

Box and slab culvert - Drawing number 2.4

Applicability of the design

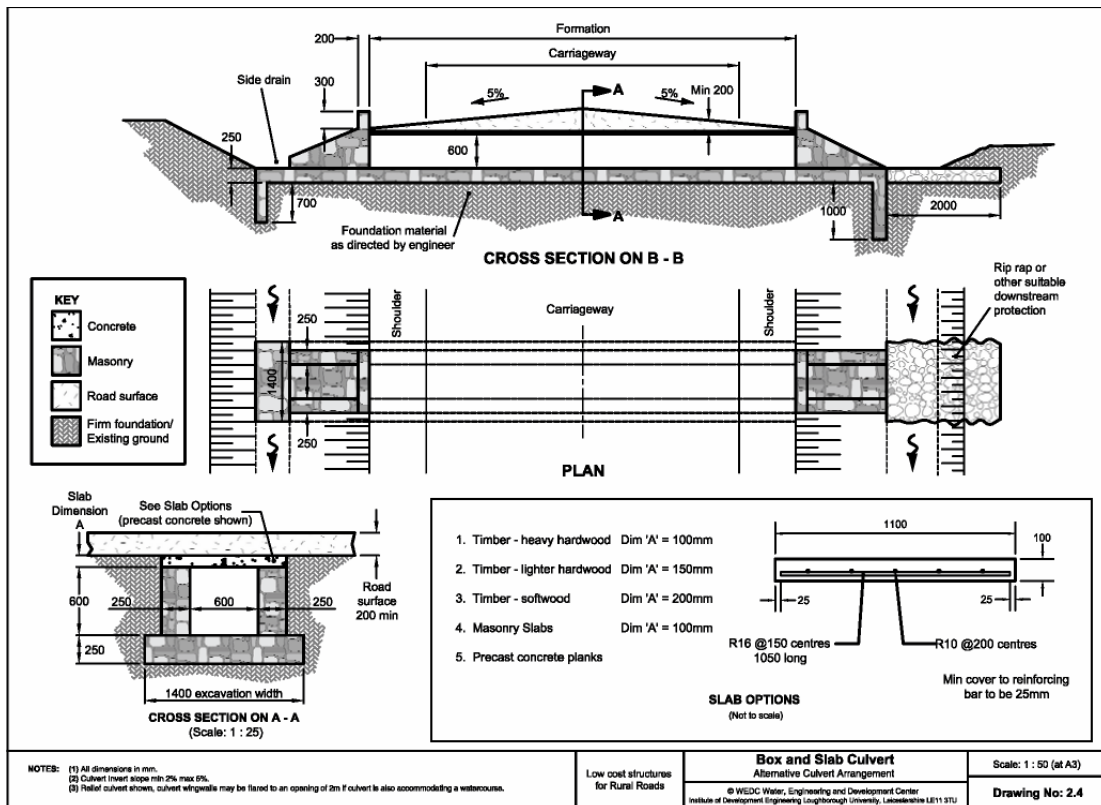
- Alternative design to single pipe culvert which does not require precast pipes
- Twin box culverts may be constructed for larger volume flows

Notes about the Drawing and Bill of Quantities

1. Culvert top slab may be constructed from any of the materials shown in the table (concrete slab shown on the drawing).

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3a. Timber for slab	m			
3b. Masonry slab (1100mm wide)	m			
3c. Precast RC for slab (1100mm wide)	m			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Masonry cut off wall and culvert base slab				
Excavation of watercourse	m ³			
Mix, place and compact blinding concrete	m ³			
Construct masonry walls and slab	m ³			
2. Masonry culvert walls, wingwalls and guide stones				
Construct masonry walls	m ³			
3. Culvert slab				
Place slab (timber / masonry / rc concrete)	m ²			
4. Rip rap protection				
Collect stones	m ³			
Place stones in riverbed	m ³			
5. Sundries				
Backfill and compact fill around culvert in 300mm layers	m ³			

	Total no. man days			
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary		Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				



