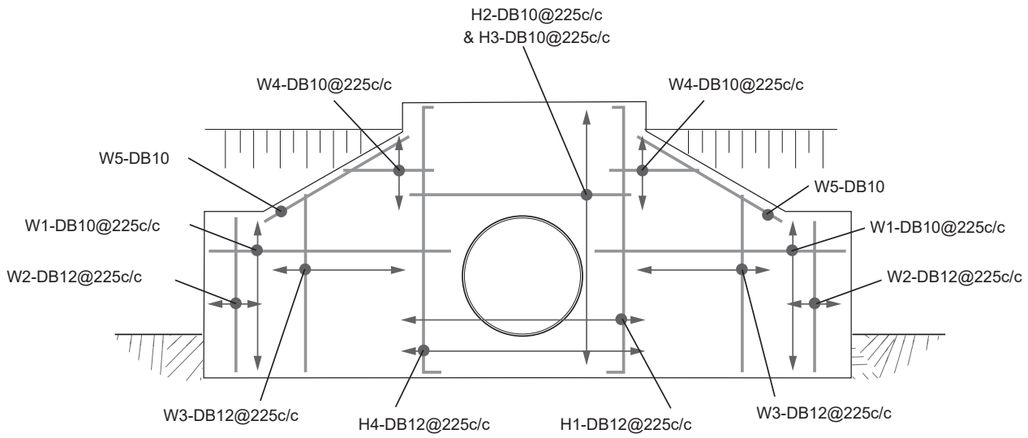
Standard Drawing RPC 2: Single Reinforced Pipe Culvert (600 mm and 900 mm) Reinforcement Layout



Reinforcement details for head wall and wing wall



Section B2-B2: Reinforcement details for head wall



Head wall and wing wall reinforcement details

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
600	720	Varies	800	200 (top) 250 (base)	300	450	Approved gravel
900	1080	Varies	1100	200 (top) 250 (base)	300	600	Approved gravel

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

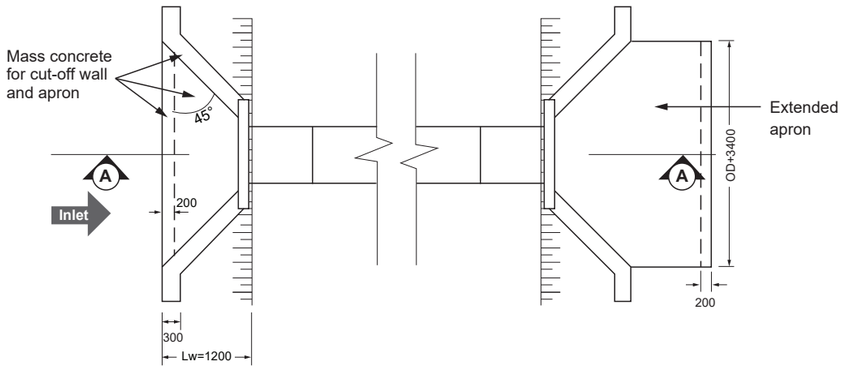
8: The Engineer shall specify the length (L) of the culvert structure.

9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

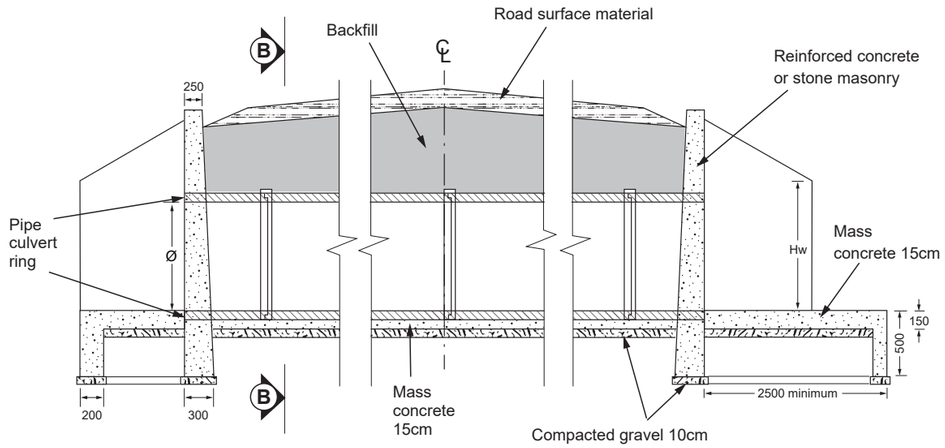
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

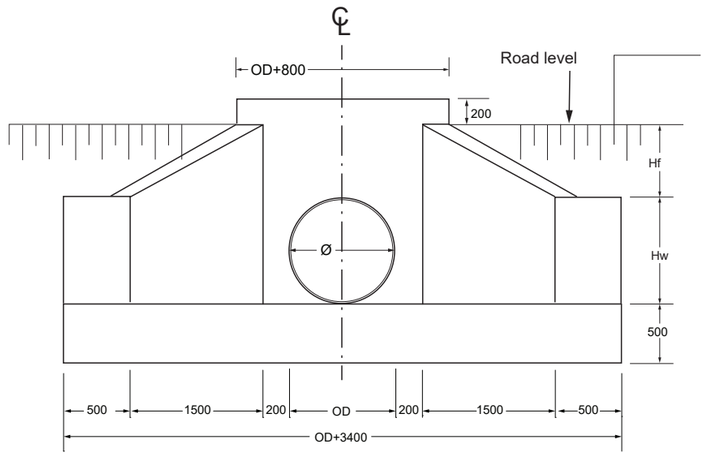
Standard Drawing RPC 3: Single Reinforced Pipe Culvert (1200 mm and 1500 mm) General Arrangement



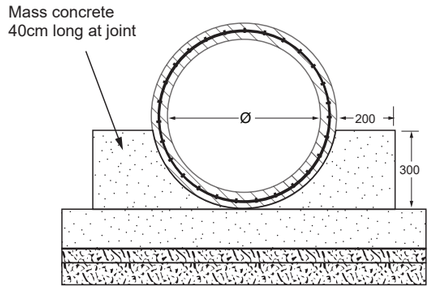
Plan view of culvert installation, headwall & wingwall



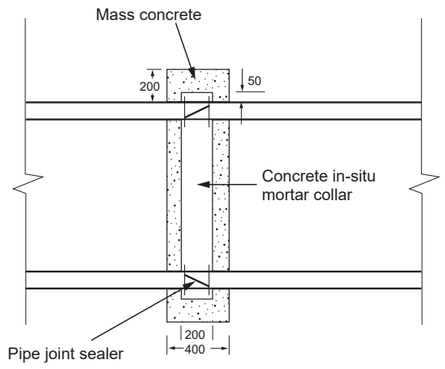
Section A-A longitudinal section of culvert structure



End elevation showing headwall and wing walls



Section B-B cross section of culvert pipe installation



Detail of pipe joint

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
1200	1440	Varies	1400	250 (top) 300 (base)	300	700	Approved gravel
1500	1800	Varies	1700	250 (top) 300 (base)	300	800	Approved gravel

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre

4: Concrete cylinder strength in 28 days shall be: 21 Mpa.

5: Pipe joint sealer shall be cement mortar.

6: OD = Outside Diameter = Inside Dia +2*H.

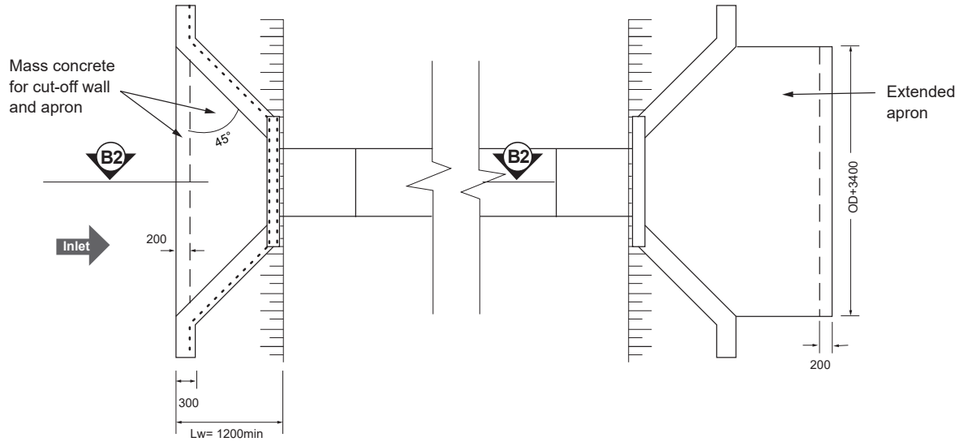
7: The Engineer shall specify the length (L) of the culvert structure.

8. Provide 20mm x 20mm chamfer to all exposed concrete edges.

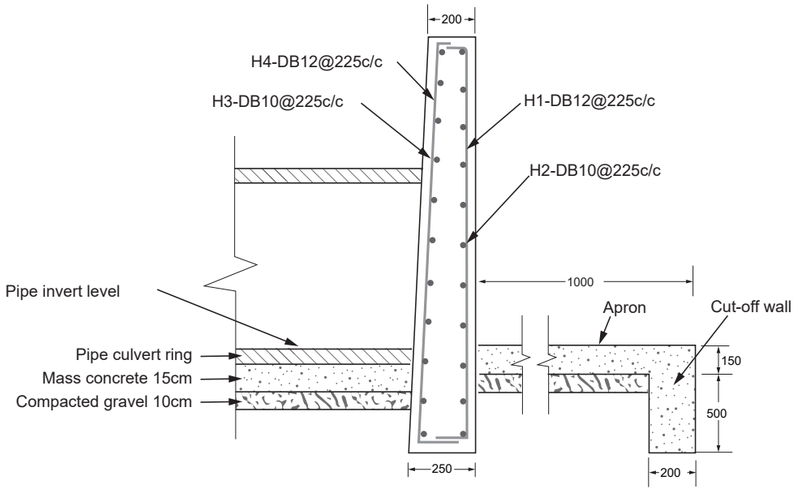
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

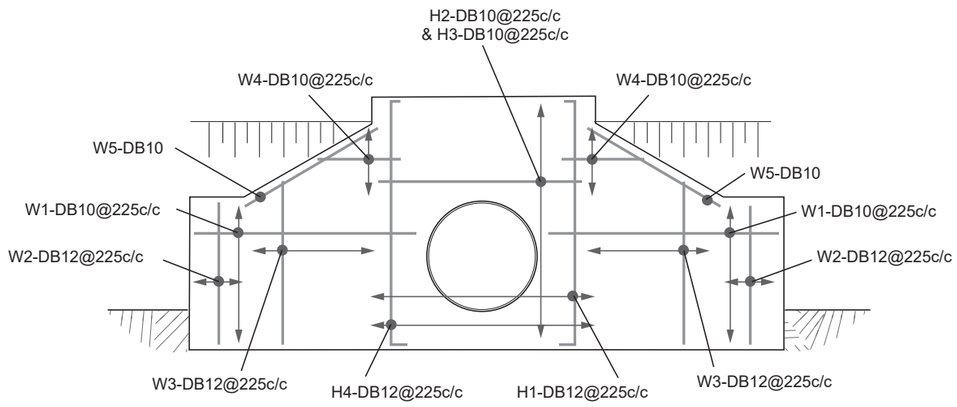
Standard Drawing RPC 4: Single Reinforced Pipe Culvert (1200 mm and 1500 mm) Reinforcement Layout



Reinforcement details for head wall and wing wall



Section B2-B2 reinforcment details for head wall



Head wall and wing wall reinforcment details

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
1200	1440	Varies	1400	250 (top) 300 (base)	300	700	Approved gravel
1500	1800	Varies	1700	250 (top) 300 (base)	300	800	Approved gravel

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Department of Urban Roads

NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

8: The Engineer shall specify the length (L) of the culvert structure.

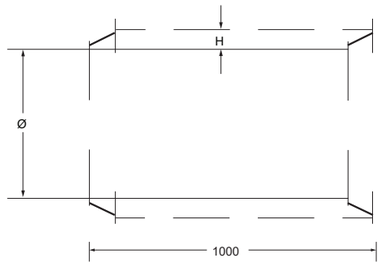
9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

DESCRIPTION

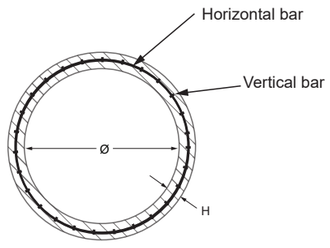
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

Standard Drawing RPC 5: Pipe Culvert Reinforcement Details

Details reinforced concrete pipe culvert rings



Details of pipe size



Reinforced bar details

Size of pipe Ø mm	Vertical bars (mm)		Horizontal bars (mm)		Thickness of pipe H (mm)
	Ø	Spacing	Ø	Spacing	
800	10	150	10	150	90
900	10	150	10	100	90
1200	12	150	12	100	120
1500	12	150	12	100	150

Reinforced bar details

Component		Bar shape	Bar mark	Ø (mm)	Spacing C/C (mm)	Length of each bar (m)
Pipe culvert Ø 60cm single/double row	Wingwalls	1400 / 450	W1	DB 10	225	1.95
			W2	DB 12	225	1.2
			W3	DB 12	225	Varies
			W4	DB 10	225	Varies
			W5	DB 10		1.4
	Head walls	160 / varies	H1	DB 12	225	Varies
			H2	DB 10	225	Varies
			H3	DB 10	225	Varies
		140 / varies	H4	DB 12	225	Varies
Pipe culvert Ø 90cm single/double row	Wingwalls	1400 / 450	W1	DB 10	225	1.95
			W2	DB 12	225	1.5
			W3	DB 12	225	Varies
			W4	DB 10	225	Varies
			W5	DB 10		1.4
	Head walls	160 / varies	H1	DB 12	225	Varies
			H2	DB 10	225	Varies
			H3	DB 10	225	Varies
		145 / varies	H4	DB 12	225	Varies
Pipe culvert Ø 120cm single/double row	Wingwalls	2100 / 450	W1	DB 10	225	2.65
			W2	DB 12	225	1.85
			W3	DB 12	225	Varies
			W4	DB 10	225	Varies
			W5	DB 10		2.1
	Head walls	220 / varies	H1	DB 12	225	Varies
			H2	DB 10	225	Varies
			H3	DB 10	225	Varies
		170 / varies	H4	DB 12	225	Varies

Bar bending schedule for pipe culvert installation

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Standard pipe length: 1.0 metre.

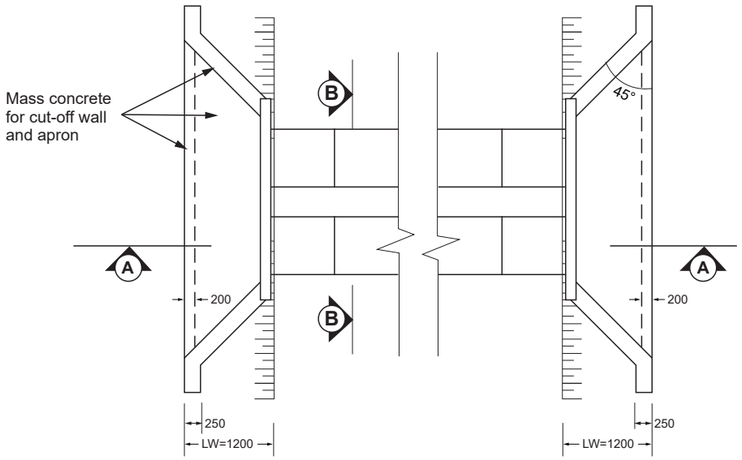
3: Concrete cylinder strength in 28 days shall be: 21 Mpa.

4: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 Mpa.

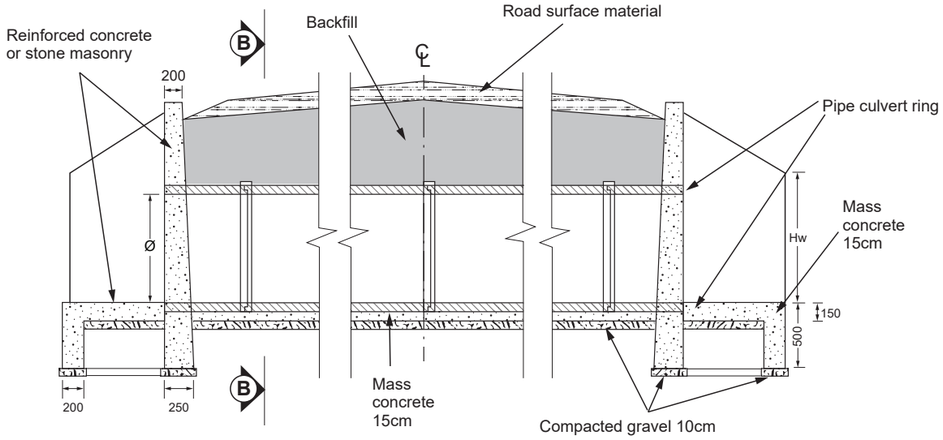
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

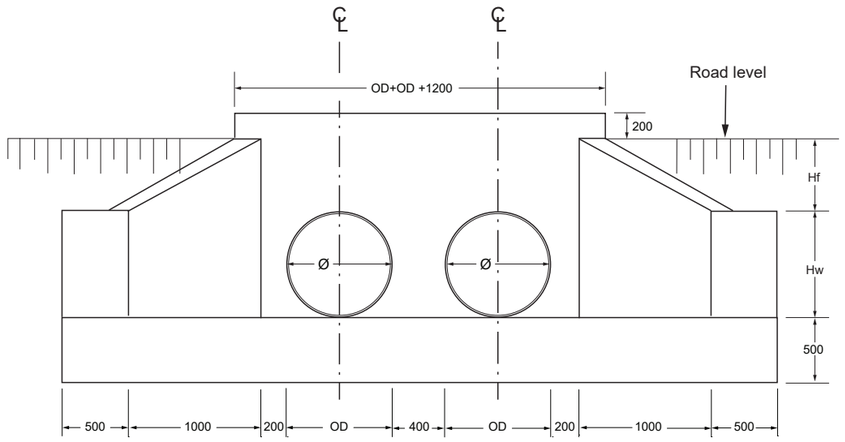
Standard Drawing RPC 6: Double Reinforced Pipe Culvert (2 x 600 mm and 2 x 900 mm) General Arrangement



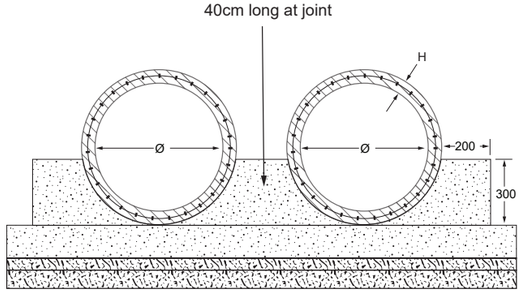
Plan view of culvert installation, headwall & wingwall



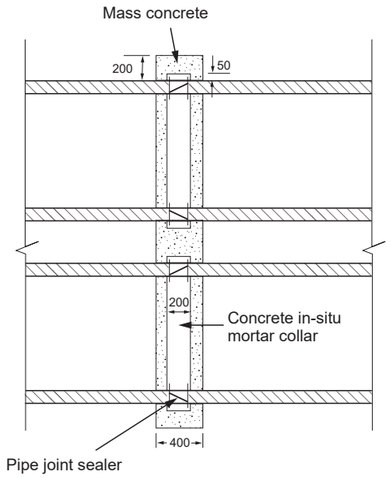
Section A-A longitudinal section of culvert structure



End elevation showing headwall and wing walls



Section B-B cross section of culvert pipe installation



Detail of pipe joint

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
600	720	Varies	800	200 (top) 250 (base)	300	450	Approved gravel
900	1080	Varies	1100	200 (top) 250 (base)	300	600	Approved gravel

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Department of Urban Roads

NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Pipe joint sealer shall be cement mortar.

6: OD = Outside Diameter = Inside Dia +2*H.

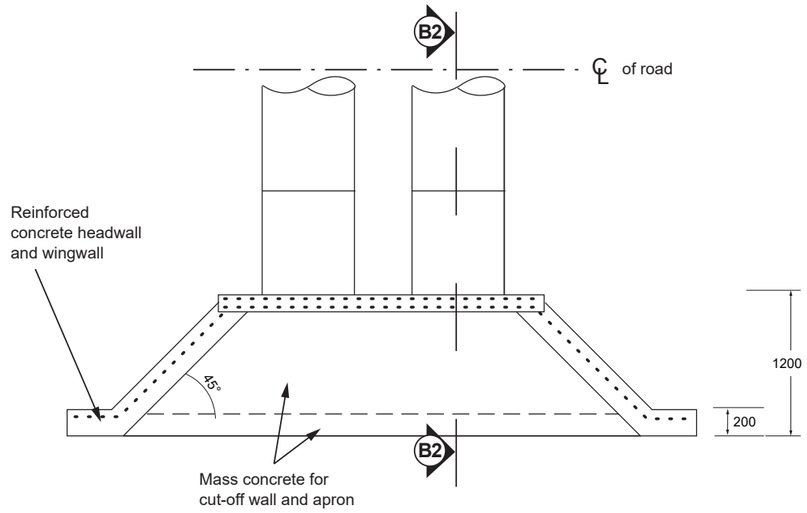
7: The Engineer shall specify the length (L) of the culvert structure.

8. Provide 20mm x 20mm chamfer to all exposed concrete edges.

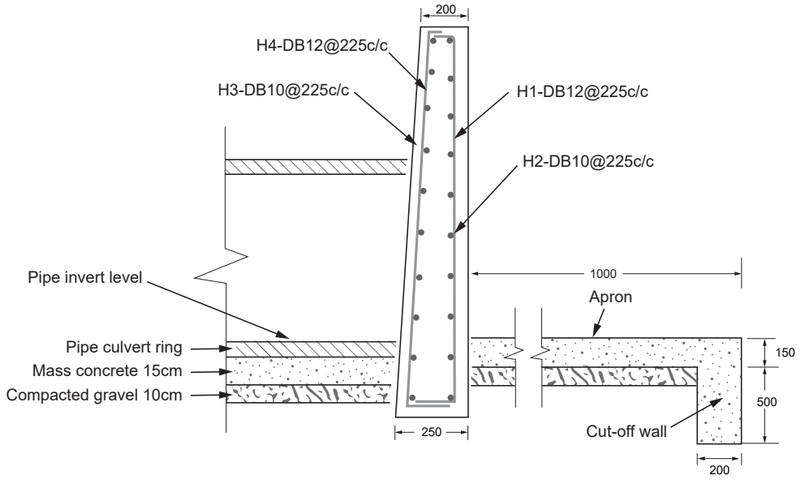
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

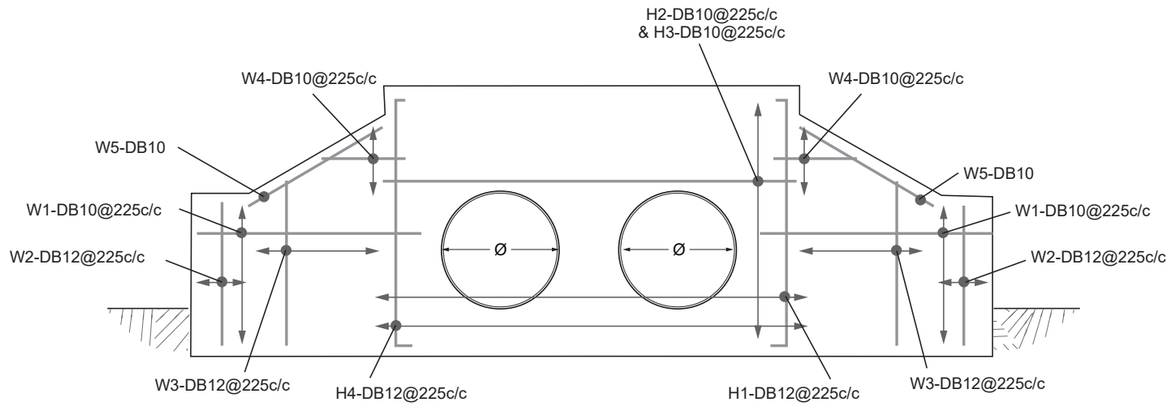
Standard Drawing RPC 7: Double Reinforced Pipe Culvert (2 x 600 mm and 2 x 900 mm) Reinforcement Layout



Reinforcement details for head wall and wing wall



Section B2-B2: Reinforcment details for head wall



Head wall & wing wall rienforcement details

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
600	720	Varies	800	200 (top) 250 (base)	300	450	Approved gravel
900	1080	Varies	1100	200 (top) 250 (base)	300	600	Approved gravel

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

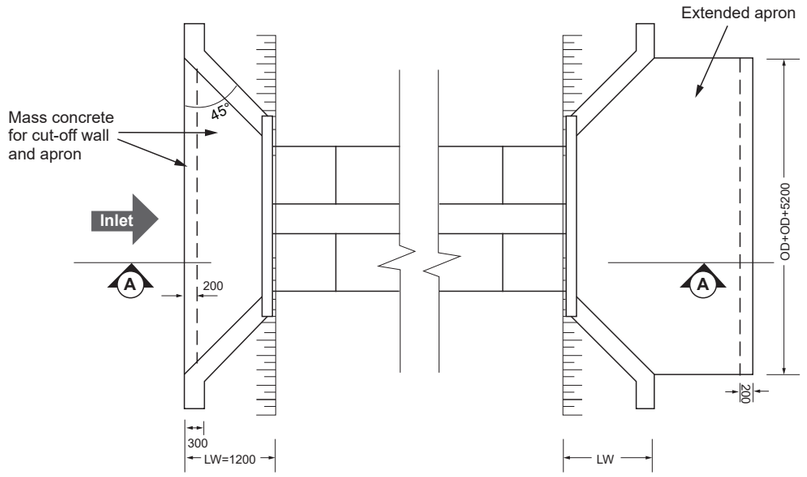
8: The Engineer shall specify the length (L) of the culvert structure.