Masonry arch culvert – Drawing number 2.5

Applicability of the design

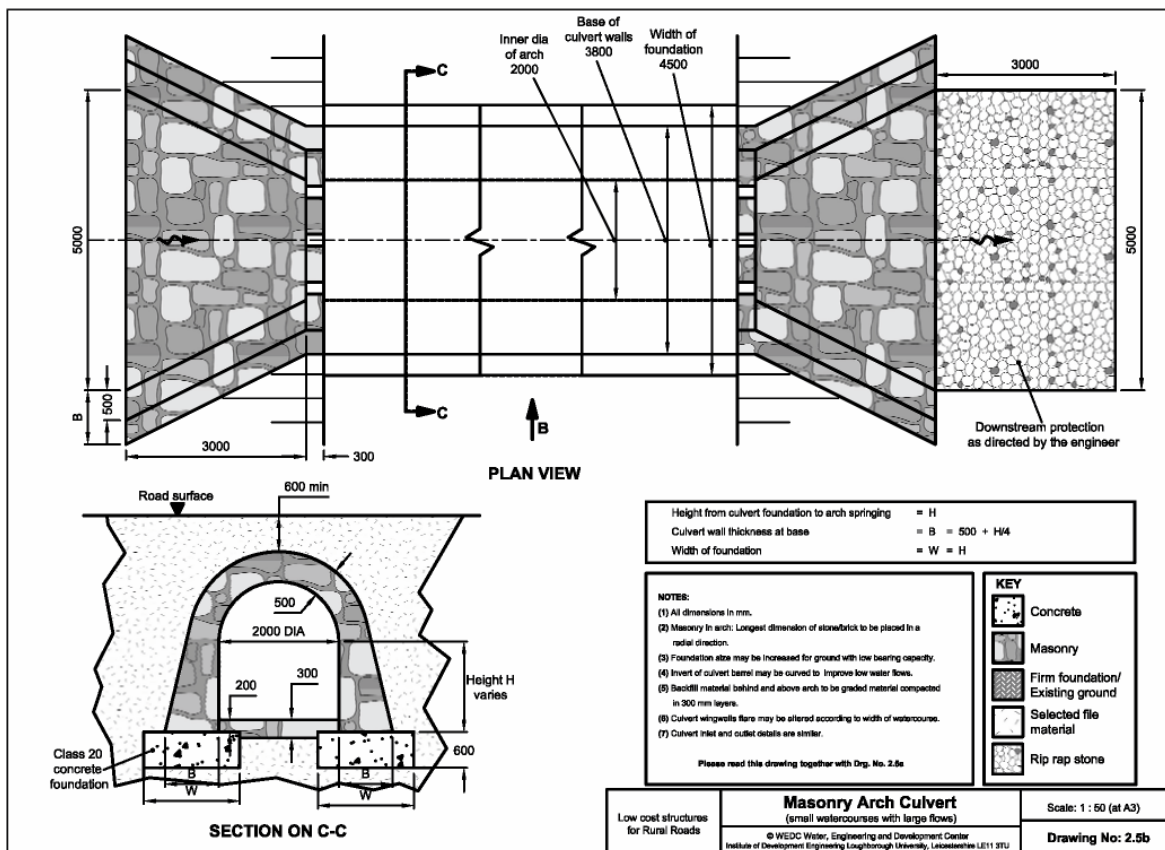
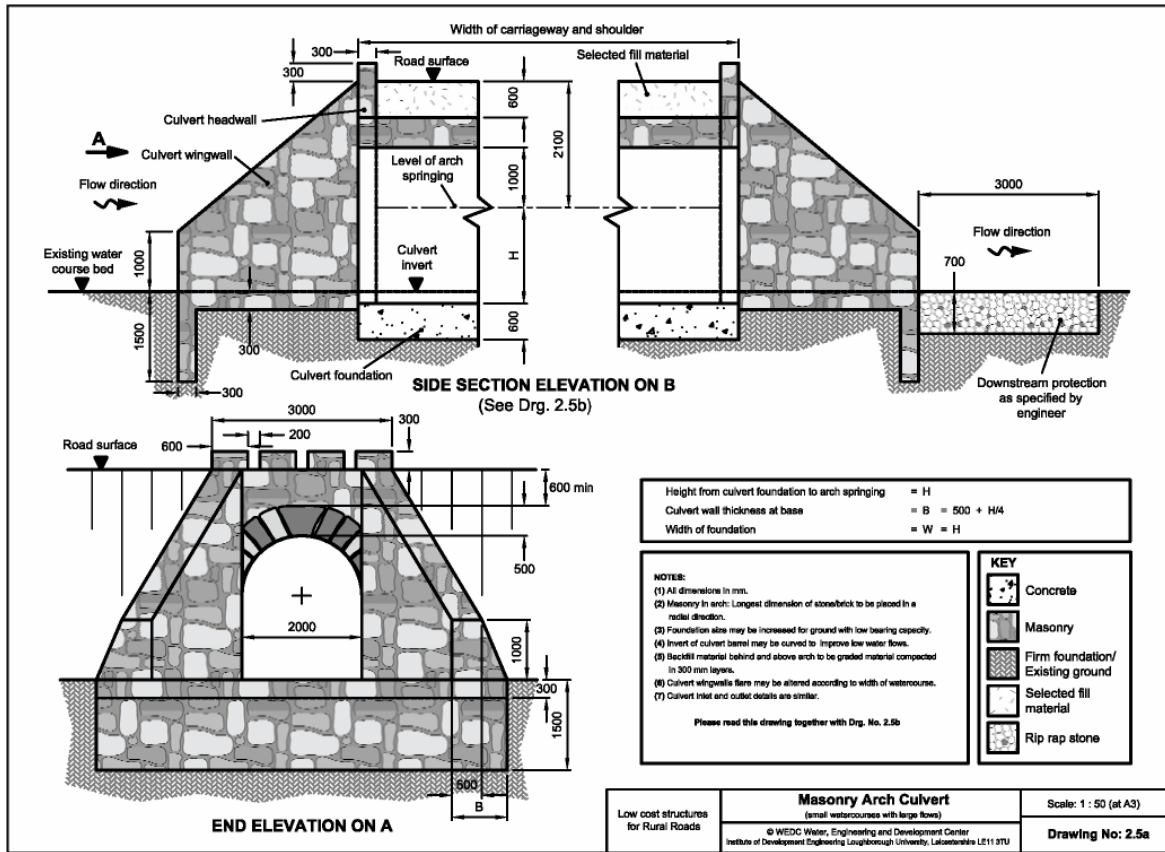
- Large size culvert for high volume flows
- Suitable for use on narrow (up to 2m wide) well defined watercourses where the road level is at least 2m above the bed level of the watercourse

Notes about the Drawing and Bill of Quantities

1. Drawing shows arch constructed from masonry. Corrugated steel sheets may be used (refer to Volume 1).

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Class 20 Concrete for foundation				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
3. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
4. Timber (for formwork)	lump sum			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Foundations				
Excavation of watercourse/ road	m ³			
Mix, place and compact class 20 concrete foundations	m ³			
2. Masonry arch				
Erect arch temporary formwork	m ²			
Construct masonry wall and arch of culvert	No.			
Remove temporary formwork	m ³			
3. Culvert headwalls, wingwalls, aprons and cut off walls				
Construct cut off walls and aprons	m ³			
Construct wingwalls and headwalls	m ³			

4. Culvert invert				
Construct masonry invert slab	m ³			
5. Rip rap downstream protection				
Excavate riverbed	m ³			
Collect stones	m ³			
Place stones in riverbed	m ³			
6. Sundries				
Backfill and compact fill each side of culvert in 300mm layers	m ³			
Collect suitable sand and gravel	m ³			
Place and compact sand and gravel above culvert arch	m ³			
		Total no. man days		
	Labour cost per day		Total labour cost	
	Other Costs	Unit	Quantity	Rate
				Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment	lump sum			
3. Temporary arch formwork (purchase, depreciation, hire costs)	lump sum			
4. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
			Total Other Costs	
	Cost Summary	Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
	Total construction cost			