9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

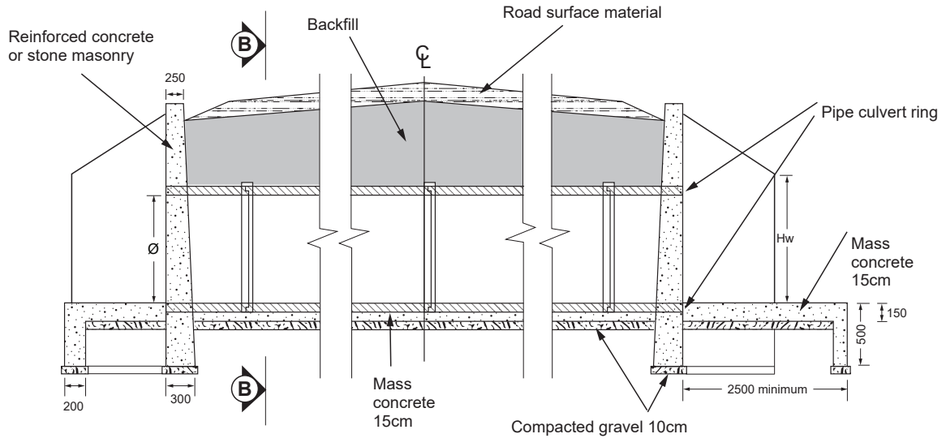
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

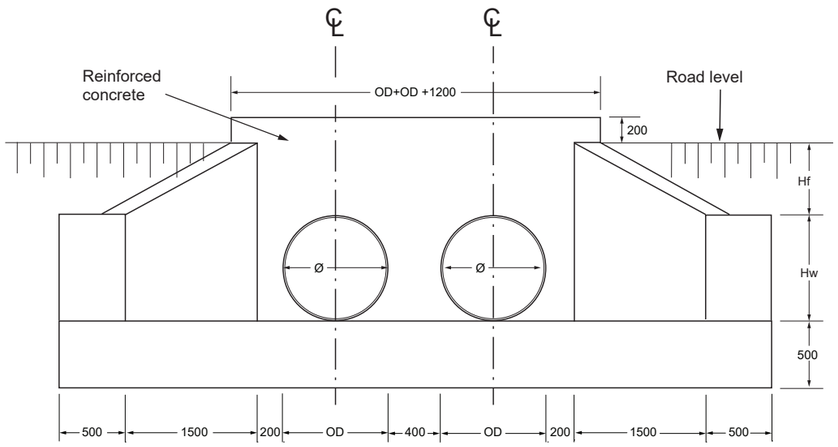
Standard Drawing RPC 8: Double Reinforced Pipe Culvert (2 x 1200 mm and 2 x 1500 mm) General Arrangement



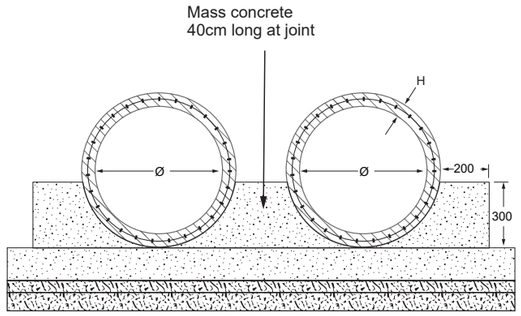
Plan view of culvert installation, headwall & wingwall



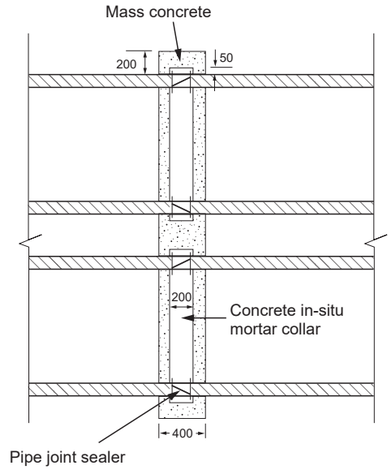
Section A-A longitudinal section of culvert structure



End elevation showing headwall and wing walls



Section B-B cross section of culvert pipe installation



Detail of pipe joint

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
1200	1440	Varies	1400	250 (top) 300 (base)	300	700	Approved gravel
1500	1800	Varies	1700	250 (top) 300 (base)	300	800	Approved gravel

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Department of Urban Roads

NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor. 1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

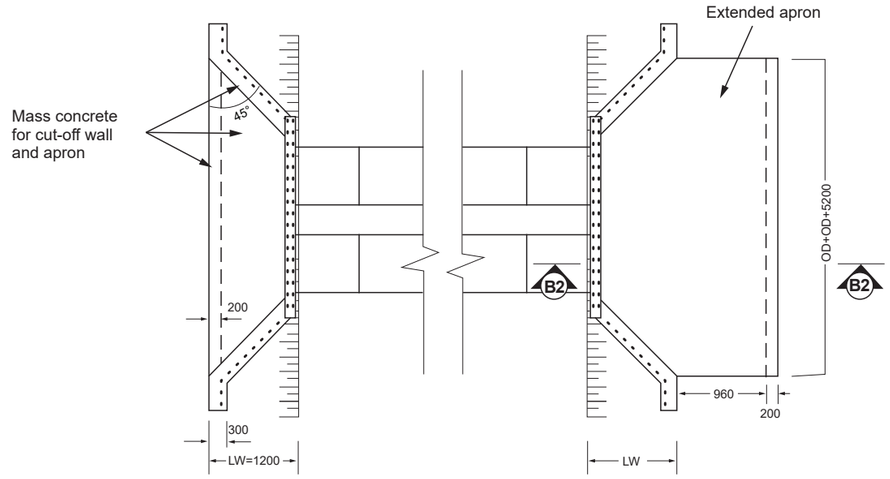
8: The Engineer shall specify the length (L) of the culvert structure.

9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

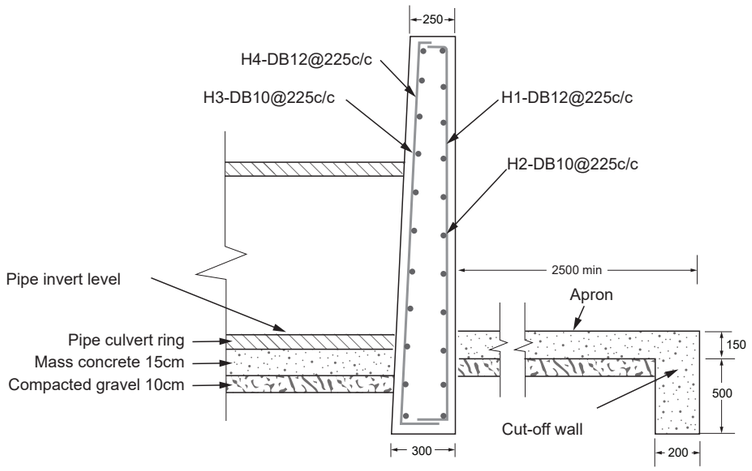
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

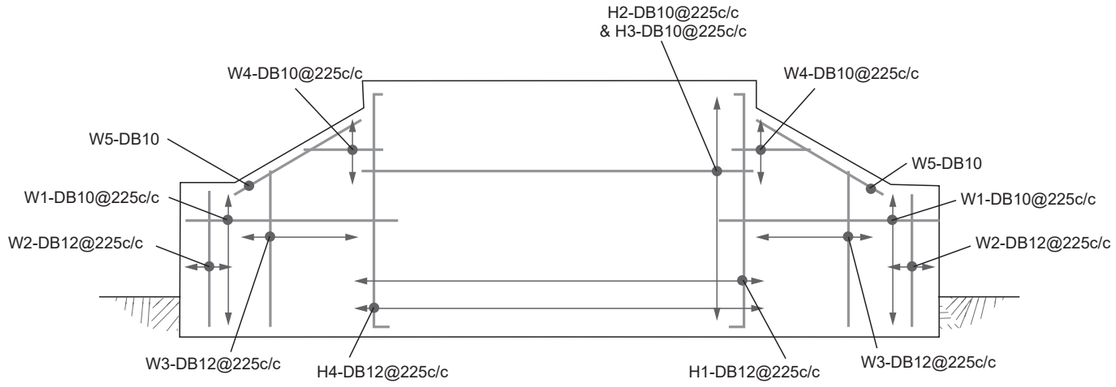
Standard Drawing RPC 9: Double Reinforced Pipe Culvert (2 x 1200 mm and 2 x 1500 mm) Reinforcement Layout



Reinforcement details for headwall & wingwall



Section B2-B2: Reinforcment details for head wall



Head wall & wing wall reinforcement details

Culvert size (Inside Ø)	OD	L	Hw	Headwall thickness		Backfill	
				Concrete	Stone masonry	Minimum cover	Material
1200	1440	Varies	1400	250 (top) 300 (base)	300	700	Approved gravel
1500	1800	Varies	1700	250 (top) 300 (base)	300	800	Approved gravel

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Department of Urban Roads

NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Conversion factor.
1mm - 0.03937 Inches.

3: Standard pipe length: 1.0 metre.

4: Concrete cylinder strength in 28 days shall be: 21 MPa.

5: Reinforcement shall be structural grade deformed bar (DB) with minimum yield strength 420 MPa.

6: Pipe joint sealer shall be cement mortar.

7: OD = Outside Diameter = Inside Dia +2*H.

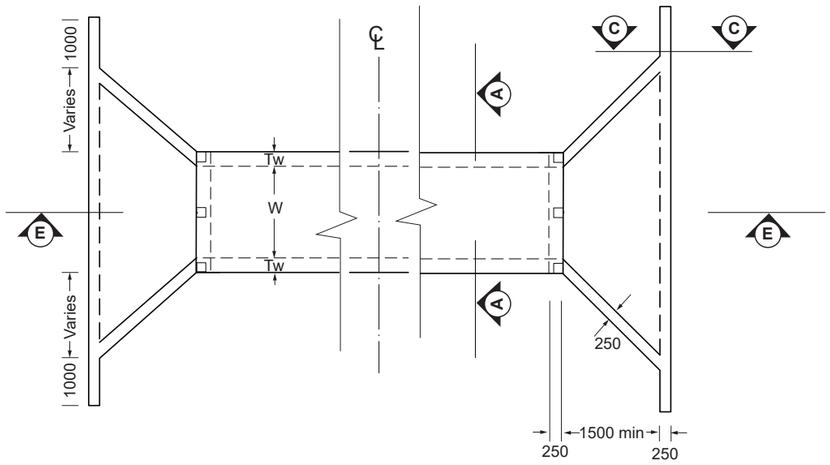
8: The Engineer shall specify the length (L) of the culvert structure.