Vented ford - Drawing number 3.1

Applicability of the design

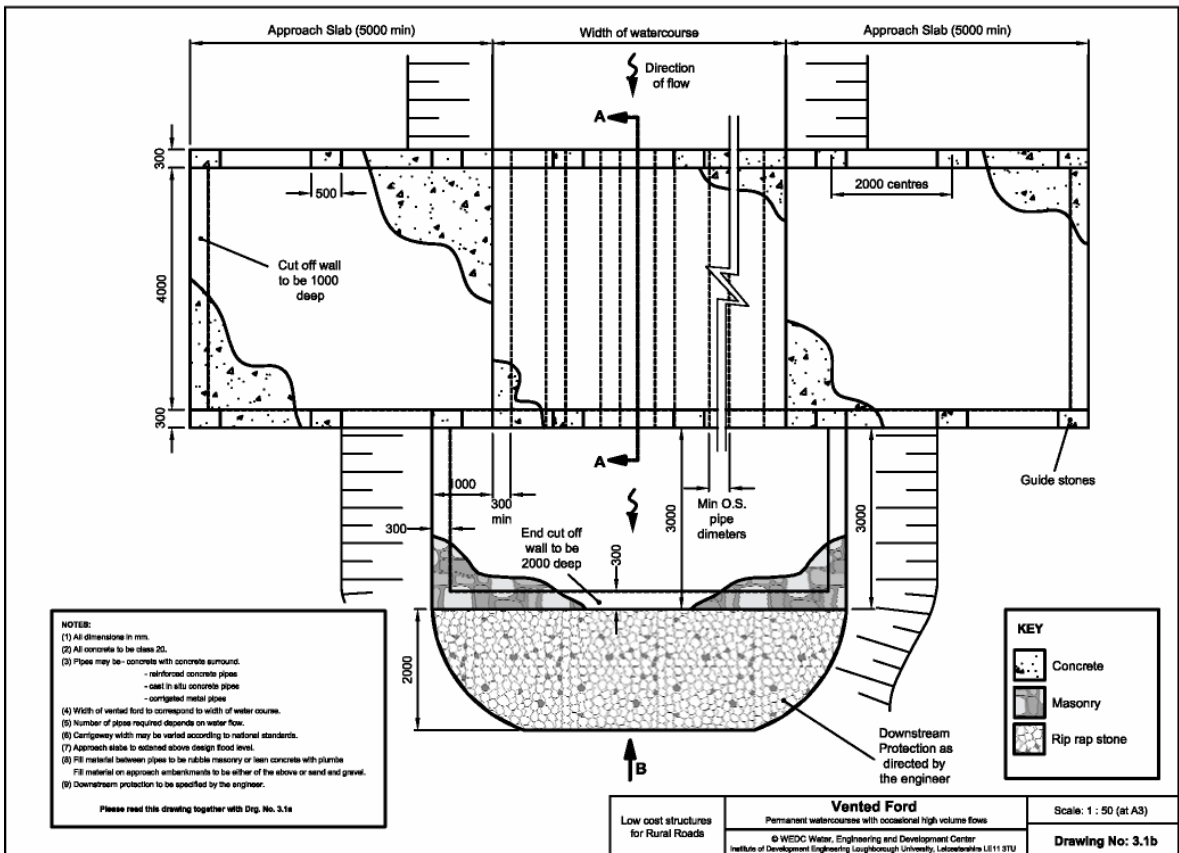
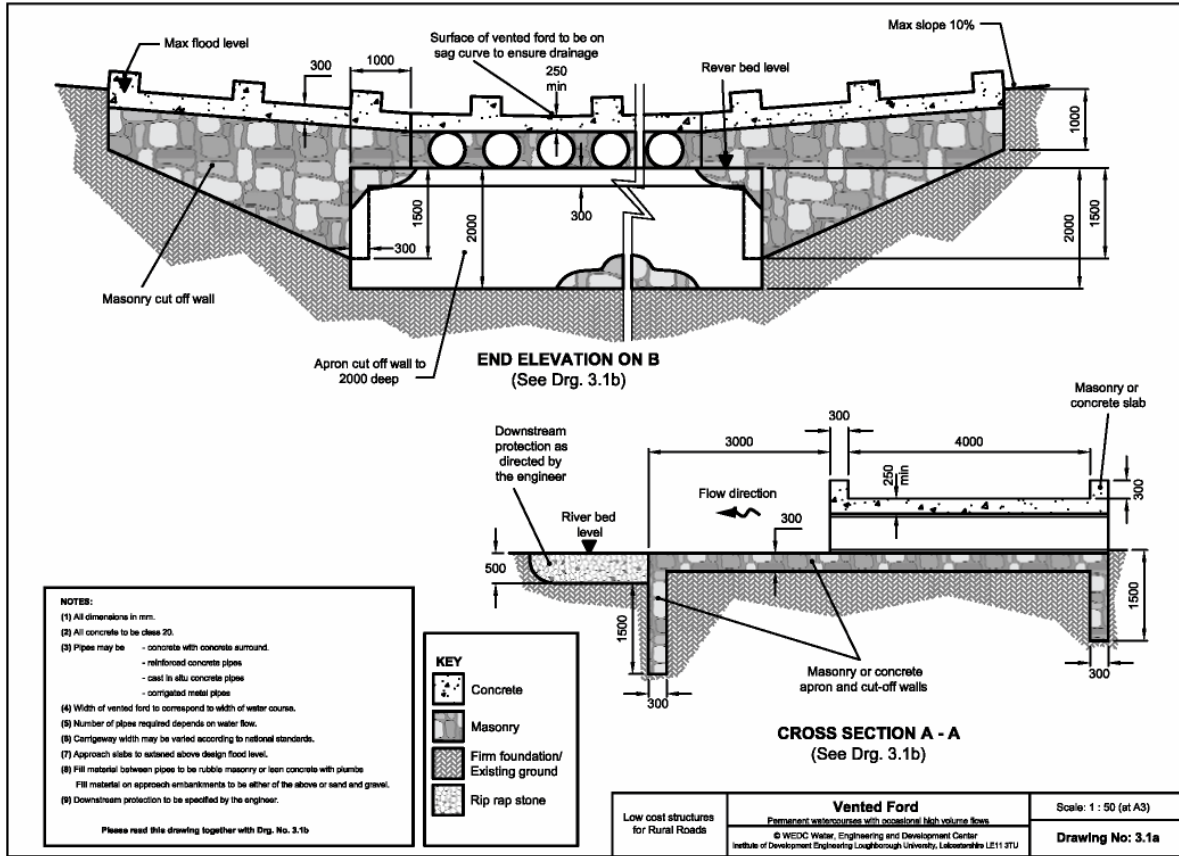
- For use in watercourses with permanent water flow and occasional high volume flows
- Any width of watercourse catered for by adjusting the number of pipes

Notes about the Drawing and Bill of Quantities

1. Road level on the drawing is shown approximately 300mm above the top of vent pipes. The road level may be raised by increasing the height of vented drift sides and fill over pipes if dictated by specific site conditions.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding and fill between culvert pipes				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3. Pipes				
Selected pipe material	m			
4. Class 20 concrete for road surface				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
5. Timber for concrete formwork	m ²			
6. Vented drift warning signs	No.			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Construction of cut off walls and apron				
Excavation of watercourse/ road	m ³			
Mix, place and compact blinding concrete	m ³			
Construct masonry cut off walls and apron	m ³			
2. Placing of the pipes				
Mix, place and compact lean culvert bedding and haunch	m ³			
Fix culvert pipes in place	m			
Mix, place and compact lean concrete fill between pipes	m ³			

3. Approach ramps fill				
Collect suitable sand and gravel	m ³			
Place and compact sand and gravel	m ³			
4. Concrete road slab				
Erect temporary formwork	m ²			
Mix, place and compact class 20 concrete	m ³			
Remove temporary formwork	m ³			
5. Downstream protection				
Excavate riverbed	m ³			
Collect stones	m ³			
Place stones in river bed	m ³			
6. Sundries				
Backfill and compact fill around cut off walls and apron in 300mm layers	m ³			
Erect vented drift warning signs	No.			
		Total no. man days		
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment				
2. Hand-tools and equipment	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary		Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				