9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

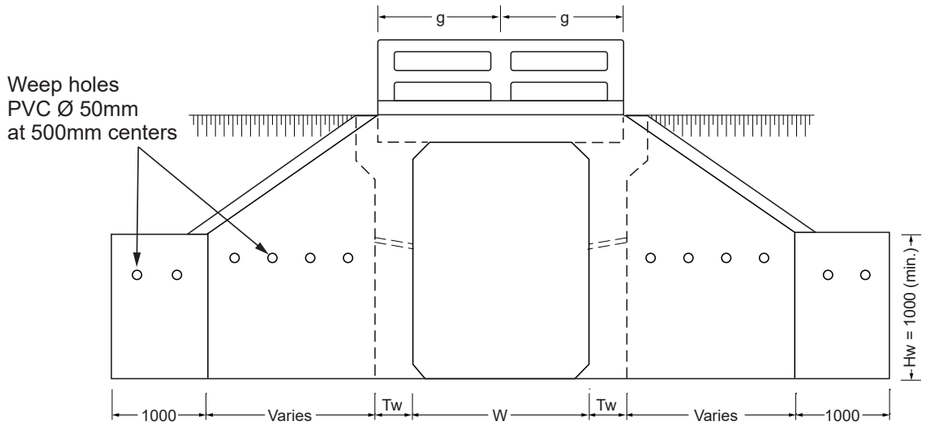
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

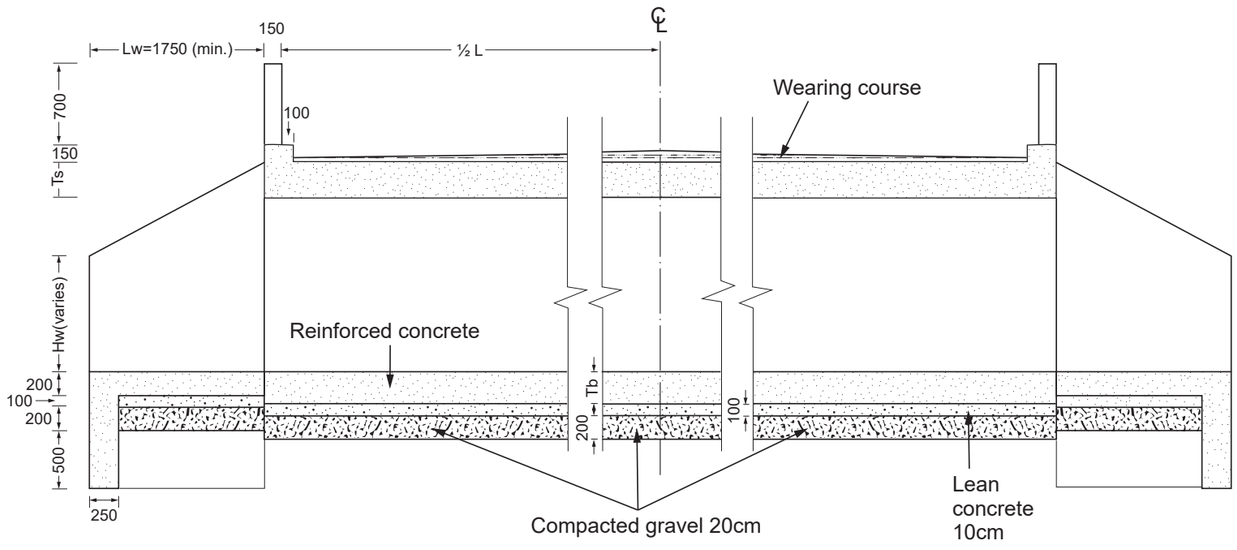
Standard Drawing BC 1: Single Box Culvert General Arrangement



Plan of single cell box culvert



Single cell box culvert elevation



Section E-E: Longitudinal section of box culvert

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Concrete cylinder strength in 28 days shall be; a) box and end structures: 21 MPa; b) Lean concrete: 10 MPa.

3: Bed shall be approved compacted non-plastic gravel and lean concrete.

4: Crushed aggregate for concrete shall not be greater than 19mm.

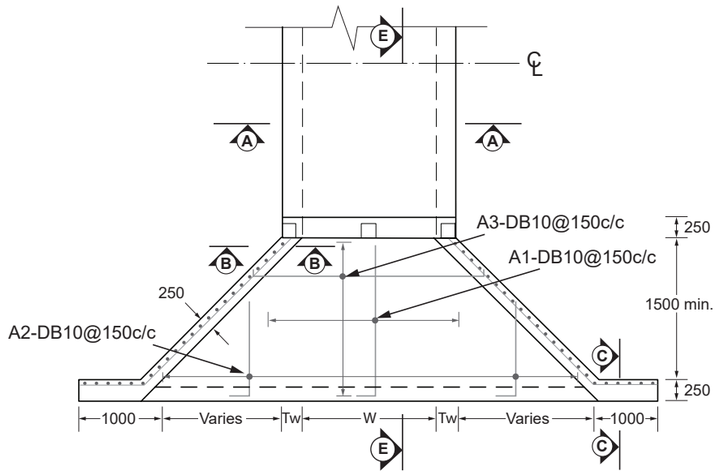
5: The Engineer shall specify the length (L) of the culvert structure.

6. Lw and Hw vary depending on site conditions.

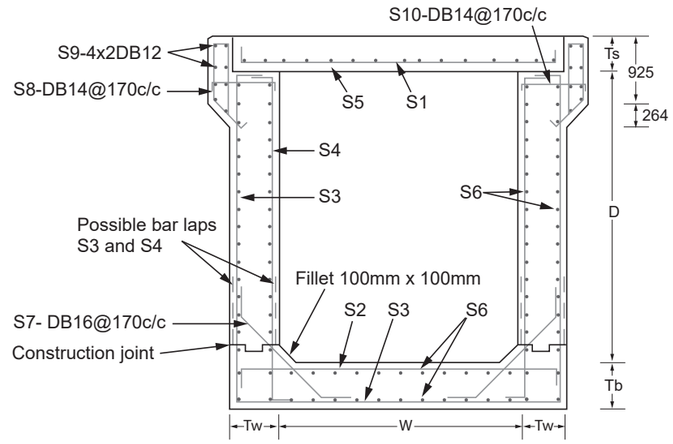
7. Provide 20mm x 20mm chamfer to all exposed concrete edges.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

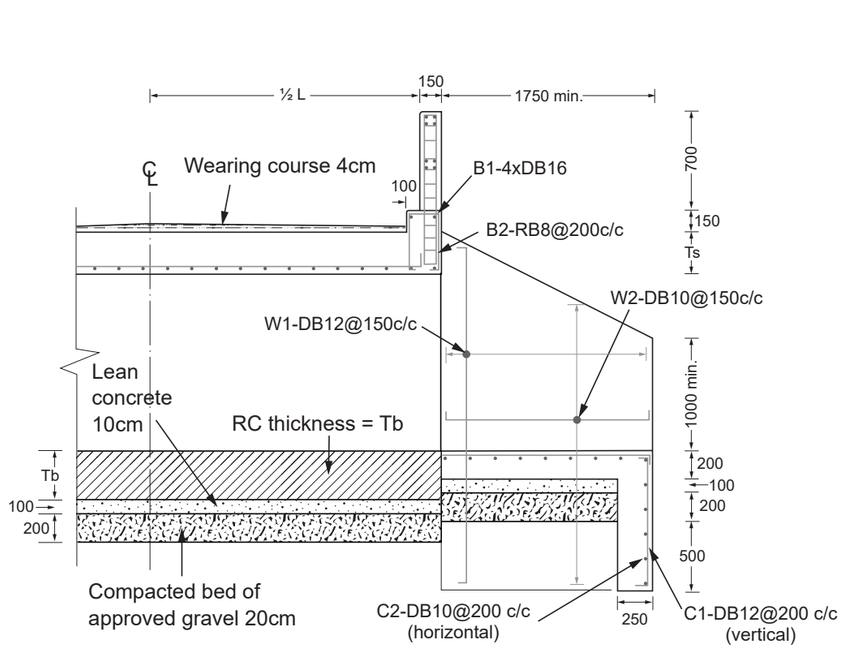
Standard Drawing BC 2: Single Box Culvert indicative Reinforcement



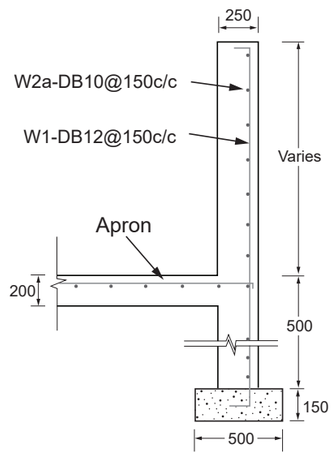
Plan of head/wing wall and apron & head/wing wall reinforcement detail



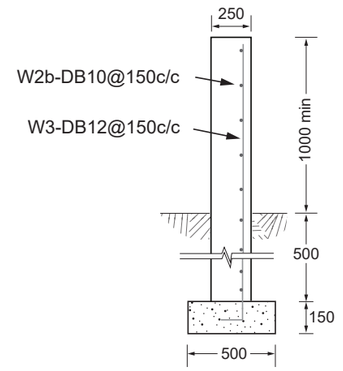
Section A-A: Reinforcement detail



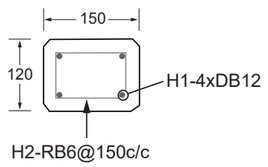
Section E-E: Culvert head/wing wall and apron reinforcement detail



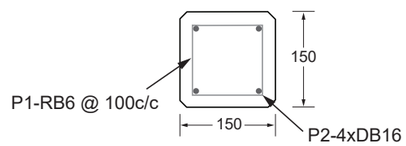
Section B-B



Section C-C



Details of handrail



Details of guardrail post

REPUBLIC OF GHANA

MINISTRY OF ROADS AND HIGHWAYS

LOW VOLUME ROADS
for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Concrete cylinder strength in 28 days shall be; a) box and end structures: 21 MPa; b) Lean concrete: 10 MPa

3: Bed shall be stone and sand mix of ration 1:1 and lean concrete.

4: Reinforcement shall be structural grade deformed bar (DB), with minimum yield strength 420 MPa or mild steel bar (RB) with minimum yield strength 250 MPa.

5: Minimum 40mm cover to reinforcement.

6: Minimum bar lap shall be 50xØ.

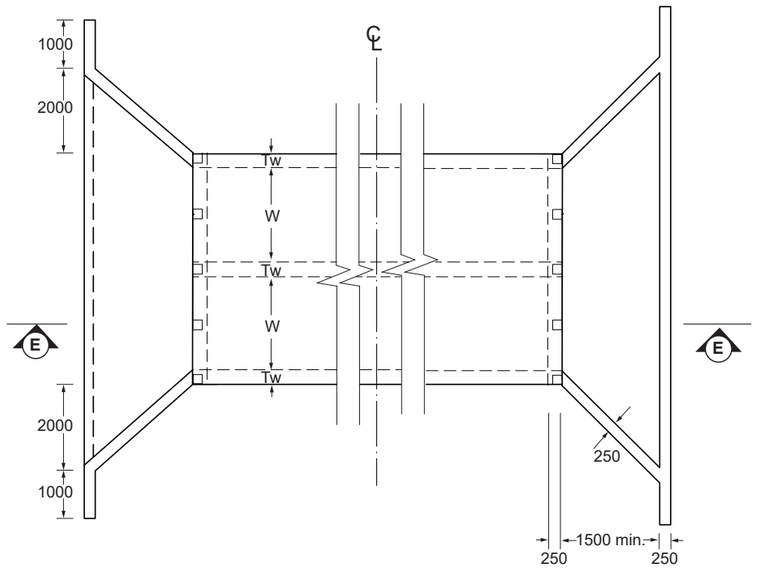
7: Crushed aggregate for concrete shall not be greater than 19mm.

8: The Engineer shall specify the length (L) of the culvert structure.

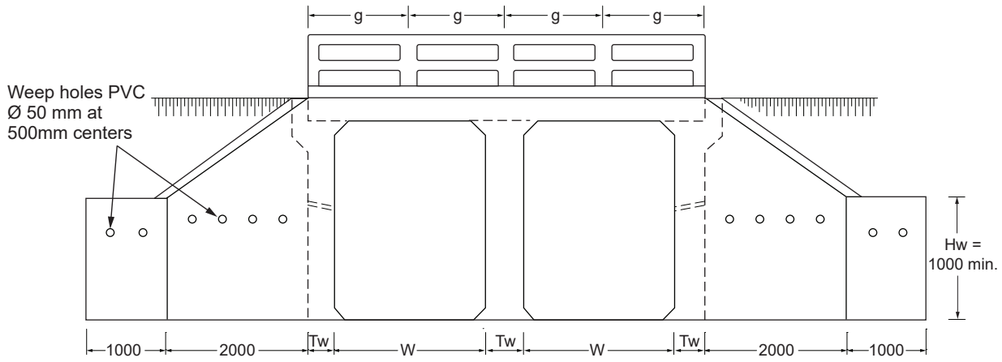
9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

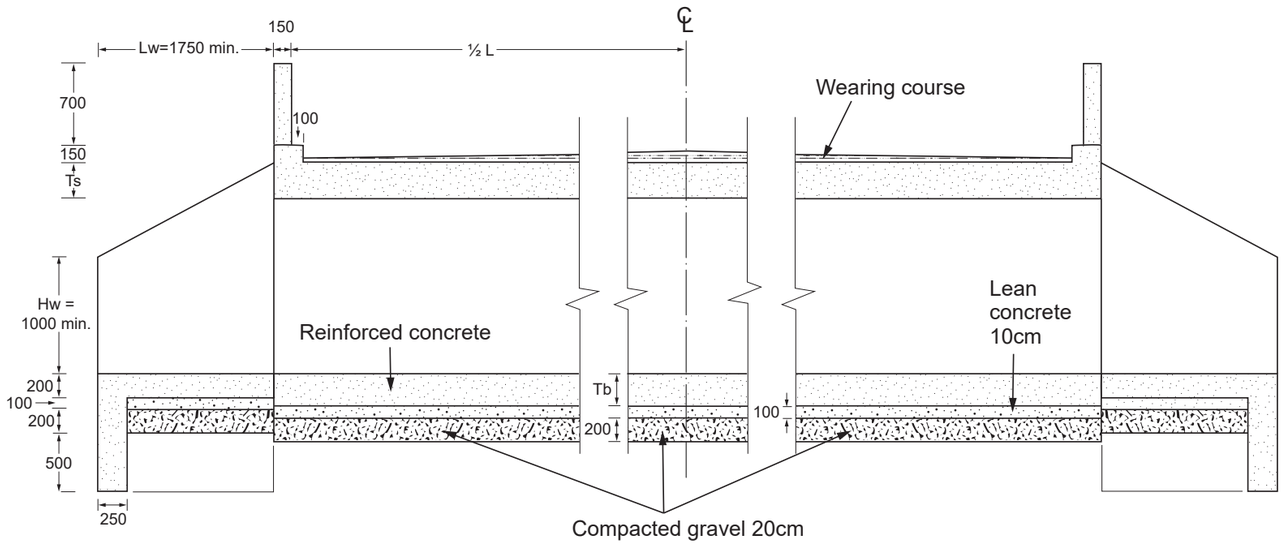
Standard Drawing BC 3: Double Box Culvert General Arrangement



Plan of multiple cell box culvert



Double, multiple cell box culvert elevation



Section E-E: Longitudinal section of box culvert

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NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Concrete cylinder strength in 28 days shall be; a) box and end structures: 21 MPa; b) Lean concrete: 10 MPa

3: Bed shall be stone and sand mix of ration 1:1 and lean concrete.

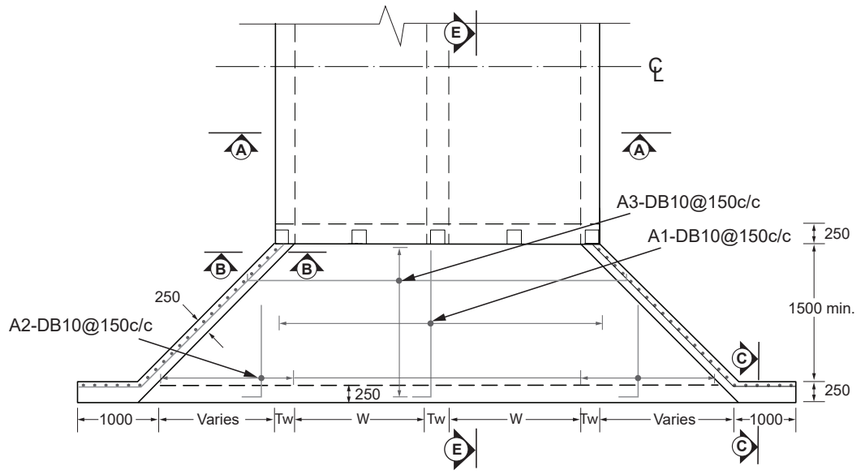
4: Crushed aggregate for concrete shall not be greater than 19mm.

5: The Engineer shall specify the length (L) of the culvert structure.

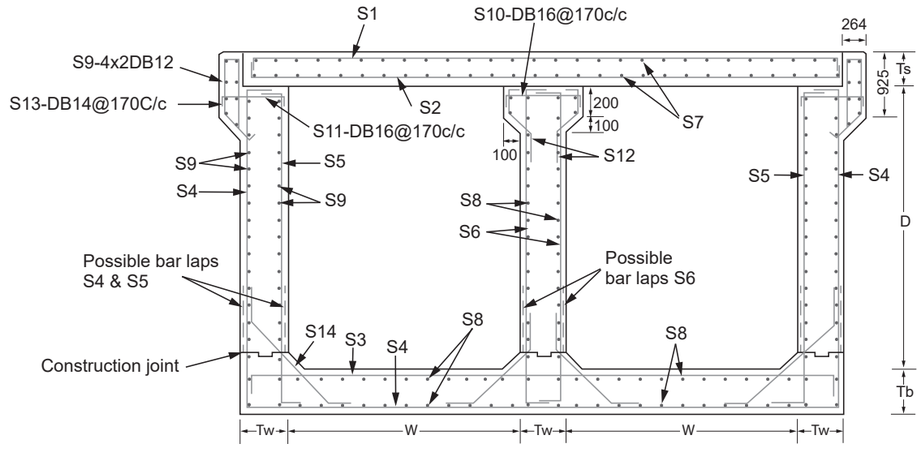
6: Provide 20mm x 20mm chamfer to all exposed concrete edges.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

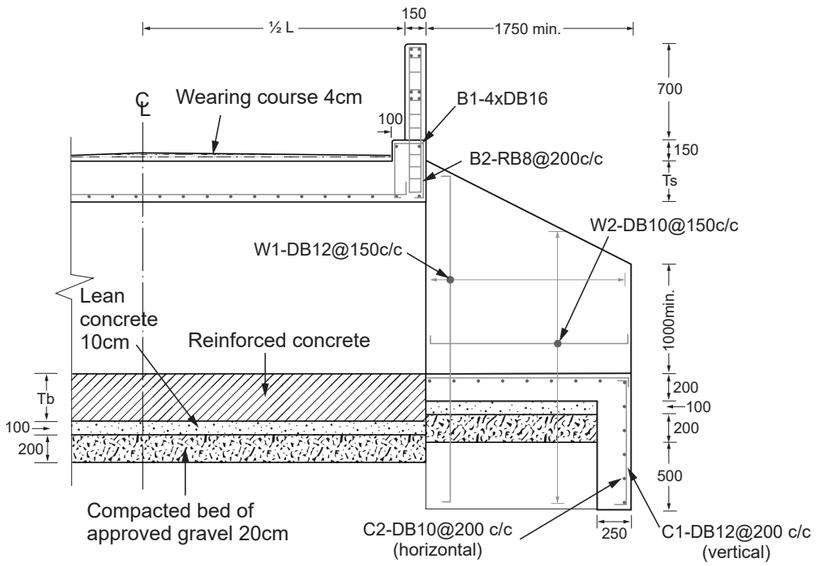
Standard Drawing BC 4: Double Box Culvert indicative Reinforcement



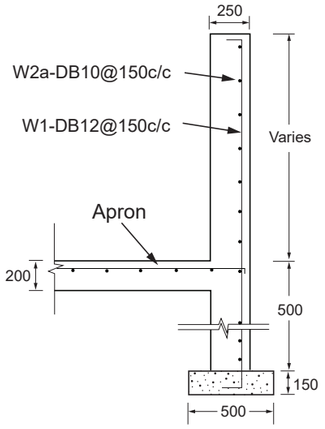
Plan of head/wing wall and apron & head/wing wall reinforcement detail



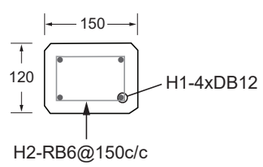
Section A-A: Reinforcement detail - double box culvert



Section E-E: Culvert head/wing wall and apron reinforcement detail



Section B-B



Details of handrail

Details of guard post

REPUBLIC OF GHANA

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LOW VOLUME ROADS
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Ghana Highways Authority
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Department of Urban Roads

NOTES

1: All dimensions are in millimeters unless otherwise specified.

2: Concrete cylinder strength in 28 days shall be; a) box and end structures: 21 MPa; b) Lean concrete: 10 MPa.

3: Bed shall be stone and sand mix of ration 1:1 and lean concrete.

4: Reinforcement shall be structural grade deformed bar (DB), with minimum yield strength 420 MPa or mild steel (RB) with minimum yield strength 250 MPa.

5: Minimum 40mm cover to reinforcement.

6: Minimum bar lap shall be 50xØ.

7: Crushed aggregate for concrete shall not be greater than 19mm.

8: The Engineer shall specify the length (L) of the culvert structure.

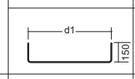
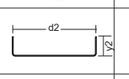
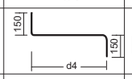
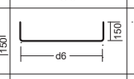
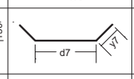
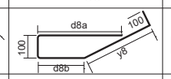
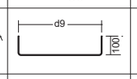
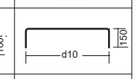
9: Height of fill Hf shall be dtetermined by the conditions on site.

10: Provide 20mm x 20mm chamfer to all exposed concrete edges.

DESCRIPTION
-
-
-
-

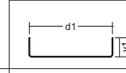
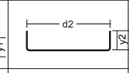
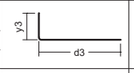
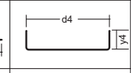
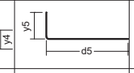
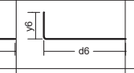
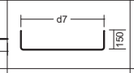
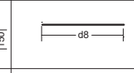
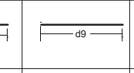
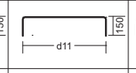
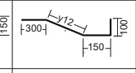
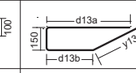
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING N°
	DATE:

Standard Drawing BC 5: Multiple Box Culvert Bending Schedules

W (mm)	D (mm)	Ts (mm)	Tb (mm)	Tw (mm)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
														
1500	1500	250	250	250	DB16@150	DB16@200	DB16@200	DB16@200	DB10@200	DB10@200	DB16@170	DB14@170	4x2DB12	DB16@170
	2500	250	250	250	DB16@150	DB16@200	DB16@200	DB16@200	DB10@200	DB10@200	DB16@170	DB14@170	4x2DB12	DB16@170
	3500	250	350	350	DB16@150	DB16@200	DB16@200	DB16@200	DB10@200	DB12@200	DB16@170	DB14@170	4x2DB12	DB16@170
2000	1500	300	250	250	DB16@125	DB16@175	DB16@175	DB16@175	DB10@200	DB10@200	DB16@170	DB14@170	4x2DB12	DB16@170
	2500	300	300	300	DB16@125	DB16@200	DB20@200	DB16@200	DB10@200	DB10@200	DB16@170	DB14@170	4x2DB12	DB16@170
	3500	300	400	400	DB16@125	DB16@200	DB25@200	DB16@200	DB10@200	DB12@200	DB16@170	DB14@170	4x2DB12	DB16@170
3000	1500	400	350	350	DB20@150	DB16@200	DB20@200	DB16@200	DB12@200	DB12@200	DB16@170	DB14@170	4x2DB12	DB16@170
	2500	400	400	400	DB20@150	DB16@200	DB20@200	DB16@200	DB12@200	DB12@200	DB16@170	DB14@170	4x2DB12	DB16@170
	3500	400	400	400	DB20@150	DB16@200	DB25@200	DB16@200	DB12@200	DB12@200	DB16@170	DB14@170	4x2DB12	DB16@170

NOTE 1. Values of d1, d2, ...dn and y1, y2, ...yn vary with design and shall be specified by the Engineer for each design. **2.** DB 16 @ 175 = Deformed Bar of Ø 16mm placed 175mm centre to centre. **3.** Conversion factor 1mm = 0.03937 inches