Large bore culvert - Drawing number 4.1

Applicability of the design

- For use on large watercourses with high volume flows

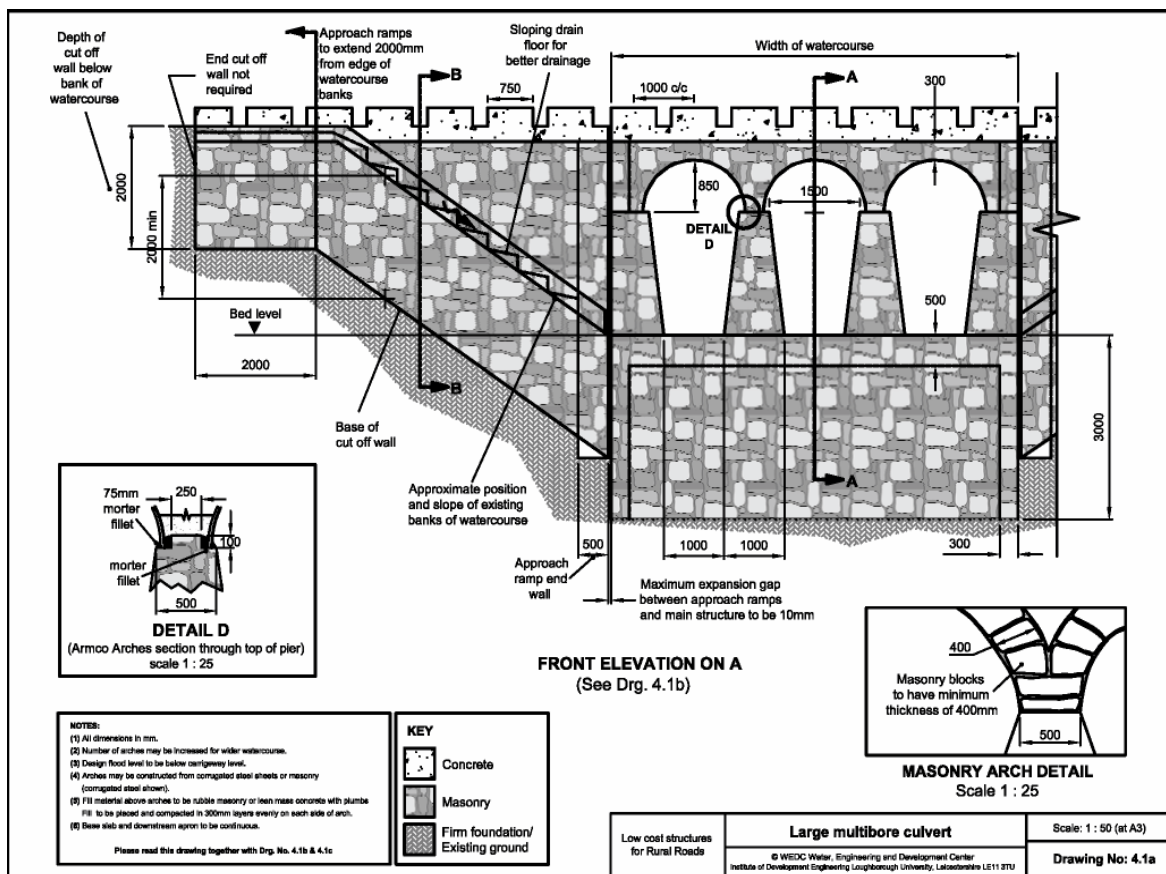
Notes about the Drawing and Bill of Quantities

1. Drawing shows 3 arches. The number of arches should be varied to correspond to the width of the watercourse.
2. The drawing shows corrugated steel sheets used to form arches. Masonry arches may be constructed using formwork; general arrangement detail is shown in an insert on the drawing.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry (approach ramps)				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3. Stone masonry (main structure)				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
4. Corrugated steel sheets for arches	m ²			
5. Lean concrete fill above arches				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
6. Timber for road surface formwork	m ²			
7. Class 20 concrete for road surface				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Construction of apron and cut off walls				
Excavation of watercourse and banks	m ³			

Mix, place and compact blinding concrete	m ³			
Construct masonry apron and cut off walls	m ³			
2. Construction of approach ramp walls				
Excavation of watercourse banks	m ³			
Mix, place and compact blinding concrete	m ³			
Construct approach ramp side and end walls	m ³			
3. Construction of arches				
Construct masonry piers	m ³			
Assemble and fix corrugated steel arch sheets	m ²			
Construct masonry spandrel walls and end walls	m ³			
4. Fill material in structure				
Mix, place and compact lean concrete above arches	m ³			
Collect suitable sand and gravel	m ³			
Place and compact sand and gravel between approach ramp walls	m ³			
4. Concrete road slab				
Erect temporary formwork	m ²			
Mix, place and compact class 20 concrete on approach ramps and main structure	m ³			
Remove temporary formwork	m ³			
5. Downstream protection				
Excavate riverbed	m ³			
Collect stones	m ³			
Place stones in river bed	m ³			
6. Sundries				
Backfill and compact fill around cut off walls and apron in 300mm layers	m ³			
Mix, place and compact gravel blinding layer on each side or approach ramp walls	m ³			
Construct masonry side drains	m ³			
		Total no. man days		
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport	km			
Delivery of materials	km			
Supervision vehicle	lump sum			
2. Hand-tools and equipment				
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		

Cost Summary	Cost		
Preliminaries			
Materials			
Labour			
Other Costs			
Total construction cost			