Reinforcement bar/steel details of single cell box culvert - mild steel - and maximum cover not exceeding 500mm

W (mm)	D (mm)	Ts (mm)	Tb (mm)	Tw (mm)	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
																	
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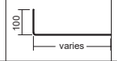
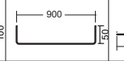
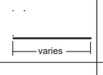
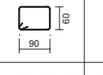
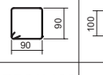
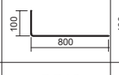
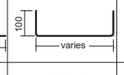
	2500	250	250	250	DB16@125	DB16@125	DB16@200	DB16@200	DB16@200	DB16@200	DB10@200	DB10@200	4x2DB12	DB16@170	DB16@170	DB14@170	DB14@170
	3500	250	350	350	DB16@125	DB16@125	DB16@200	DB16@200	DB20@200	DB16@200	DB10@200	DB12@200	4x2DB12	DB16@170	DB16@170	DB14@170	DB14@170
2000	1500	300	250	250	DB20@175	DB20@175	DB16@175	DB16@175	DB16@175	DB16@175	DB10@200	DB10@200	4x2DB12	DB16@170	DB16@170	DB14@170	DB14@170
	2500	300	300	300	DB20@175	DB20@175	DB20@200	DB16@200	DB16@200	DB16@200	DB10@200	DB10@200	4x2DB12	DB16@170	DB16@170	DB14@170	DB14@170
	3500	300	400	400	DB20@175	DB20@175	DB25@200	DB16@200	DB16@200	DB16@200	DB10@200	DB12@200	4x2DB12	DB16@170	DB16@170	DB14@170	DB14@170

NOTE 1. Values of d1, d2, ...dn and y1, y2, ...yn vary with design and shall be specified by the Engineer for each design. **2.** DB 16 @ 175 = Deformed Bar of Ø 16mm placed 175mm centre to centre **3.** Conversion factor 1mm = 0.03937 inches

Reinforcement bar/steel details of double cell box culvert - mild steel - and maximum cover not exceeding 500mm

Bar Mark	A1	A2	A3	C1	C2
Shape					
Reinforcement	DB10@150	DB10@150	DB10@150	DB12@200	DB10@200

Bar Mark	H1	H2	P1	P2	B1	B2
Shape						
Reinforcement	DB12	RB6@150	RB6@100	DB16	DB16	RB8@200

Reinforcement bar/steel details of wing wall

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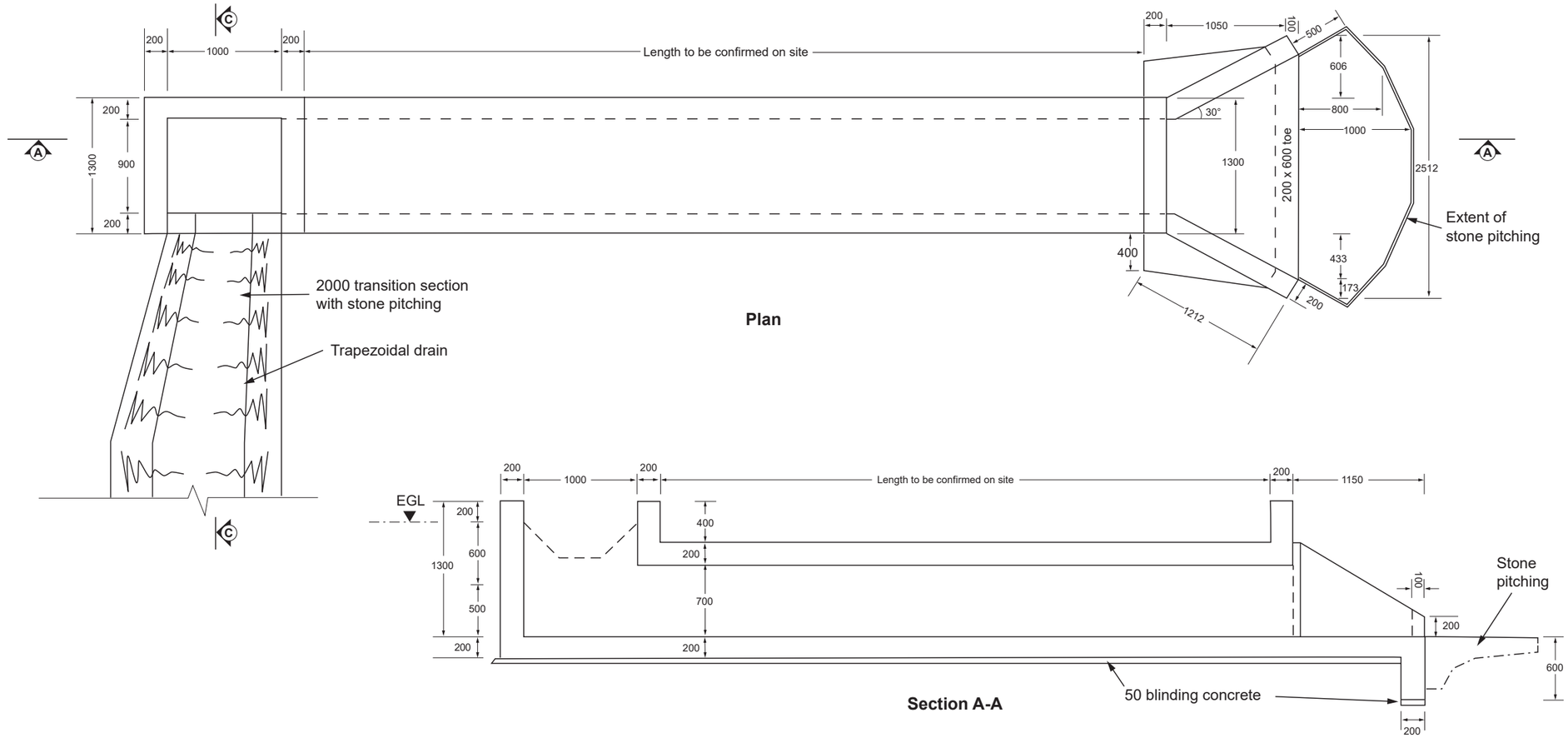
LOW VOLUME ROADS
for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

NOTES

DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

Standard Drawing MCRC 1: Mass Concrete Relief Culvert (700 mm x 900 mm diameter) General Layout



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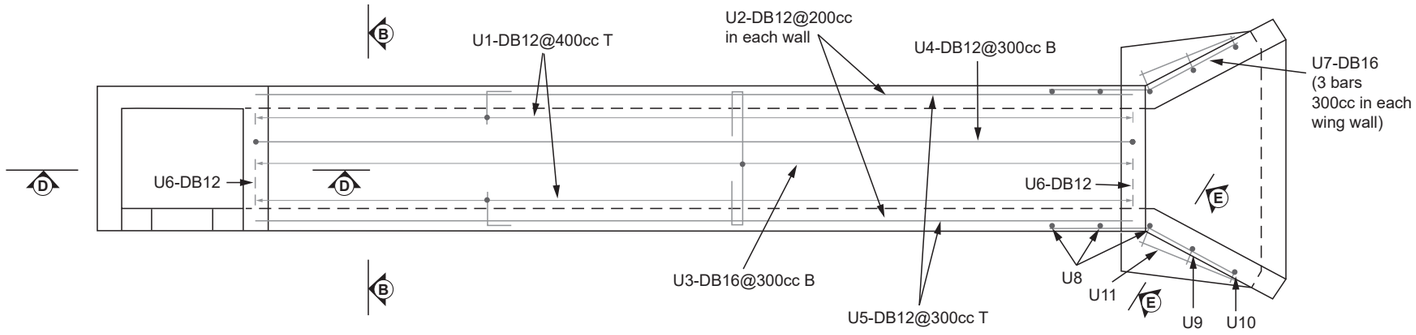
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

NOTES

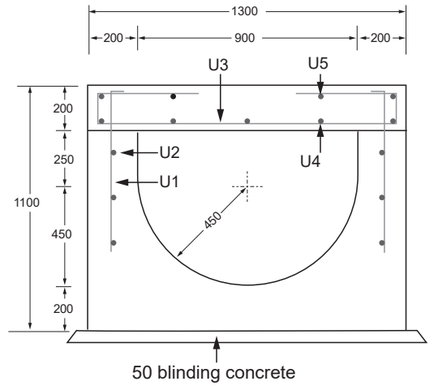
1. This drawing must be read in conjunction with all relevant structural drawings.
2. All dimensions are in mm unless otherwise stated.
3. Concrete class shall be 25/20.
4. Reinforcing bars shall be mild steel - minimum strength 250N/mm^2, unless otherwise stated.
4. Concrete cover to all reinforcement bars shall be 40mm minimum.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

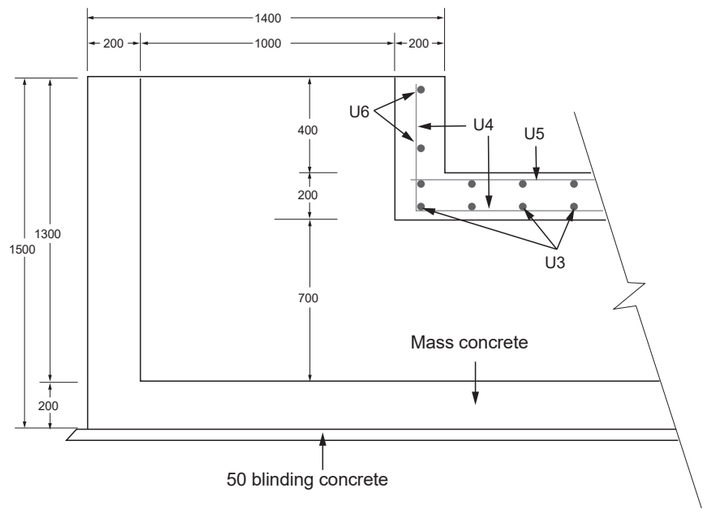
Standard Drawing MCRC 2: Mass Concrete Relief Culvert (700 mm x 900 mm) Reinforcement Layout



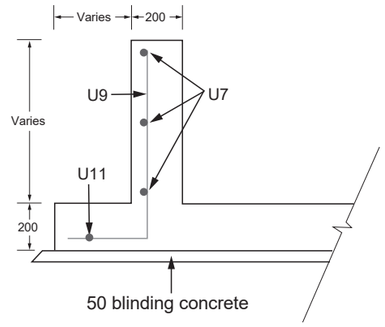
Plan - Deck slab details



Section B-B through deck



Section D-D through catchpit



Section E-E through wing wall

Location	Bar Code	Bar type	Ø (mm)	Shape
Culvert Wall	U1	DB [deformed Bar or Ribbed]	12	300 / 700
Culvert Wall	U2	DB [deformed Bar or Ribbed]	12	straight / varies
Deck Slab	U3	DB [deformed Bar or Ribbed]	16	100 / 400 / 400 / 1200
Deck Slab	U4	DB [deformed Bar or Ribbed]	12	500 / varies
Deck Slab	U5	DB [deformed Bar or Ribbed]	12	straight / varies
Parapet	U6	DB [deformed Bar or Ribbed]	12	straight / 1200
Wing Wall / Culvert Wall	U7	DB [deformed Bar or Ribbed]	16	800 / 800 / 555
Wing Wall / Culvert Wall	U8	DB [deformed Bar or Ribbed]	12	300 / 1000
Wing Wall	U9	DB [deformed Bar or Ribbed]	12	300 / 775
Wing Wall	U10	DB [deformed Bar or Ribbed]	12	200 / 550
Wing Wall	U11	DB [deformed Bar or Ribbed]	12	1000

Bending schedule

REPUBLIC OF GHANA

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for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

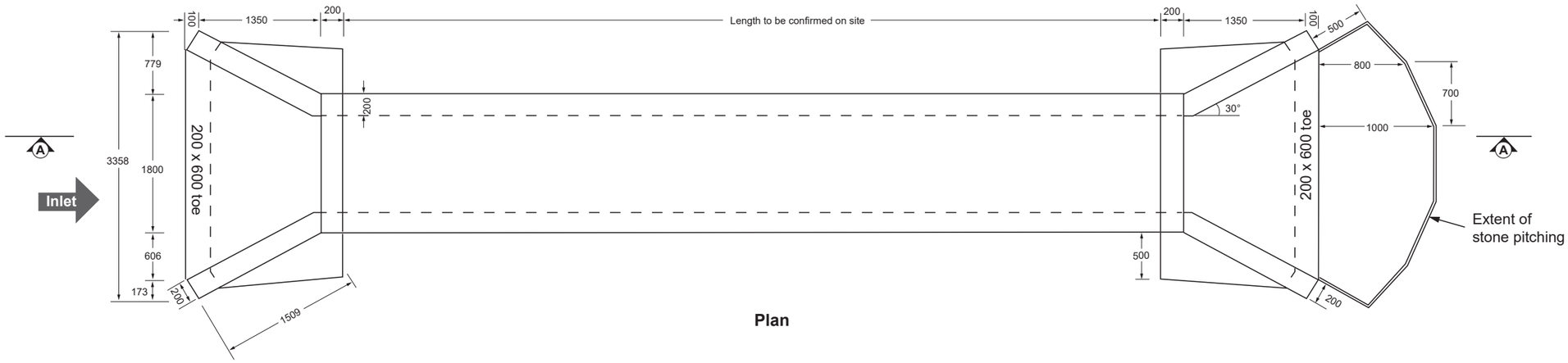
NOTES

1. All dimensions are in millimeters unless otherwise specified.
2. All angles are in degrees (360°).
3. Structural concrete 28 day crushing strength = 25 MPa.
4. Reinforcement shall be structural grade deformed bar (DB), with minimum yield strength 420 MPa or mild steel (RB) with minimum yield strength 250 MPa.
5. Minimum depth of cover to reinforcement = 40mm.
6. This 700 x 900mm Ø U culvert is the hydraulic equivalent of a 1000 x 600mm deep rectangular aperture.
7. Conversion factor 1mm = 0.0394 Inches.
8. Provide 20mm x 20mm chamfer to all exposed concrete corners.

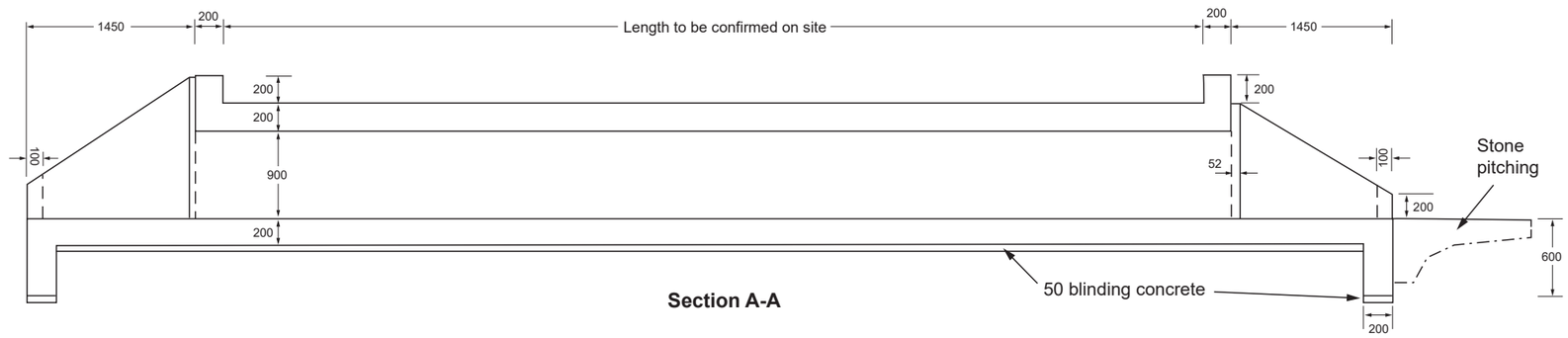
DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

Standard Drawing MCRC 3: Mass Concrete Relief Culvert (900 mm x 1200 mm diameter) General Layout



Plan



Section A-A

REPUBLIC OF GHANA

MINISTRY OF ROADS AND HIGHWAYS

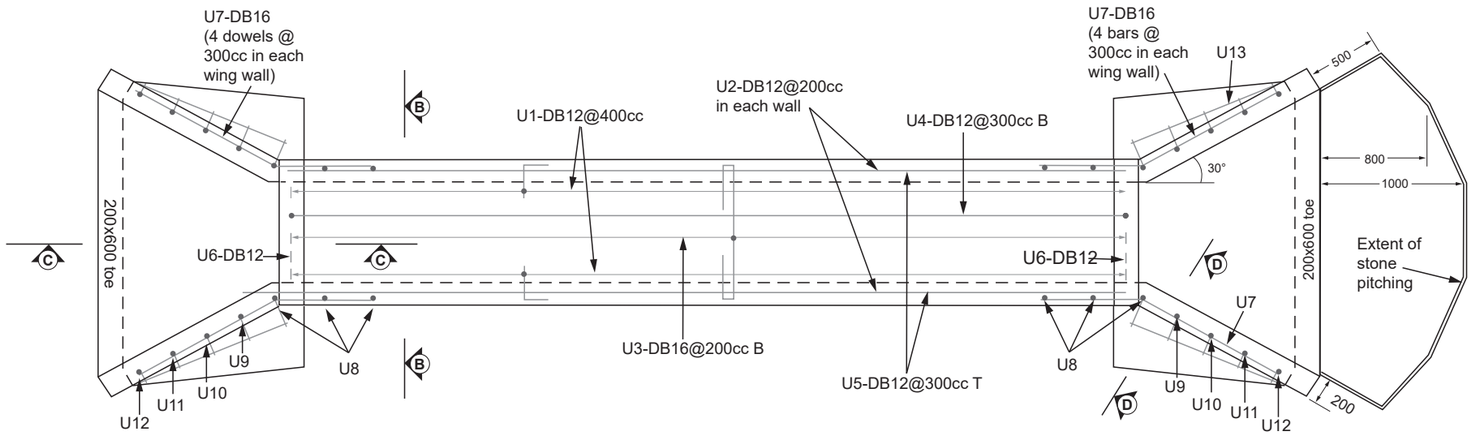
LOW VOLUME ROADS
for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

NOTES

DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

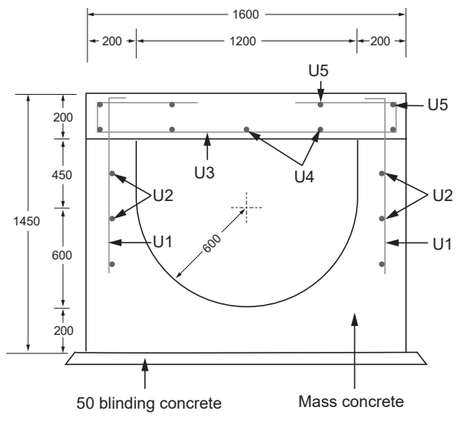
Standard Drawing MCRC 4: Mass Concrete Relief Culvert (900 mm x 1200 mm diameter) Reinforcement Layout



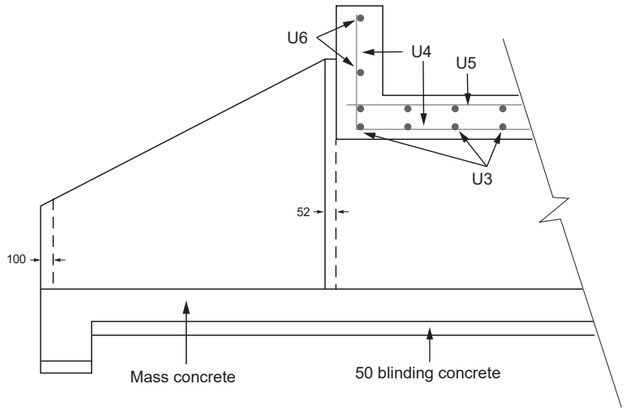
Plan - Deck slab details

Location	Bar Code	Ø (mm)	Shape
Culvert Wall	U1	12	300, 700
Culvert Wall	U2	12	straight, varies
Deck Slab	U3	16	100, 400, 400, 1500
Deck Slab	U4	12	400, varies
Deck Slab	U5	12	straight, varies
Parapet	U6	12	straight, 1500
Wing Wall / Culvert Wall	U7	16	1200, 800, 1555
Wing Wall / Culvert Wall	U8	12	400, 1200
Wing Wall	U9	12	400, 1035
Wing Wall	U10	12	300, 875
Wing Wall	U11	12	300, 700
Wing Wall	U12	12	200, 535
Wing Wall	U13	12	1300

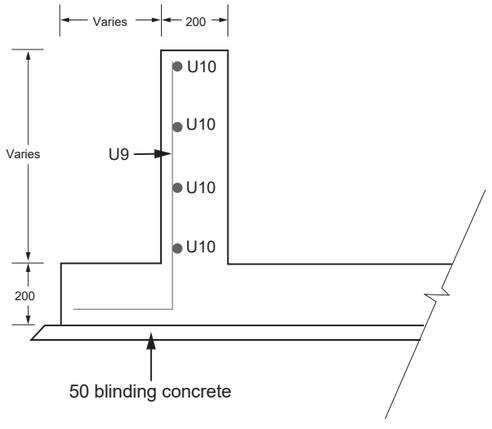
Bending schedule



Section B-B through deck



Section C-C through parapet



Section D-D through wing wall

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Department of Feeder Roads
Department of Urban Roads

NOTES

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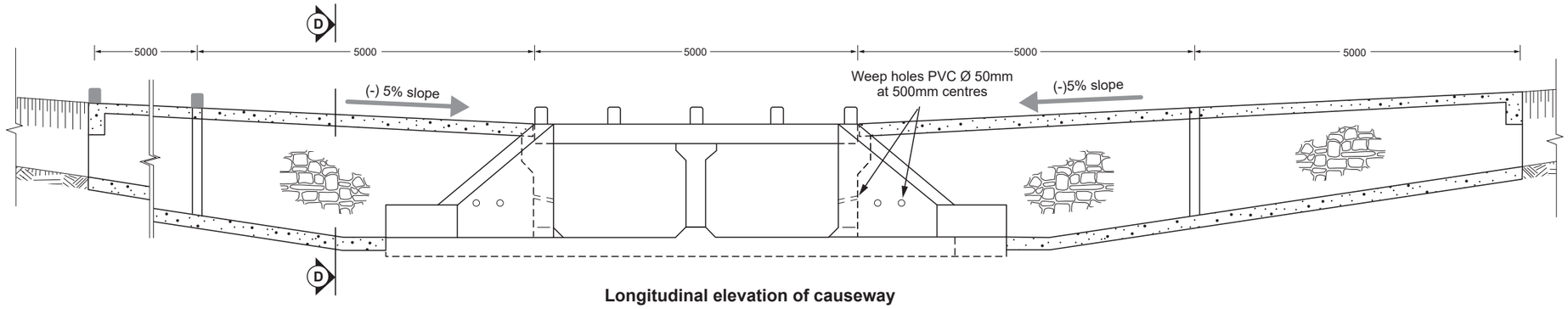
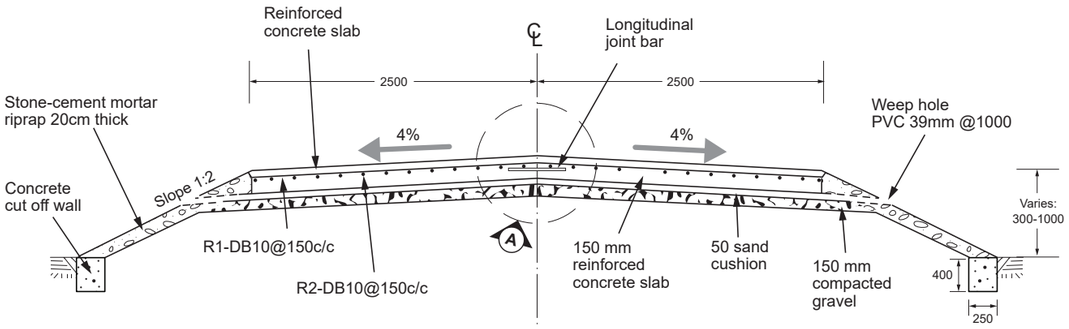
2. All angles are in degrees (360°).
3. Structural concrete 28 day crushing strength = 25 MPa.
4. Reinforcement shall be structural grade deformed bar (DB), with minimum yield strength 420 MPa or mild steel (RB) with minimum yield strength 250 MPa.
5. Minimum depth of cover to reinforcement = 40mm.
6. This 700 x 900mm Ø U culvert is the hydraulic equivalent of a 1000 x 600mm deep rectangular aperture.
7. Conversion factor 1mm = 0.0394 Inches.
8. Provide 20mm x 20mm chamfer to all exposed concrete edges.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