Gabion abutment - Drawing number 5.1

Applicability of the design

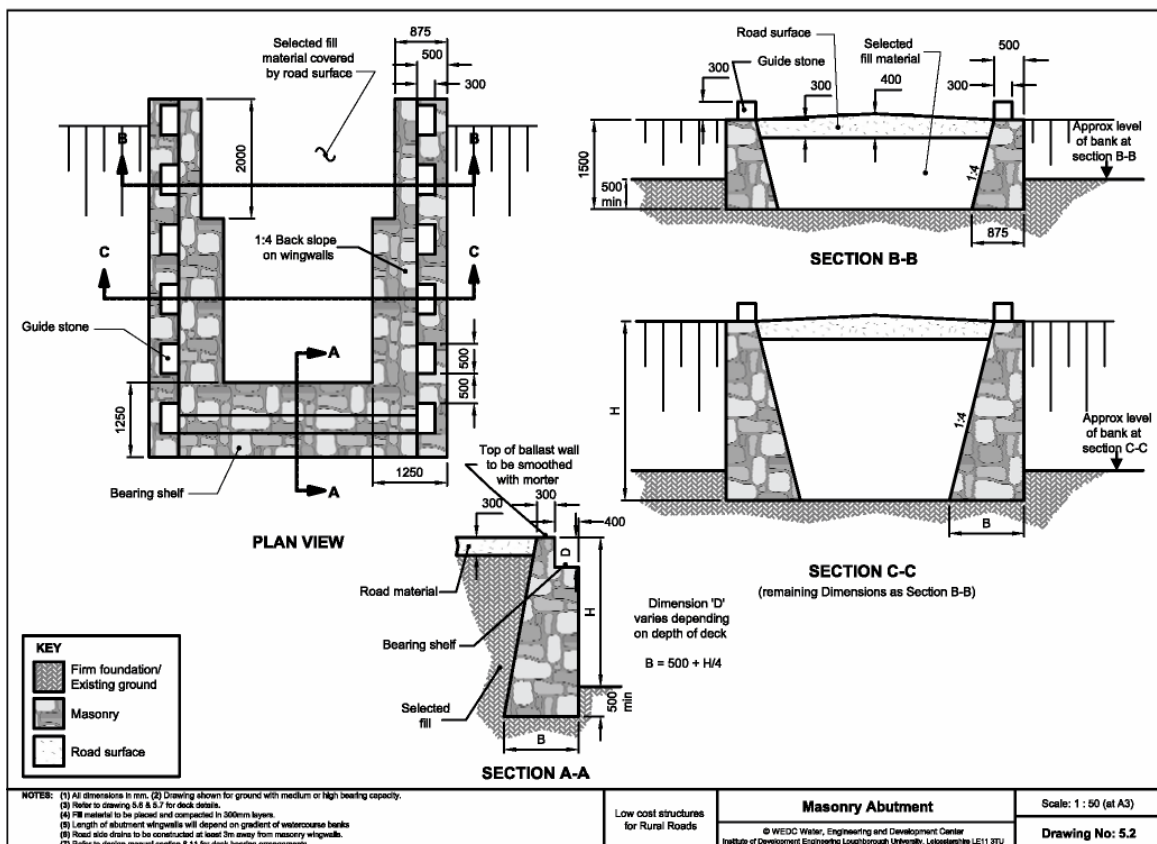
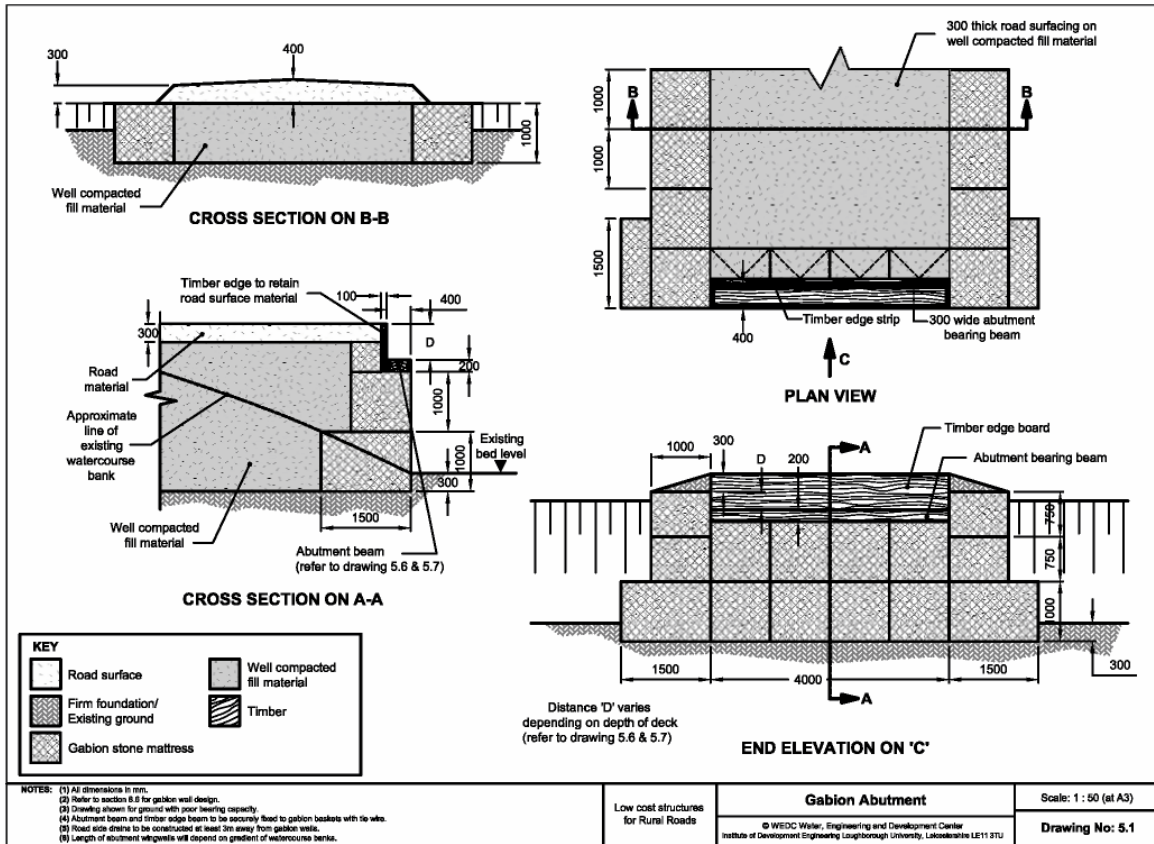
- Suitable for use as a low level abutment with timber deck

Notes about the Drawing and Bill of Quantities

1. Suitable for use as a high or low level abutment.
2. Dimensions of specific gabion baskets should be determined according to the site.
3. Following construction, gabion baskets can be covered in soil and grass planted to prevent theft of basket wire.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Wire mesh for gabion baskets	m ²			
2. Tie wire for gabion baskets	m			
3. Timber for bearing shelf	m ³			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Site Preparation				
Excavation banks and bed of watercourse	m ³			
2. Gabion walls				
Assemble place and join gabion baskets in position	m ²			
Collect stones	m ³			
Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
3. Abutment fill				
Compact selected fill behind abutment in 300mm layers	m ³			
Surface compacted fill with gravel wearing surface	m ³			
4. Sundries				
Fix timber edge board and abutment bearing beam	lump sum			
		Total no. man days		

Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools	lump sum			
3. Equipment costs				
Hire/depreciation cost	hr			
Running costs	hr			
4. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary		Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				



Masonry abutment - Drawing number 5.2

Applicability of the design

- Suitable for use as a high or low level abutment
- May be combined with any deck arrangement

Notes about the Drawing and Bill of Quantities

1. The length of the abutment and position of the change in section will be determined by the slope of the watercourse banks.
2. It is essential that the fill material placed in the abutment is well compacted to ensure settlement does not occur, as this would result in a drop in the road surface and a step at the edge of the deck.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Site Preparation				
Excavation of watercourse and banks	m ³			
Mix, place and compact blinding concrete	m ³			
Construct masonry apron and cut off walls	m ³			
2. Construction of abutment walls				
Construct masonry wingwalls, abutment wall and guide stones	m ³			
3. Abutment fill				
Compact selected fill behind abutment in 300mm layers	m ³			
Surface compacted fill with gravel wearing surface	m ³			
4. Sundries				

Backfill and compact around front faces of masonry walls in 300mm layers	m ³			
	Total no. man days			
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary		Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				

Masonry pier - Drawing number 5.3

Applicability of the design

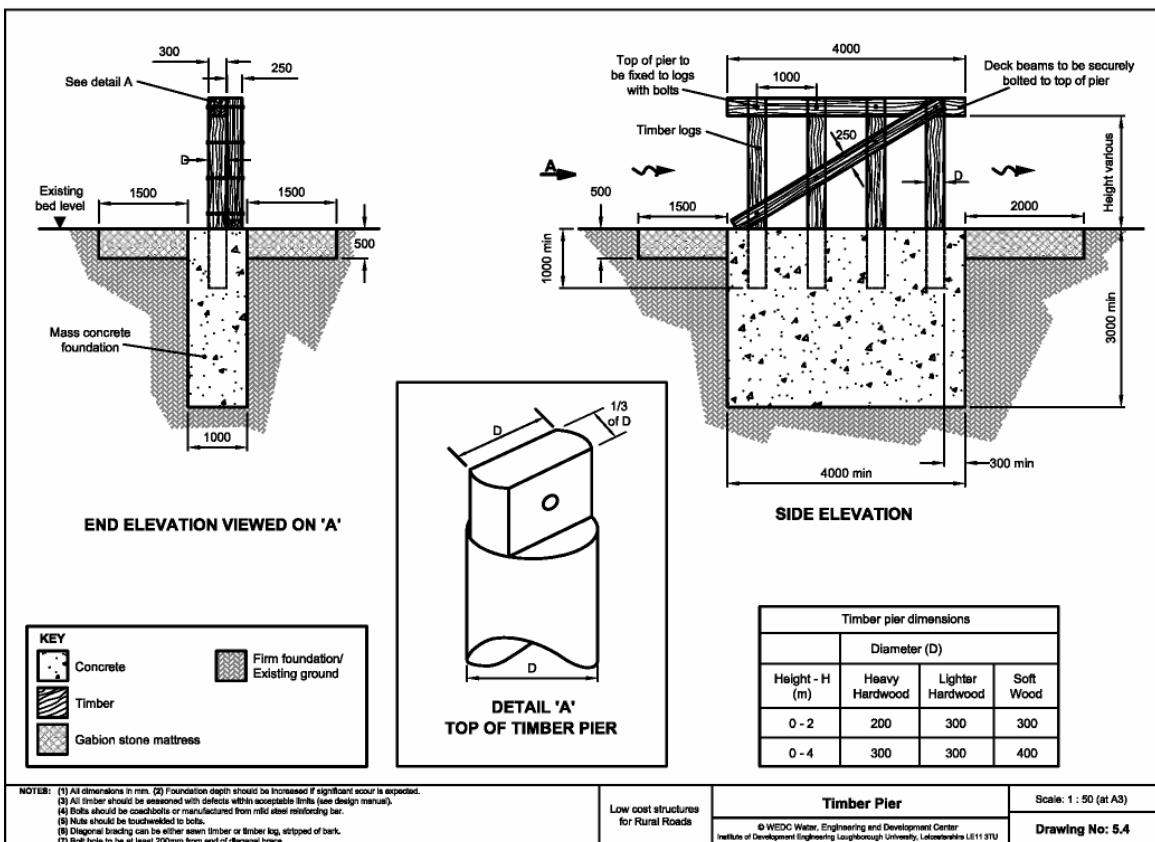
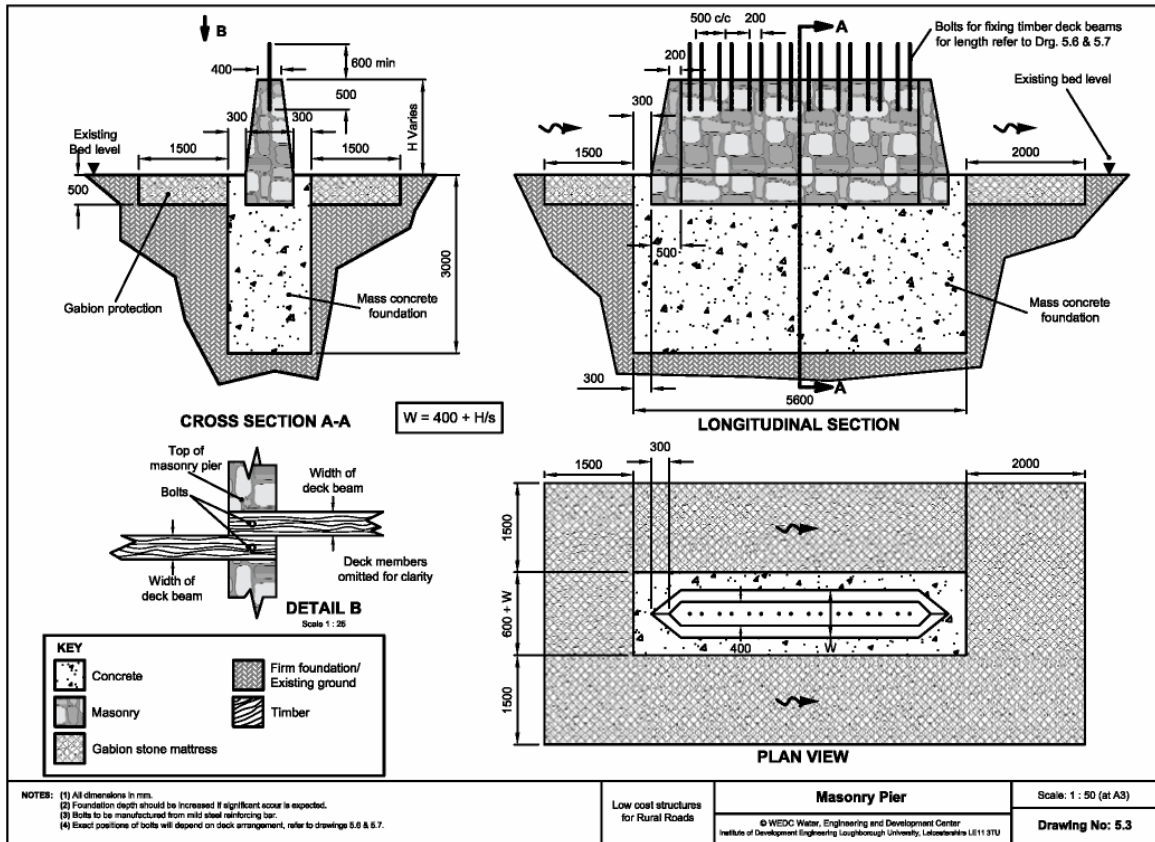
- Wide watercourses where vented drifts or large multi-bore culverts are not acceptable
- Watercourses where it is possible to provide a dry working area in the watercourse bed during construction

Notes about the Drawing and Bill of Quantities

1. Bolts shown in the top of the pier are for fixing timber beams. The exact position will depend on the deck arrangement.
2. The construction of the foundation and pier may require significant temporary work to divert the water flow, which could significantly increase cost.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Mass Concrete for foundation				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3. Wire mesh for gabion baskets	m ²			
4. Tie wire for gabion baskets	M			
5. Bolts for fixing deck	No.			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Construction of foundation				
Excavation of watercourse and banks	m ³			
Mix, place and compact mass concrete	m ³			
2. Construction of pier				
Construct masonry pier	m ³			
Fix deck securing bolts	No.			
3. Gabion protection				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			
Collect stone	m ³			

Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
		Total no. man days		
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary		Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				



Timber pier - Drawing number 5.4

Applicability of the design

- Wide watercourses where vented drifts or large multi-bore culverts are not acceptable
- Watercourses where it is possible to provide a dry working area in the watercourse bed during construction
- Regions where suitable timber is widely available

Notes about the Drawing and Bill of Quantities

1. The drawing shows timber logs used for the pier. Sawn timber may be used but is likely to be more expensive.
2. The lower end of the diagonal brace should be upstream, to reduce the risk of floating debris being trapped by the pier.
3. Where long bolts are required to join timber together they can be manufactured from mild steel bar. Threads should be cut on a short length at each end of the bar and one end tapered to a point to facilitate locating the bolt and the timber members. The bar should be threaded before it is tapered to ensure that the threads are not damaged when the bolt is knocked into place. The nut should not be on the tapered section of the thread once it has been tightened.
4. The construction of the foundation and pier may require significant temporary work to divert the water flow, which could significantly increase cost.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Mass Concrete for foundation				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Timber				
Piles	m			
Diagonal bracing	m			
Pier Capsil	m			
3. Timber bolts	No.			
4. Bolts for fixing deck	No.			
		Materials Total		

Labour	Unit	Quantity	Man day / unit	Days
1. Construction of foundation				
Excavation of watercourse and banks	m ³			
Shape top of timber piles and drill hole	No.			
Fix piles in position	No.			
Mix, place and compact mass concrete	m ³			
2. Construction of pier				
Drill holes in piles and diagonal bracing	No.			
Fix diagonal bracing	No.			
Prepare cut outs and holes in pier capsil	No.			
Fix capsil on top of pier	No.			
5. Gabion protection				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			
Collect stone	m ³			
Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
	Total no. man days			
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment				
	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary	Cost			
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				

Simple reinforced concrete deck - Drawing number 5.5

Applicability of the design

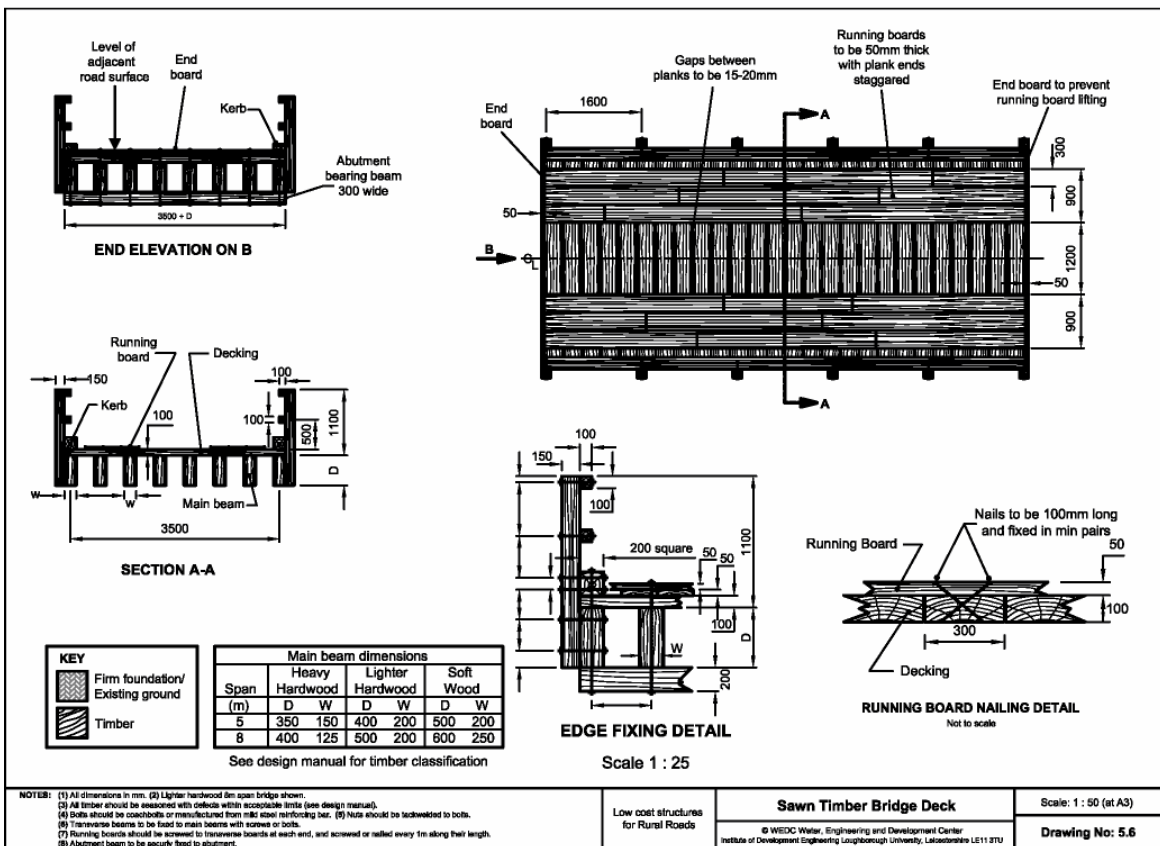
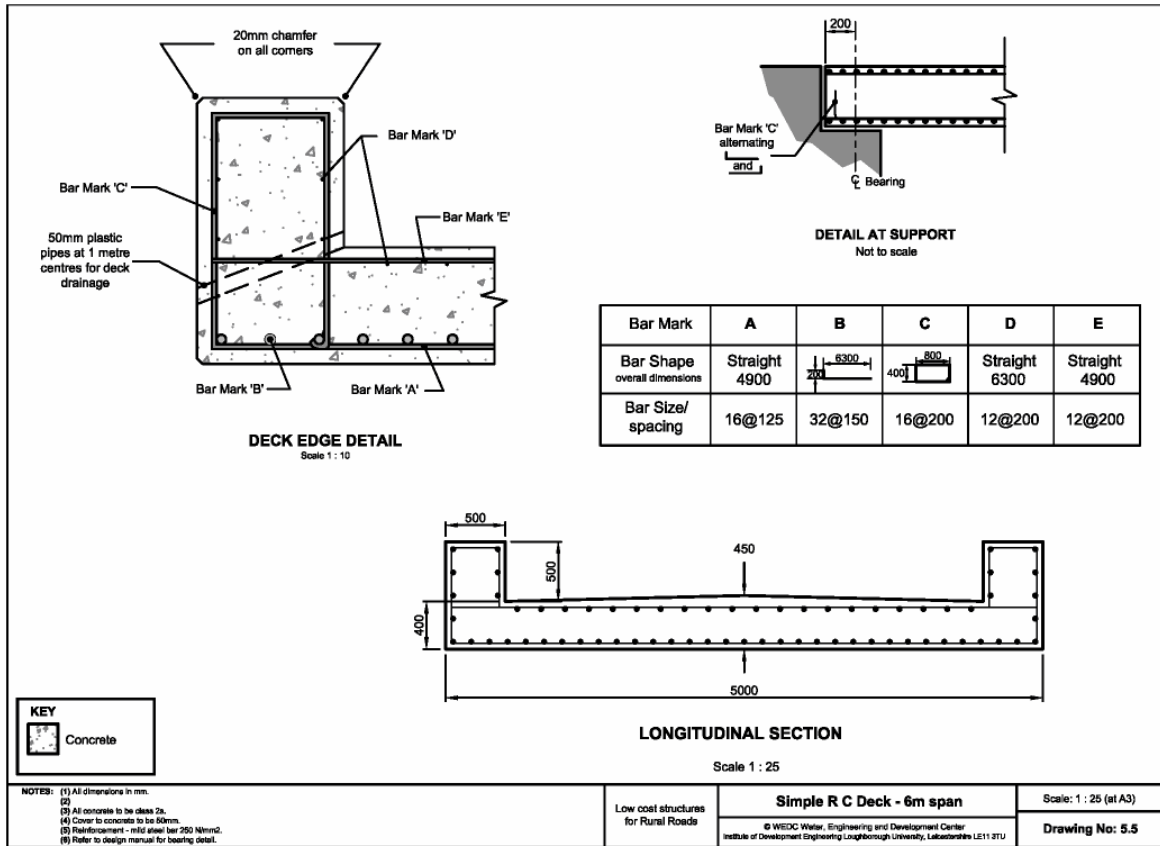
- Where cement and reinforcement is available at an acceptable cost and suitable construction skills exist
- Spans up to 6m
- The maximum weight limit that can be supported on the deck is 25 tonnes

Notes about the Drawing and Bill of Quantities

1. The drawing shows the use of mild steel reinforcing bars which have a yield strength of at least 250N/mm².
2. For longer spans refer to ORN 9

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Grade 25 Concrete				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Mild Steel reinforcement				
12mm dia	m			
16mm dia	m			
32mm dia	m			
Spacing hoops (temp. works)	m			
3. 50mm plastic pipes for drainage	m			
4. Timber for formwork	m ²			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Site Preparation				
Erect temporary support structure	lump sum			
Erect formwork base and sides	m ²			
2. Construction of deck				
Fix reinforcement in position	m			
Fix drainage pipes in position	No.			
Mix, place and compact grade 25 concrete	m ³			
3. Dismantle formwork and temporary support	lump sum			

	Total no. man days			
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary	Cost			
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				



Sawn timber deck - Drawing number 5.6

Applicability of the design

- Where treated timber is available at acceptable cost
- Maximum span 8m
- The maximum weight limit that can be supported on the deck is 25 tonnes

Notes about the Drawing and Bill of Quantities

1. The drawing shows the use of nails or screws to join deck elements. Maintenance requirements (eg. refixing lifting running boards) will be significantly reduced if the deck is joined with screws or coach bolts.
2. Where long bolts are required to join timber together they can be manufactured from mild steel bar. Threads should be cut on a short length at each end of the bar and one end tapered to a point to facilitate locating the bolt and the timber members. The bar should be threaded before it is tapered to ensure that the threads are not damaged when the bolt is knocked into place. The nut should not be on the tapered section of the thread once it has been tightened.
3. For longer spans refer to ORN 9.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Timber				
Abutment bearing beams	m			
8 No. Deck beams	m			
Transverse beams	m			
Kerb timber	m			
Parapet posts	m			
Parapet rails	m			
Running boards	m			
End boards	m			
2. Fixing bolts / screws	No.			
3. Timber nails	kg			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Main structure				
Drill and fix abutment bearing beams	No.			
Erect main timber beams	No.			

Fix transverse decking	m			
Drill and fix kerb timbers	m			
2. Parapets				
Drill and fix parapet posts	No.			
Drill and fix parapet rails	m			
3. Running surface				
Fix running boards to deck	m			
Fix end boards to deck	m			
		Total no. man days		
	Labour cost per day		Total labour cost	
	Other Costs	Unit	Quantity	Rate
				Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment				
	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
			Total Other Costs	
	Cost Summary	Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
	Total construction cost			

Round timber deck - Drawing number 5.7

Applicability of the design

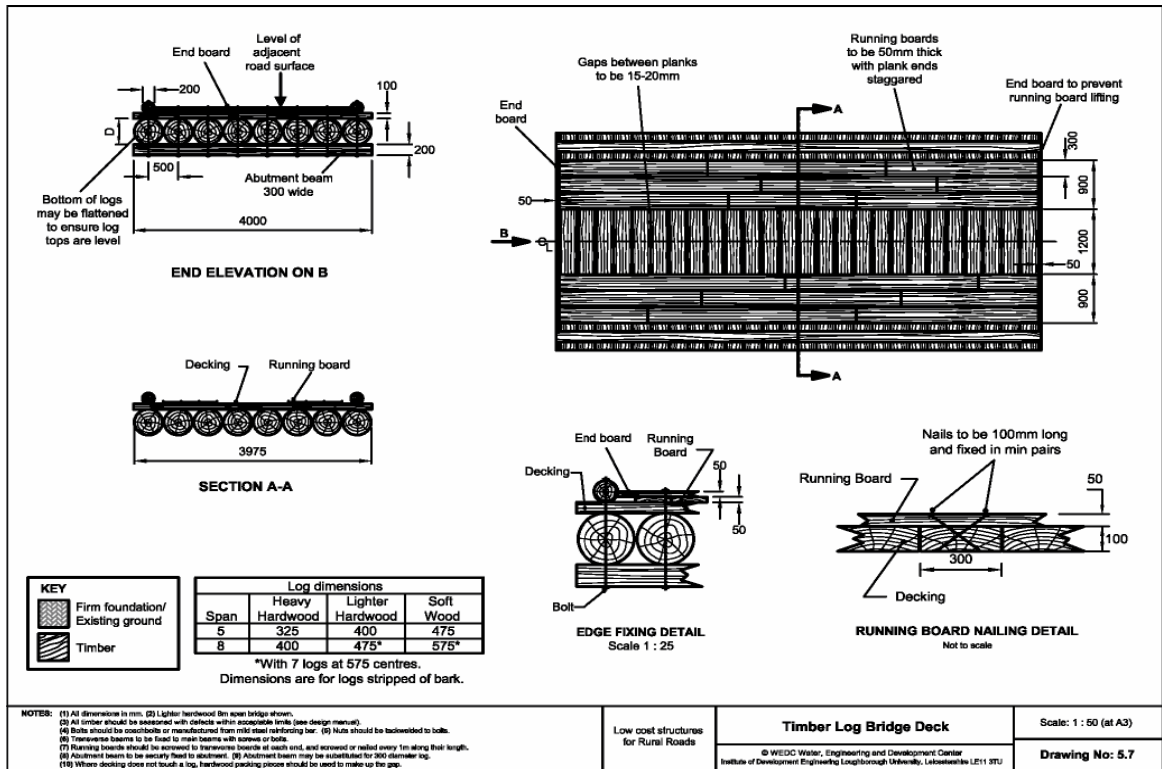
- Where felled timber or suitable trees are available at acceptable cost
- Maximum span 8m
- The maximum weight limit that can be supported on the deck is 25 tonnes

Notes about the Drawing and Bill of Quantities

1. The drawing shows the use of nails or screws to join deck elements. Maintenance requirements (eg. refixing lifting running boards) will be significantly reduced if the deck is joined with screws or coach bolts.
2. Where long bolts are required to join timber together they can be manufactured from mild steel bar. Threads should be cut on a short length at each end of the bar and one end tapered to a point to facilitate locating the bolt and the timber members. The bar should be threaded before it is tapered to ensure that the threads are not damaged when the bolt is knocked into place. The nut should not be on the tapered section of the thread once it has been tightened.
3. For longer spans refer to ORN 9.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Timber				
Abutment bearing beams	m			
8 No. Deck logs	m			
Transverse beams	m			
Kerb log	m			
Running boards	m			
End boards	m			
2. Fixing bolts / screws	No.			
3. Timber nails	kg			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Main structure				
Drill and fix abutment bearing beams	No.			
Erect main timber logs	No.			
Fix transverse decking	m			
Drill and fix kerb logs	m			

2. Running surface				
Fix running boards to deck	m			
Fix end boards to deck	m			
		Total no. man days		
Labour cost per day		Total labour cost		
Other Costs	Unit	Quantity	Rate	Cost
1. Transport				
Delivery of materials	km			
Supervision vehicle	km			
2. Hand-tools and equipment	lump sum			
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary		Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				



Committed to Sustainable Transport

The **global Transport Knowledge Partnership (gTKP)** is an initiative which brings together knowledge, funding and implementation partners to provide sector experts access to the best available road transport information, expertise and technical advice to accelerate poverty reduction in the developing world.

The project is managed by the **International Road Federation (IRF)** and supported by the **UK Department for International Development**.

For more information visit www.gtkp.com



**global Transport
Knowledge Partnership**

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