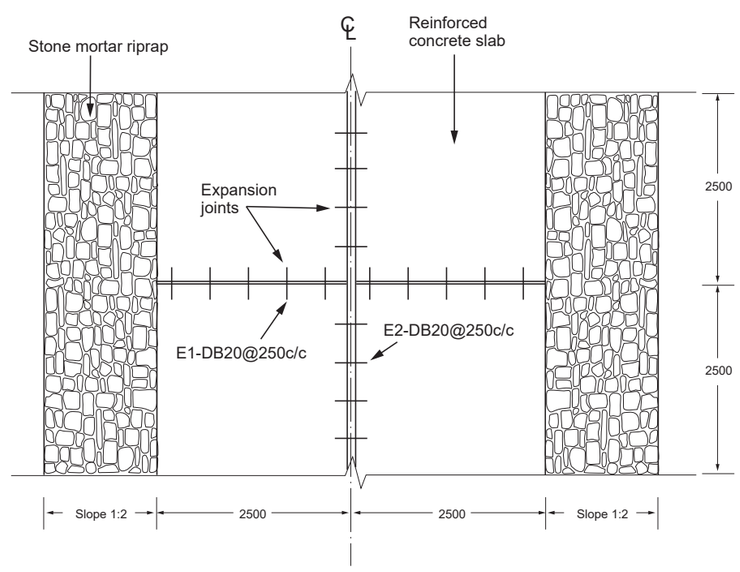
Standard Drawing VF 1: Vented Ford General Arrangement



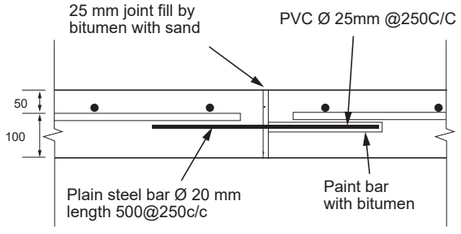
Longitudinal elevation of causeway



Section D-D



Plan of concrete slab



Detail A: expansion joints

REPUBLIC OF GHANA

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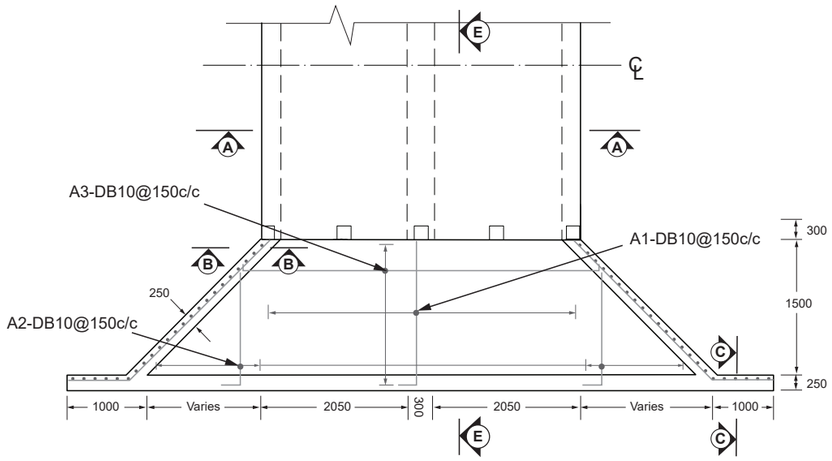
Department of Urban Roads

NOTES

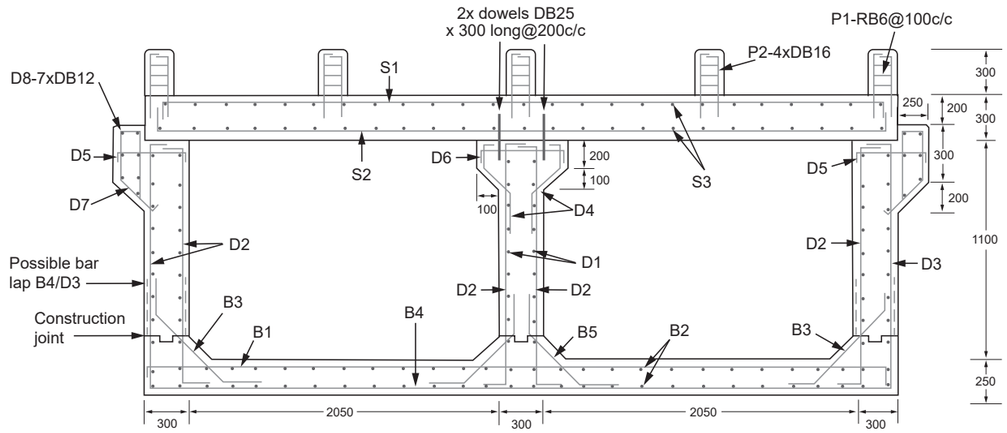
1. All dimensions are in millimeters unless otherwise specified.
2. Conversion factor. 1mm - 0.03937 Inches.
3. Concrete characteristic strength at 28 days shall be: a) box and end structures: 25 MPa; b) Lean concrete: 10 MPa
4. Stone and sand mix bed of ratio 1:1 shall be placed under lean concrete.
5. Reinforcement shall be structural grade deformed bar (DB), with minimum yield strength 420 MPa.
6. Minimum 40mm cover to reinforcement.
7. Minimum bar lap shall be 50xØ of bar.
8. Crushed aggregate for concrete shall not be greater than 19mm.
9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

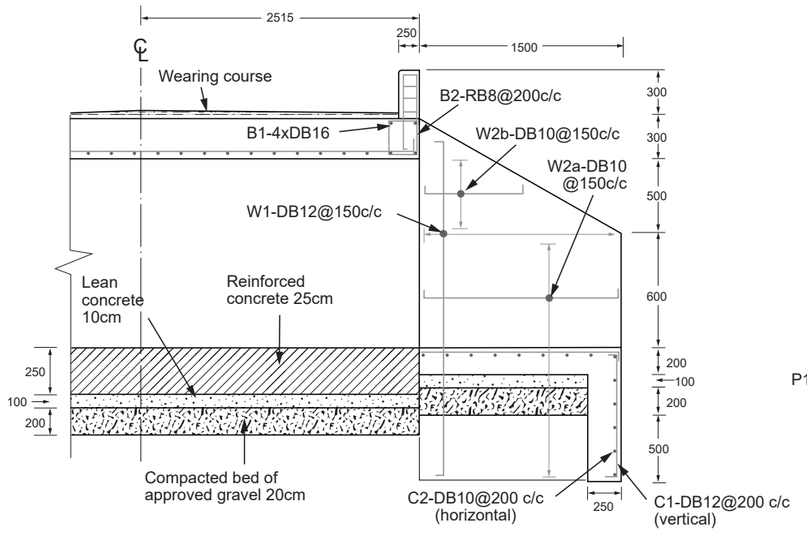
Standard Drawing VF 2: Vented Ford Reinforcement Layout



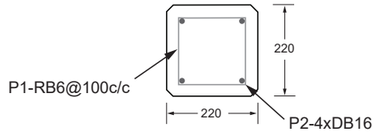
Plan of head/wing wall and apron & head/wing wall reinforcement detail



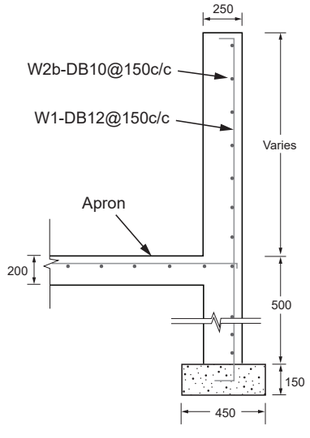
Section A-A: Reinforcement details



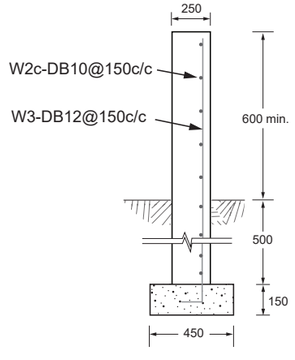
Section E-E: Culvert head/wing wall and apron reinforcement detail



Details of guard post



Section B-B



Section C-C

REPUBLIC OF GHANA

MINISTRY OF ROADS AND HIGHWAYS

LOW VOLUME ROADS
for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

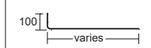
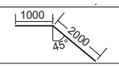
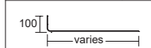
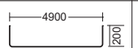
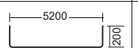
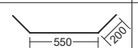
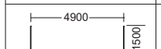
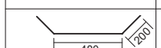
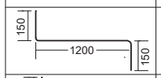
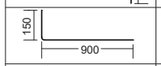
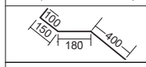
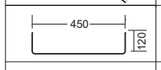
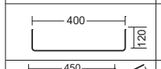
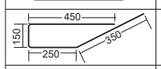
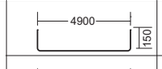
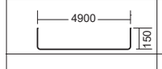
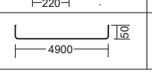
NOTES

1. All dimensions are in millimeters unless otherwise specified.
2. Conversion factor. 1mm - 0.03937 Inches.
3. Concrete characteristic strength after 28 days shall be: a) box and end structures: 25 MPa; b) Lean concrete: 10 MPa.
4. Stone and sand mix bed of ratio 1:1 shall be placed under lean concrete.
5. Reinforcement shall be structural grade deformed bar (DB), with minimum yield strength 420 MPa.
6. Minimum 40mm cover to reinforcement.
7. Minimum bar lap shall be 50xØ of bar.
8. Crushed aggregate for concrete shall not be greater than 19mm.
9. Provide 20mm x 20mm chamfer to all exposed concrete edges.

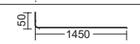
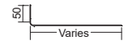
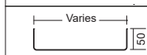
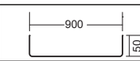
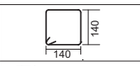
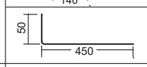
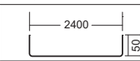
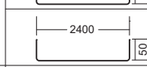
DESCRIPTION	
DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE:

Standard Drawing VF 3: Vented Ford indicative Bending Schedules

Bars bending schedule for causeway

Component	Bar shape	Barmark	Ø (mm)	Spacing CC (mm)	Length of each bar (m)
Wingwalls		W1	DB 12	150	Varies
		W2a	DB 10	150	1.6
		W2b	DB 10	150	Varies
		W2c	DB 10	150	3.0
		W3	DB 12	150	Varies
Bottom slab		B1	DB 16	170	5.3
		B2	DB 16	170	5.6
		B3	DB 16	170	0.95
		B4	DB 20	170	5.3
		B5	DB 16	170	0.88
Abutment walls & middle wall		D1	DB 10	200	5.2
		D2	DB 16	170	1.5
		D3	DB 16	170	1.05
		D4	DB 14	170	0.82
		D5	DB 14	170	0.59
		D6	DB 14	170	0.64
		D7	DB 14	170	1.2
		D8	DB 14		5.2
Slab		S1	DB 20	170	5.2
		S2	DB 20	170	5.2
		S3	DB 12	200	5.0
Edge beam		B1	RB8	200	0.6
		B2	DB 16		5.0

Note: DB 12-Deformed Bar, Dia 12mm, RB 10-Round Bar, Dia 10mm

Component	Bar shape	Barmark	Ø (mm)	Spacing CC (mm)	Length of each bar (m)
Aprons		A1	DB 10	150	1.5
		A2	DB 10	150	Varies
		A3	DB 10	150	Varies
Cut off walls		C1	DB 12	200	1.0
		C2	DB 10		7.3
Post guard		P1	RB6	100	0.6
		P2	DB 16		0.55
Rcc slab aproach		R1	DB 10	150	2.5
		R2	DB 10	150	2.5
Extension joint		E1	DB 20	250	0.5
		E2	DB 20	250	0.5

Note: DB 12-Deformed Bar, Dia 12mm, RB 10-Round Bar, Dia 10mm

REPUBLIC OF GHANA

MINISTRY OF ROADS AND HIGHWAYS

LOW VOLUME ROADS
for
Ghana Highways Authority
Department of Feeder Roads
Department of Urban Roads

NOTES

DESCRIPTION

DESIGNED	CHECKED
REFERENCE	APPROVED
SCALE: Not To Scale	DRAWING Nº
	DATE: