

**Volume 3
Design
Drawings and
Bills of
Quantities**

Small Structures for Rural Roads

**A Practical Planning, Design,
Construction & Maintenance Guide**

Paul Larcher, Robert Petts & Robin Spence
English Version, May 2010



**global Transport
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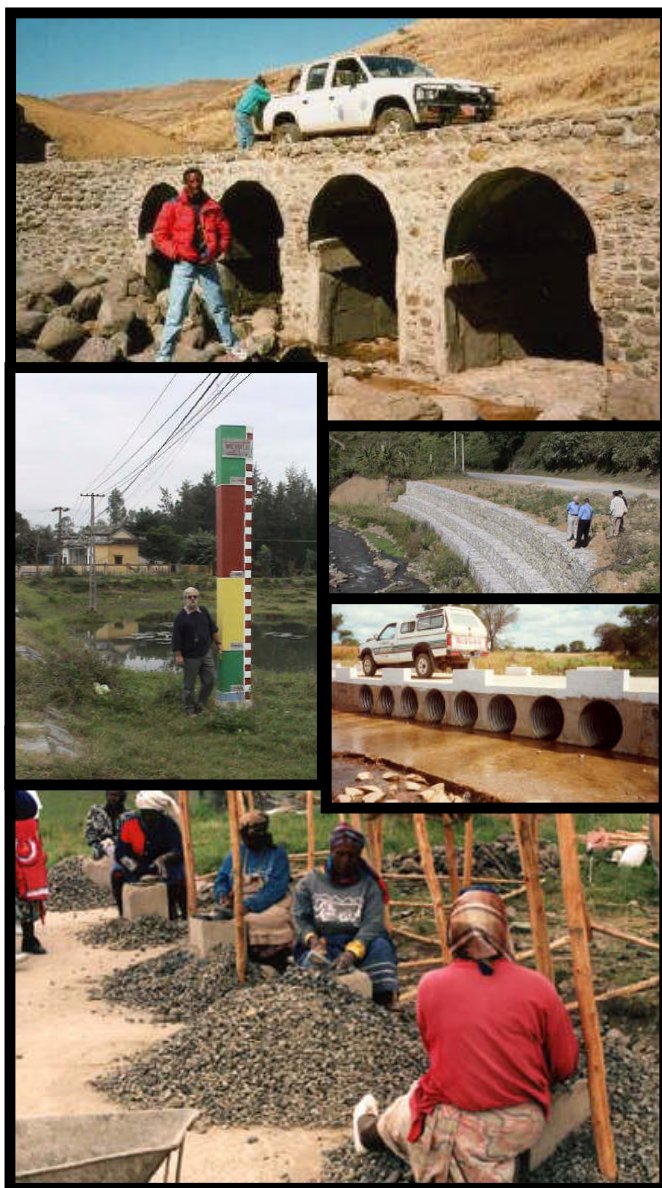
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Small Structures for Rural Roads: A Practical Planning, Design, Construction & Maintenance Guide



Volume 3 Design Drawings and Bills of Quantities

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Paul Larcher, Robert Petts & Robin Spence
English Version
May 2010

Small Structures for Rural Roads

A Practical Planning, Design, Construction & Maintenance Guide

Volume 1	Planning & Initial Design
Volume 2	Detailed Design, Construction & Maintenance
Volume 3	Design Drawings and Bills of Quantities
Volume 4	Design Drawings (A3)

The chart on Volume 1, Page 6 will assist the reader to navigate this document.

DESIGN DRAWINGS AND BILL OF QUANTITIES

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The views expressed are not necessarily those of DFID, WB, ADB or IRF.

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The aim of this document is to provide guidance to planners, designers and practitioners of rural roads in developing and transition countries. It is based on proven techniques and experience and should be the basis of introduction of low cost but durable construction practices in environments experiencing severe resource restrictions. It is intended that rural road practitioners and professionals will be able to utilise and adapt the knowledge in this document to introduce more appropriate, affordable and sustainable techniques, standards and specifications into everyday practice, academic curricula and training, and contribute to rural poverty reduction.

This document is web-posted by gTKP (www.gtkp.com) to be available to practitioners free of charge. Hard copies may be obtained on application to info@gtkp.com .

It is intended that this Guideline should be a dynamic document with regular updates to accommodate new knowledge and experience. Users are actively encouraged to comment on and contribute to the ongoing development of this Guideline. Please send your comments or contributions for future editions to:

Robert Petts, Theme Champion, Rural Transport, gTKP rob.petts@gtkp.com

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Introduction

This is the third volume of the guideline covering the design, construction and maintenance of road structures on low volume roads. A broad introduction to the guideline is provided in Volume 1. The guideline covers a wide range of drainage structures from drifts to small bridges (Chapter 4 in the design manual, Volume 1, describes the characteristics of these structures). These structures vary in complexity and are ranked in order of increasing complexity as follows:

- ◆ Drifts
- ◆ Simple culverts
- ◆ Vented fords
- ◆ Large bore culverts
- ◆ Small bridges

This volume of the guideline contains standard designs and bills of quantities for low cost structures. It is hoped that by standardisation of these designs, which have been checked technically:

- ◆ economies of scale will lead to an improvement in cost and quality;
- ◆ speed of construction will be increased as labourers, supervisors and engineers will be more familiar with the design;
- ◆ approval procedures will be simplified.

The guideline has been written as a design guide, to complement design codes and standards from the relevant Ministry or Roads Authority. However, experience has shown that in many areas national design standards are not applicable to the small cost structures on Low Volume Rural Roads (LVRR) covered by this guideline. It is therefore envisaged that this document will be recognised by road authorities as a useful tool and that, by following the advice and information contained in the guide, engineers and technicians will be able to design, construct and maintain acceptable and durable structures.

Steps in the design process for road drainage structures are often missed or neglected. Volumes 1 and 2 therefore explain the steps that should be carried out and the reasons for undertaking them. They also explain the type and detail of information required and how it should be used to undertake a design.

The designs contained in this volume are standard designs and may therefore not be fully applicable for all structures. Small modifications to the drawings may be required for individual circumstances. Before using these designs, engineers and technicians should consult Volume 1 and 2, to ensure that the drawings are suitable for specific water crossing locations.

Volume 4 contains the drawings at full scale 'A3' format. The drawings in this Volume 3 are reduced in size and are for reference only and cannot be 'scaled'.

How to use this Guideline

This volume of the guideline should be read in conjunction with Volume 1 and 2. There is a logical sequence of work that should be undertaken in the selection and design of any road structure. The preliminary design section (Volume 1) is laid out in sequence with each chapter covering one aspect of the process shown in the diagram in Figure 1.1 below. The detailed design process is described in Volume 2. The two initial tasks which should be carried out are to identify the problem (Chapter 2) and determine the design criteria (Chapter 3) for the structure. The initial design data may then be collected (Chapter 2) to enable the preliminary design to be carried out. Preliminary design, shaded yellow in the flow diagram in Figure 1.1 involves 4 different stages which may be performed a number of times before a design solution is proposed. It is suggested that a review of structural options (Chapter 4) is initially undertaken followed by an appraisal of a potential construction site (Chapter 5). The water flow characteristics of the watercourse (Chapter 6) should then be considered before a selection of the most appropriate structure is made (Chapter 4). It is likely that the preliminary design loop will need to be followed a number of times to review different potential structures and construction sites.

Following completion of the preliminary design the proposed design solution should be checked to ensure that it complies with the design criteria. Detailed design of the structure can then be undertaken (Chapter 8 – Volume 2). This requires reference to be made to chapters covering site selection and appraisal (Chapter 5) and watercourse characteristics (Chapter 6). It is also necessary to review the options for available construction materials (Chapter 7) that may be available.

The designs referenced in this volume (and reproduced at full scale in Volume 4) may be incorporated at the detailed design stage. Structure designers should ensure that the designs meet all the design criteria, or make the necessary modifications. The proforma bills of quantities will aid the calculation of the cost of the structure. Following the preparation of the design drawings it will be necessary to refer to the guidance in the chapters on construction and maintenance to ensure that no issues will arise that cannot be satisfactorily accommodated in the expected construction and maintenance regimes.

Volume 4 contains the standard drawings reproduced at full 'A3' size. In this Volume 3 they have been reduced to 'A4' size for convenience and the scales will be accordingly distorted.

The Volume 4 drawings at 'A3' size have been prepared to a scale noted at the bottom right hand corner of each drawing sheet (some inserts are drawn at a larger scale, where this occurs the scale will be listed under the insert drawing title). Some dimensions are shown on the drawings. If a dimension is not shown on the drawing an approximation may be obtained by measuring the dimension on the drawing with a ruler and applying the correct scale factor.

Example:

If the dimension of a structure on a drawing is 12mm and the scale is 1:50 the actual dimension will be 600mm.

$$12\text{mm} \times 50 = 600\text{mm}$$

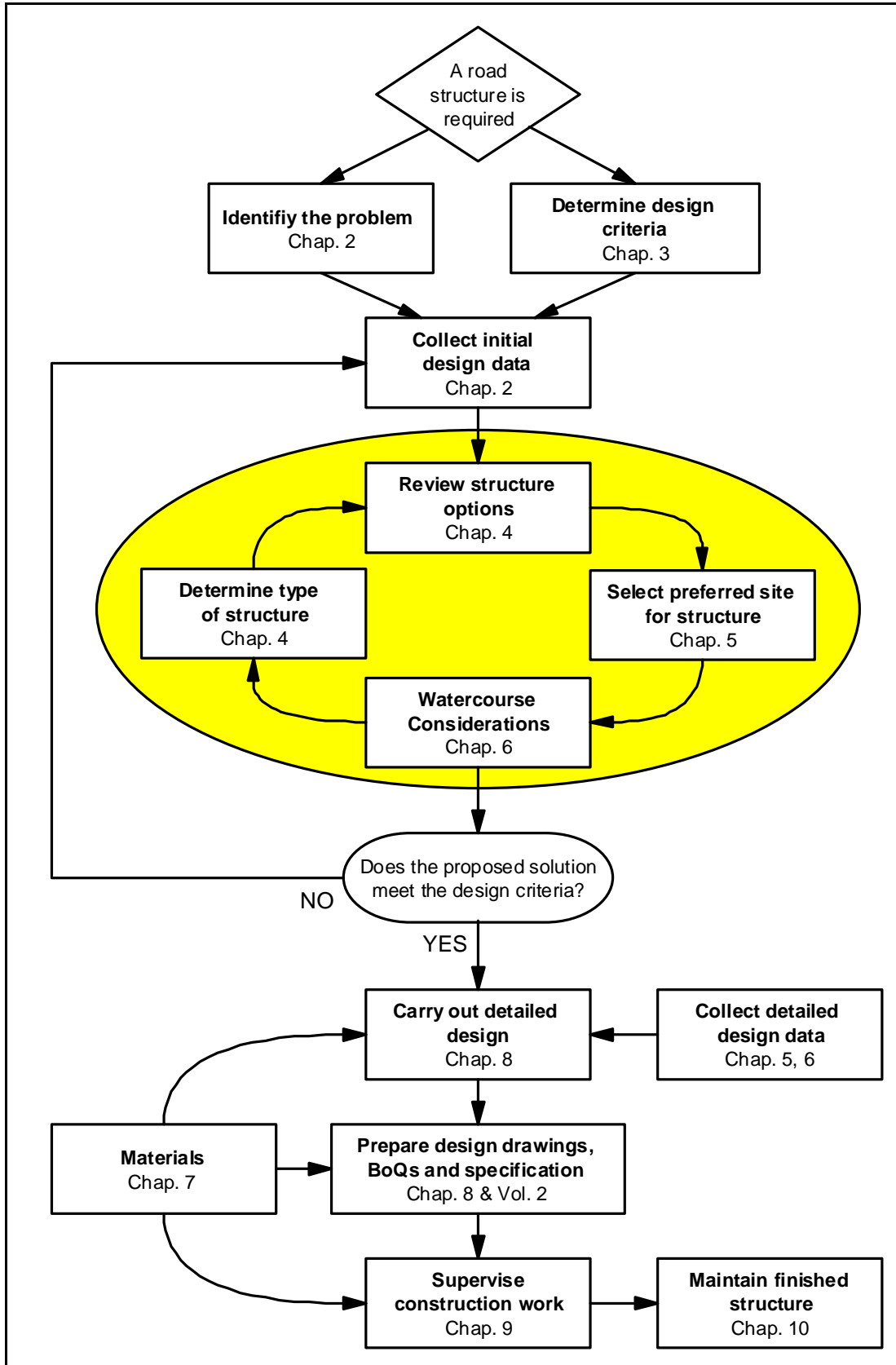
The box on the drawing indicates the scale and the text "at A3" paper size. Note that the scaling will not apply to the reduced drawings in this Volume 3. Likewise, if the 'A3' drawing is increased or decreased in size (e.g. on a photocopier) it will no longer be possible to calculate the dimensions of the structure by taking measurement on the drawing.

NOTE: Photocopiers can often distort drawings when they make copies. This distortion will not be apparent unless accurate measurements are taken from the drawing. Drawings which have

HOW TO USE THIS GUIDELINE

been photocopied should not be used to measure unmarked dimensions as their accuracy cannot be guaranteed. The drawings contained in the text in this Volume 3 are for reference only and are not scalable.

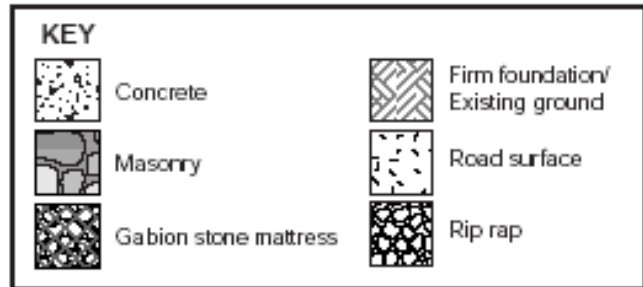
Figure 1.1 Flow diagram of the planning, design and construction process



HOW TO USE THIS GUIDELINE

Each drawing has a page of notes which relate to the use of the particular drawing. There may also be some notes about assumptions that have been made when preparing the bill of quantities. The notes below apply to all the drawings.

1. Drawings that are used for construction should include a location map and description to assist maintenance and inspection teams to find the structure.
2. Each drawing contains a key to indicate different materials. An example of a complete key is shown below. The stone shown in different shading patterns is only indicative and may not be representative of the actual stone sizes in the structure. The diagonal shading “Firm foundation/existing ground” is widely used on the drawings. Areas shaded in this style include:
 - a. Ground undisturbed by the construction work which provides a suitable foundation for construction
 - b. Areas which have poor quality ground which has been excavated and replaced by good quality material to provide a suitable foundation for construction
 - c. Existing ground backfilled after construction
 - d. Lean concrete or gravel blinding layers
3. Masonry has been shown as a construction material on many of the drawings. Where masonry is shown any of the masonry types listed below may be used subject to the requirements of Chapter 7 (Materials) and any applicable material specifications:
 - a. Random stone masonry
 - b. Dressed stone masonry
 - c. Bricks
 - d. Blocks
4. It may be possible for some structures to change the material type shown on the drawings. In some cases an alternative material is shown on the drawings however, designers should refer to Volume 1 and 2 before making any material substitutions.



The objective of the bills of quantities is to provide an estimate of the construction cost of the structure. The following notes apply to all the bills of quantities:

1. The drawings provided in this manual are general arrangements. Exact quantities will be dependent on the specific characteristics of the site for the structure. Designers should make modifications where required.
2. The quantity of excavation required for specific structures is very difficult to estimate for different structures. Difficulty of excavation can also vary dramatically between construction sites. The figures provided for quantity of excavation and labour requirements should only be used as a rough guide.
3. Suggested labour work rates are provided for the different construction tasks. These rates are based on surveys and analysis carried out in different areas of the world by the ASIST programme of the ILO. They are provided as a guide and should be modified based on local or personal experience.
4. Before work can start at any construction site preliminary work must be carried out to facilitate the construction. This may include the establishment of a work compound for storing materials, labourers accommodation etc. A bill of quantities for preliminary cost items that should be considered for all structures is provided below. The preliminary items that are required for a specific structure should be added to the structure's bill of quantities to calculate the full cost of the structure.

HOW TO USE THIS GUIDELINE

Worker productivity

In the absence of local data the following productivity standards may be useful in estimating the resources and time required for each activity.

<ul style="list-style-type: none"> ◆ Site preparation Site clearance (bush clearing, tree felling, etc.) Removal of tree stumps 	100 – 350m ² / worker day 1 / worker day
<ul style="list-style-type: none"> ◆ Material excavation and movement Soil excavation (and stockpiling alongside) Loose rock collection Rock (fractured) excavation (solid rock will require drilling and blasting/splitting) Loading Haulage by wheelbarrow 0 - 20m 20 - 40m 40 - 60m 60 - 80m 80 - 100m 100 - 150m 	2 - 5m ³ / worker day 2.5m ³ / worker day 0.8m ³ / worker day 8.5m ³ / worker day 8.5m ³ / worker day 7.0m ³ / worker day 6.5m ³ / worker day 5.5m ³ / worker day 5.0m ³ / worker day 4.5m ³ / worker day
<ul style="list-style-type: none"> ◆ Pipe installation Install only 600 or 900mm diameter culvert lines (including excavation and backfill) 	0.8 - 1.2 lin.m / worker day
<ul style="list-style-type: none"> ◆ Masonry and concrete work Mix and place concrete Erect masonry work 	1.0m ³ / worker day 1.0m ³ / worker day

Productivity depends on a number of factors, including worker fitness, nutrition, experience and motivation, site organisation, tool quality and condition, and climate. Individual small structure sites do not allow much scope for improvement of performance with experience, due to the short time spans involved for individual activities. New workers under training will also be less productive. Poor quality and condition handtools can affect productivity by up to 25%.

Aggregate and cement quantities for concrete

Class of concrete	Expected 28 day strength N/mm ²	Mix cement/ fine aggregate/ coarse aggregate	Material required for 1m ³ finished concrete		
			Cement bags (kg)	Fine (m ³)	Coarse (m ³)
Lean	-	1:4:8	3.3 (166)	0.47	0.94
Mass	15	1:3:6	4.3 (215)	0.46	0.92
Grade 20	20	1:2:4	6.0 (300)	0.42	0.84
Grade 25	25	1:1.5:3	7.3 (365)	0.38	0.76

BILLS OF QUANTITIES – PRELIMINARY WORKS

Bill of Quantities - Preliminary works

Preliminaries	Unit	Quantity	Rate	Cost
Site Compound				
Set up and remove temporary site compound	lump sum			
Water supply	lump sum / m ³			
Sanitation facilities	lump sum			
Provide site office	lump sum			
Provide workshop	lump sum			
Provide store	lump sum			
Provide labourers temporary accommodation	lump sum	(No. of labourers)		
Staffing				
Recruitment of labourers	lump sum			
Store keeper	No./day			
Day watchmen	No./day			
Night watchmen	No./day			
Labourers protective clothing				
Traffic Control				
Provide temporary deviation for public traffic	lump sum / day			
Provide temporary signage and traffic control	lump sum / day			
Existing Structure				
Demolish old structure	lump sum			
Remove from site and dispose of old structure	m ³			
Site preparation				
Temporary site access	lump sum			
Site clearance (bush clearing, tree felling)	m ²			
Removal of tree stumps	No.			
Construction work				
Temporary support to foundations				
De-watering of foundations				
Temporary diversion of watercourse				
Temporary support to superstructure				
Work completion				
Remove surplus material				
Clear and tidy site				
Preliminaries Total				

Gabion drift - Drawing number 1.1

Applicability of the design

- ◆ Suitable for all drift sites
- ◆ May be used for high velocity flows

Notes about the Drawing and Bill of Quantities

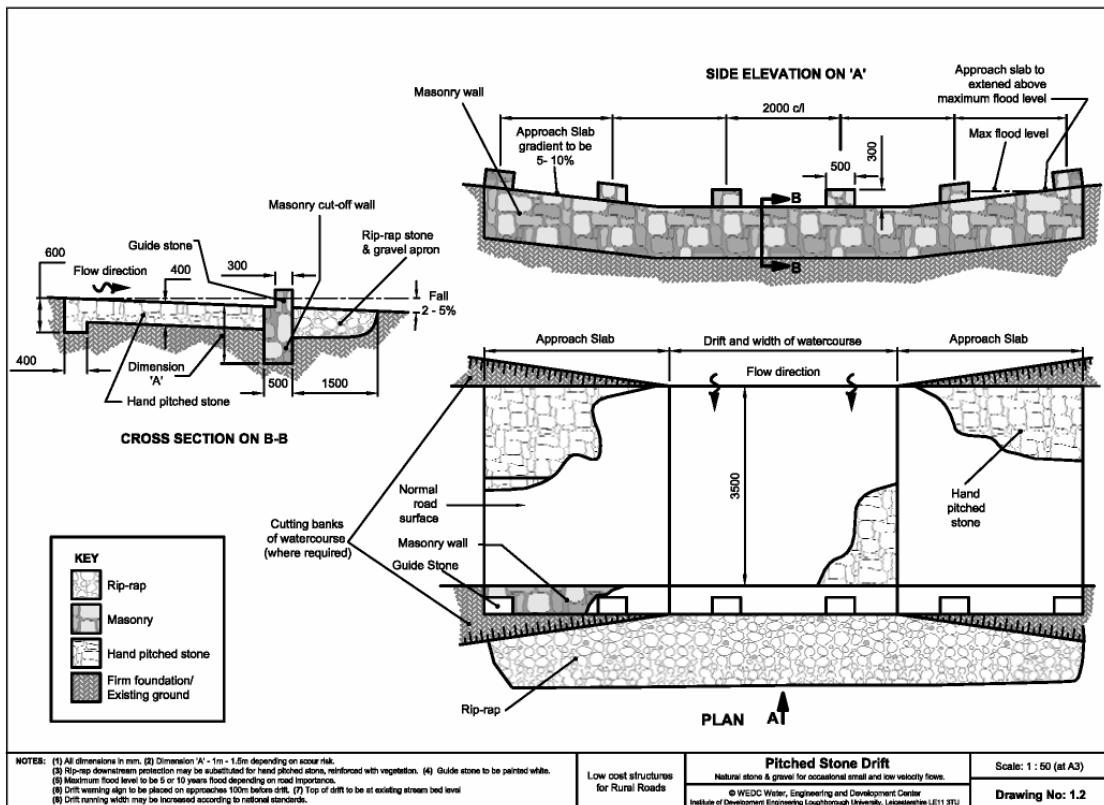
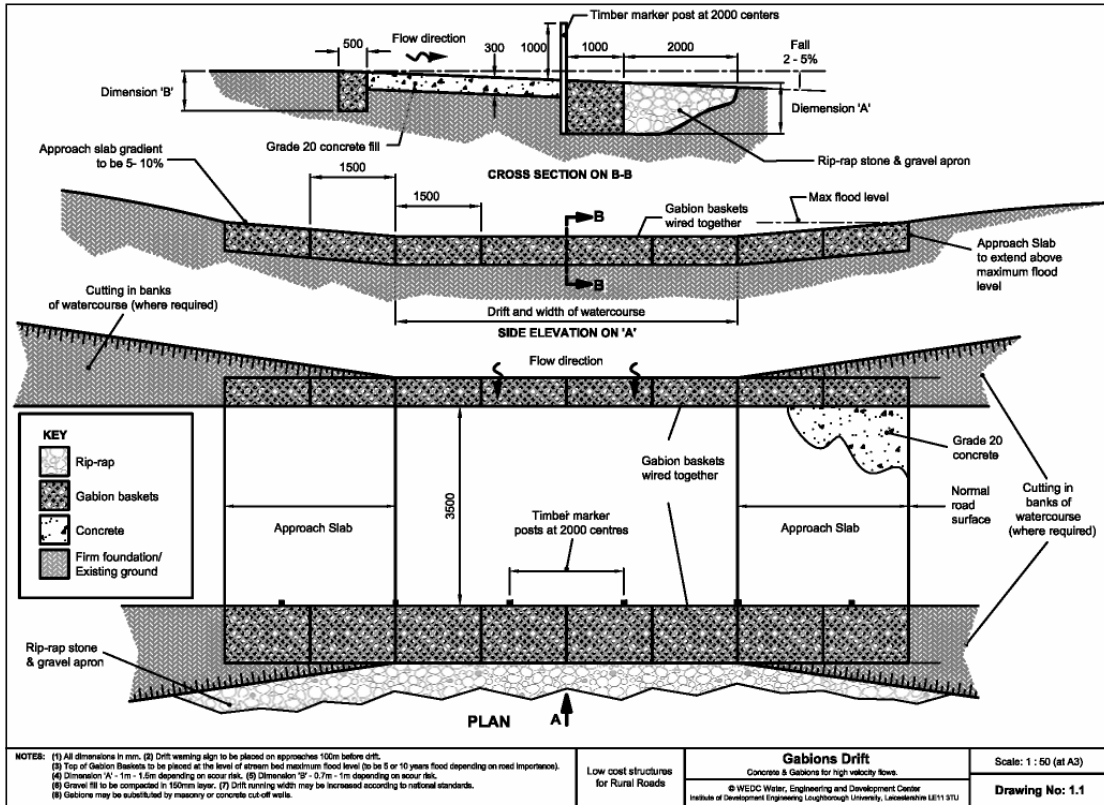
1. It is recommended that dimension 'A' is constructed at 1.5m and dimension 'B' is constructed at 1m unless low flows are expected.
2. Gabion basket wire; 10% extra wire should be allowed for laps.

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. Grade 20 concrete				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
3. Painted timber marker posts	No.			
4. Timber for concrete formwork	m ²			
5. Wire mesh for gabion baskets	m ²			
6. Tying wire for gabions	m			
7. Drift warning sign and posts	No.			
Materials Total				
Labour	Unit	Quantity	Man day / unit	Days
1. Concrete drift and approach slabs				
Excavation of riverbed	m ³			
Mix, place and compact blinding concrete	m ³			
Fix marker posts	No.			
Erect and dismantle rough formwork	m ²			
Mix, place and compact concrete slabs	m ³			
2. Gabion cut off walls				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			

DESIGN DRAWINGS AND BILL OF QUANTITIES

Collect stones	m3			
Fill gabion baskets	m3			
Close and tie off wire baskets	m2			
3. Rip rap protection				
Collect stones	m3			
Place stones in riverbed	m3			
4. Sundries				
Excavation of watercourse banks, where required (estimated)	m3			
Erect 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				
	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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



Pitched stone drift - Drawing number 1.2

Applicability of the design

- ◆ Suitable for occasional small and low velocity flows
- ◆ Minimal requirements for cement

Notes about the Drawing and Bill of Quantities

1. Hand pitched stones should be placed on their edge to ensure a good interlock between adjacent stones
2. It is recommended that dimension 'A' is constructed at 1.5m unless a low flow risk and low flows are expected.

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			
3. Hand pitched stone	No.			
4. Drift warning sign and posts	No.			
Materials Total				
Labour	Unit	Quantity	Man day / unit	Days
1. Masonry cut off wall				
Excavation of riverbed	m ³			
Mix, place and compact blinding concrete	m ³			
Construct masonry wall including guide stones	m ³			
2. Hand pitched stone				
Excavate riverbed	m ³			
Place stones	m ³			
3. Rip rap protection				
Collect stones	m ³			
Place stones in riverbed	m ³			

DESIGN DRAWINGS AND BILL OF QUANTITIES

4. Sundries				
Excavation of watercourse banks, where required (estimated)	m ³			
Erect 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	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 drift - Drawing number 1.3

Applicability of the design

- ◆ Suitable for all drift sites
- ◆ Reduces the current requirements when compared to Drawing 1.1

Notes about the Drawing and Bill of Quantities

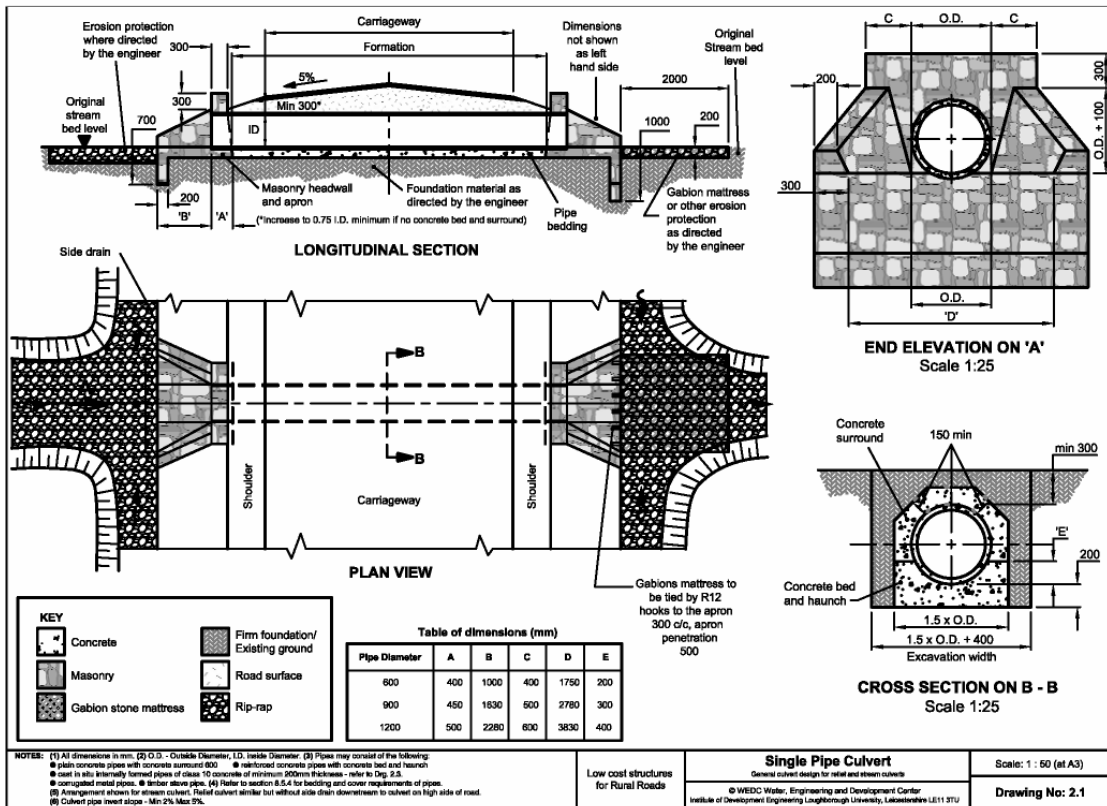
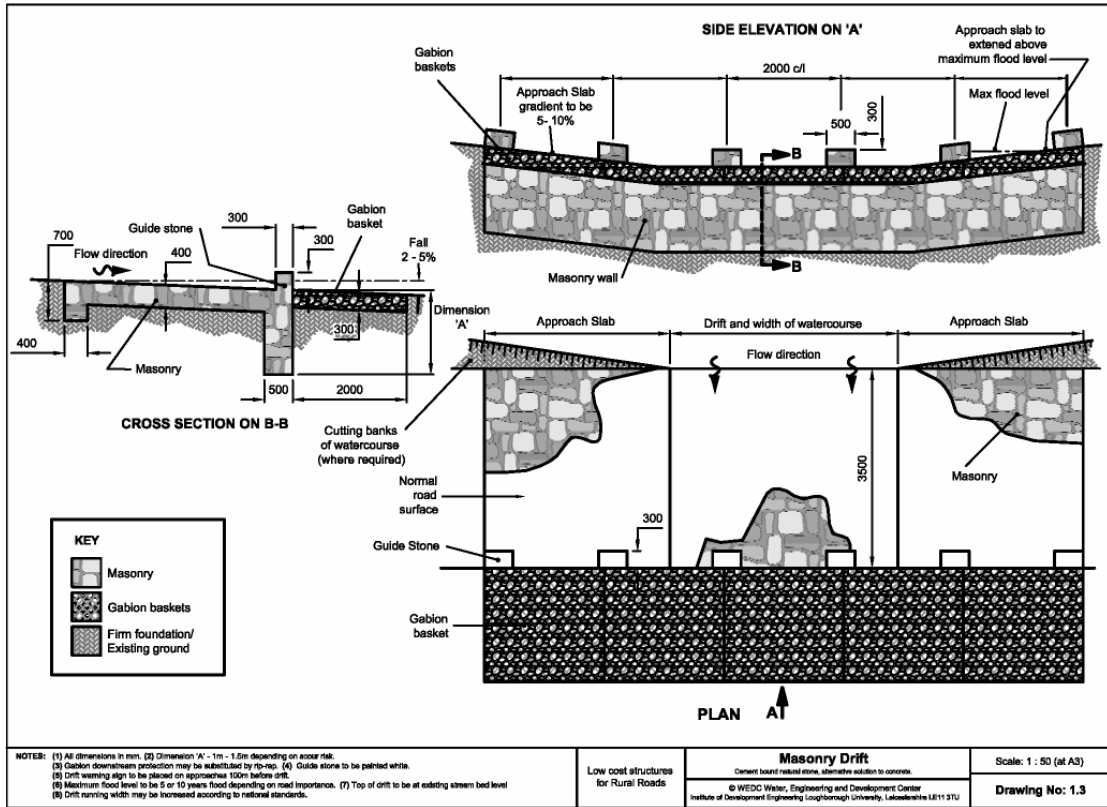
1. It is recommended that dimension 'A' is constructed at 1.5m unless a low flow risk and low flows are expected.
2. Gabion baskets: 10% extra wire should be allowed for laps.

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			
3. Wire mesh for gabion baskets	m ²			
4. Tying wire for gabion baskets	M			
5. Drift warning sign and posts	No.			
Materials Total				
Labour	Unit	Quantity	Man day / unit	Days
1. Masonry cut off wall, drift and approach slabs				
Excavation of riverbed	m ³			
Mix, place and compact blinding concrete	m ³			
Construct masonry walls, slab and guide stones	m ³			
2. Gabion protection				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			
Collect stone	m ³			

DESIGN DRAWINGS AND BILL OF QUANTITIES

Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
3. Rip rap protection				
Collect stones	m ³			
Place stones in riverbed	m ³			
4. Sundries				
Excavation of watercourse banks, where required (estimated)	m ³			
Erect 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				
	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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



Single pipe culvert - Drawing number 2.1

Applicability of the design

- ◆ Standard culvert arrangement for use as stream or relief culvert on all sites
- ◆ Design may be used with any precast pipe material
- ◆ Drawing also applicable to cast in situ concrete pipes when it is read with Drawing 2.3.

Notes about the Drawing and Bill of Quantities

1. Drawing shows a 600mm diameter culvert which will be suitable for the majority of sites. Drawing has table of dimensions A-O which should be used for 900mm and 1200mm diameter culverts.
2. Drawing should be read with the following other drawings for specific applications:

Twin barrel culvert	Drawing 2.2
Drop inlet	Drawing 2.3
Cast in situ pipe	Drawing 2.3

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding, pipe bed and haunch				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3. Culvert pipe				
Selected pipe material	m			
4. Mass concrete for pipe surround				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
5. Wire mesh for gabion baskets	m ²			
6. Tying wire for gabion baskets	m			
		Materials Total		
Labour	Unit	Quantity	Man day / unit	Days
1. Placing of the culvert pipe				
Excavation of watercourse/ road	m ³			
Mix, place, compact culvert bedding and haunch	m ³			

DESIGN DRAWINGS AND BILL OF QUANTITIES

Fix culvert pipes in place	m			
2. Masonry culvert headwalls, wingwalls, aprons and cut off walls				
Construct cut off walls and aprons	m ³			
Fix reinforcement hooks in downstream apron to secure gabion protection	No.			
Construct wingwalls and headwalls	m ³			
3. Pipe surround				
Mix, place, compact concrete pipe surround	m ³			
4. Gabion downstream protection				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			
Collect stones	m ³			
Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
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	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				

Alternative culvert arrangements: Twin barrel culvert - Drawing number 2.2

Applicability of the design

- ◆ For large volume flows where 1 pipe does not provide sufficient flow capacity
- ◆ Design may be used with any precast pipe material

Notes about the Drawing and Bill of Quantities

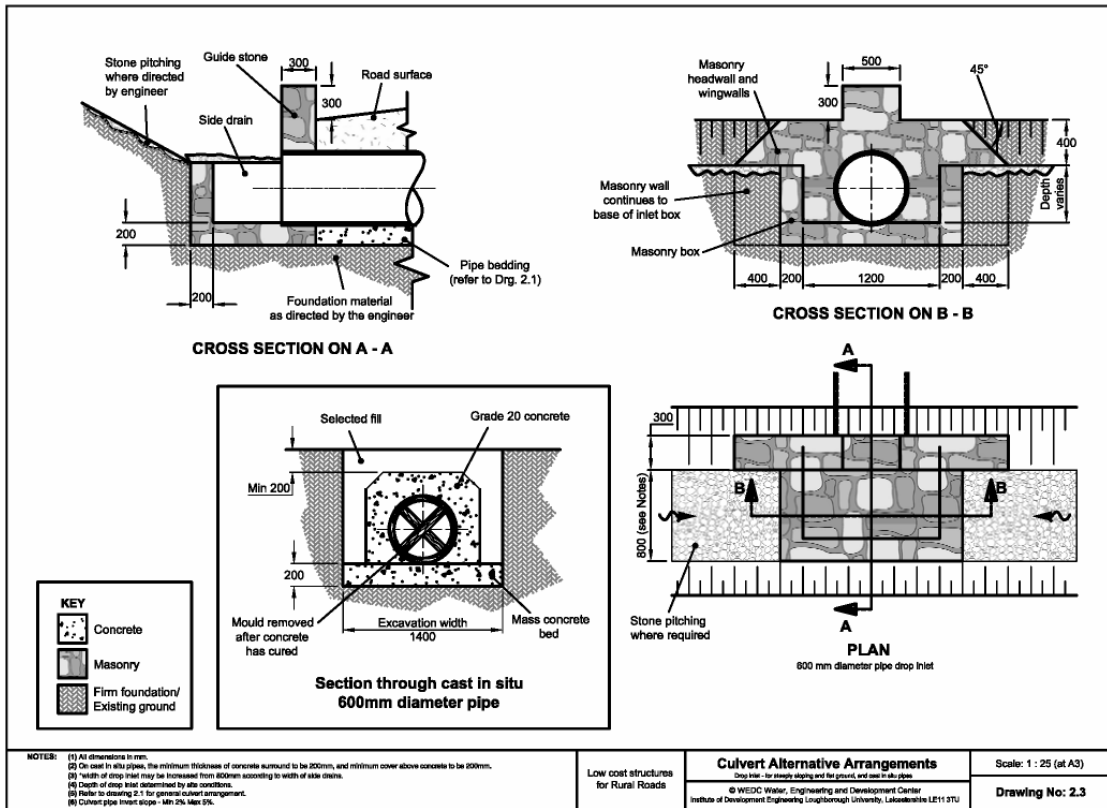
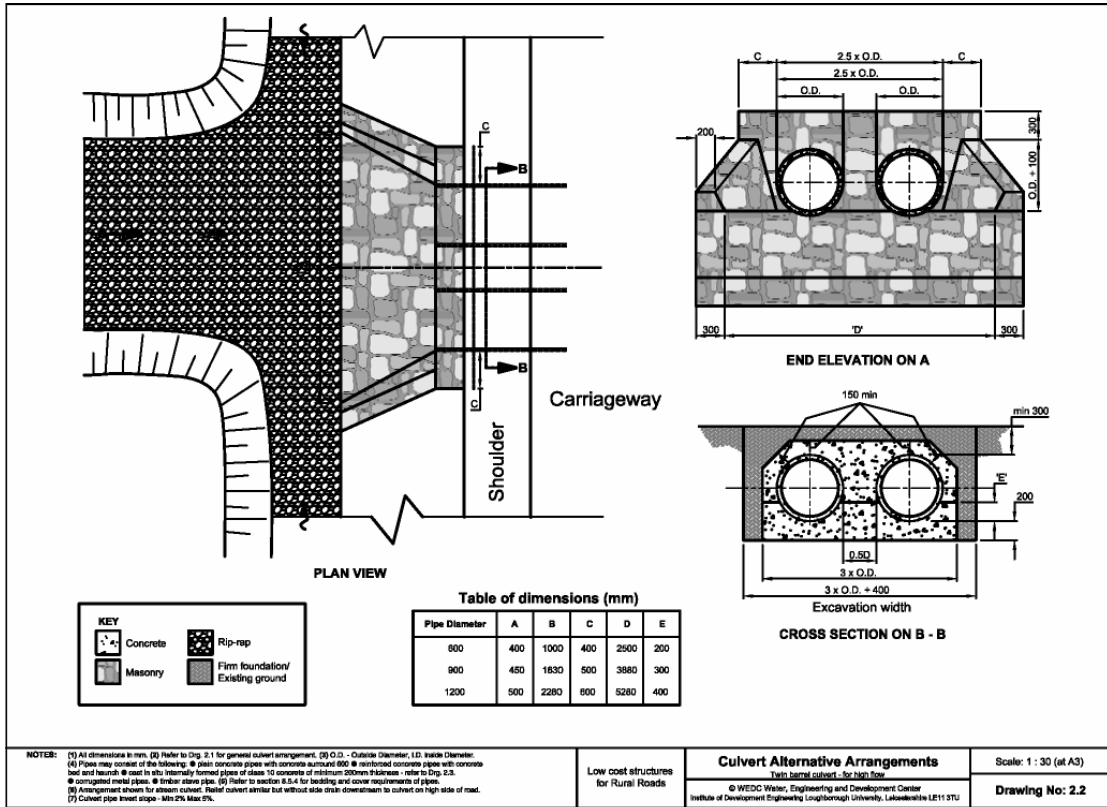
1. Drawing should be read in conjunction with Drawing 2.1 for general culvert arrangements.
2. Drawing shows 600mm diameter pipes. Table of dimensions A should be used for 900mm and 1200mm diameter pipes.

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
Preliminaries Total				
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding and pipe beds and haunches				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3. Culvert pipes				
Selected pipe material	m			
4. Mass concrete for pipe surrounds				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
5. Wire mesh for gabion baskets	m ²			
6. Tie-wire for gabion baskets	m			
Materials Total				
Labour	Unit	Quantity	Man day / unit	Days
1. Placing of the culvert pipes				
Excavation of watercourse/ road	m ³			
Mix, place and compact culvert bedding and haunches	m ³			

DESIGN DRAWINGS AND BILL OF QUANTITIES

Fix culvert pipes in place	m			
2. Masonry culvert headwalls, wingwalls, aprons and cut off walls				
Construct cut off walls and aprons	m ³			
Fix reinforcement hooks in downstream apron to secure gabion protection	No.			
Construct wingwalls and headwalls	m ³			
3. Pipe surround				
Mix, place and compact concrete pipe surrounds	m ³			
4. Gabion downstream protection				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			
Collect stones	m ³			
Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
5. Sundries				
Backfill and compact fill around culvert pipes in 300mm layers	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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



Alternative culvert arrangements: Drop inlet and cast insitu pipes - Drawing number 2.3

Applicability of the design

Drop inlet

- ◆ For culverts on intermediate sloping ground (refer to structure design section in Volume 1.)
- ◆ For relief culverts on long gradients

Cast in situ pipes

- ◆ General arrangement for cast in situ pipes

Notes about the Drawing and Bill of Quantities

1. Drawing should be read in conjunction with Drawing 2.1 for general culvert arrangement
2. Drop inlet
 - a. Width of inlet pit should be constructed to correspond to the width of side drain.
 - b. Depth of inlet pit will depend on slope of each specific site.
3. Cast in situ pipes
 - a. Drawing shows circular timber formwork. Other formwork configurations may be used eg. steel, arches or sections of a circle.

Drop inlet – Bill of Quantities

Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
Preliminaries Total				
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding and pipe bed and haunch				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3. Culvert pipe				
Selected pipe material	m			
4. Mass concrete for pipe surround				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
5. Wire mesh for gabion baskets	m ²			
6. Tie wire for gabion baskets	m			

DESIGN DRAWINGS AND BILL OF QUANTITIES

Labour	Unit	Materials Total		Days
		Quantity	Man day / unit	
1. Placing of the culvert pipe (drawing 2.1)				
Excavation of watercourse/ road	m ³			
Mix, place and compact culvert bedding and haunch	m ³			
Fix culvert pipes in place	m			
2. Masonry culvert headwalls, wingwalls, aprons and cut off walls (drawing 2.1)				
Construct cut off wall and apron	m ³			
Fix reinforcement hooks in downstream apron to secure gabion protection	No.			
Construct wingwalls and headwalls	m ³			
3. Drop inlet (drawing 2.3)				
Excavate drain for drop inlet	m ³			
Construct masonry drop inlet	m ³			
3. Pipe surround (drawing 2.1)				
Mix, place and compact concrete pipe surround	m ³			
4. Gabion downstream protection (drawing 2.1)				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			
Collect stones	m ³			
Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
5. Sundries				
Backfill and compact fill around culvert and drop inlet in 300mm layers	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				

DESIGN DRAWINGS AND BILL OF QUANTITIES

3. Staff allowances			
Supervisor	Man / day		
Artisan	Man / day		
		Total Other Costs	
Cost Summary	Cost		
Preliminaries			
Materials			
Labour			
Other Costs			
Total construction cost			

Cast in situ – Bill of Quantities

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			
3. Mass concrete for base of pipe				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
4. Class 20 concrete for pipe surround				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
5. Wire mesh for gabion baskets	m ²			
6. Tying wire for gabion baskets	m			
		Materials Total		

DESIGN DRAWINGS AND BILL OF QUANTITIES

Labour	Unit	Quantity	Man day / unit	Days
1. Placing of the culvert pipe				
Excavation of watercourse/ road	m ³			
Mix, place and compact blinding concrete	m ³			
Mix, place and compact mass concrete bed				
2. Masonry culvert headwalls, wingwalls, aprons and cut off walls				
Construct cut off walls and aprons	m ³			
Fix reinforcement hooks in downstream apron to secure gabion protection	No.			
Construct wingwalls and headwalls	m ³			
3. In situ pipe				
Fix pipe formwork in place	lump sum			
Mix, place and compact class 20 concrete pipe surround	m ³			
Remove pipe formwork after 3 days	lump sum			
4. Gabion downstream protection				
Excavate riverbed	m ³			
Assemble place and join gabion baskets in river bed	m ²			
Collect stones	m ³			
Fill gabion baskets	m ³			
Close and tie off wire baskets	m ²			
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				
1. Transport	km			
Delivery of materials	km			
Supervision vehicle	Lump sum			
2. Hand-tools and equipment (including depreciation cost of pipe formwork)				
3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			

DESIGN DRAWINGS AND BILL OF QUANTITIES

	Total Other Costs		
Cost Summary	Cost		
Preliminaries			
Materials			
Labour			
Other Costs			
Total construction cost			

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

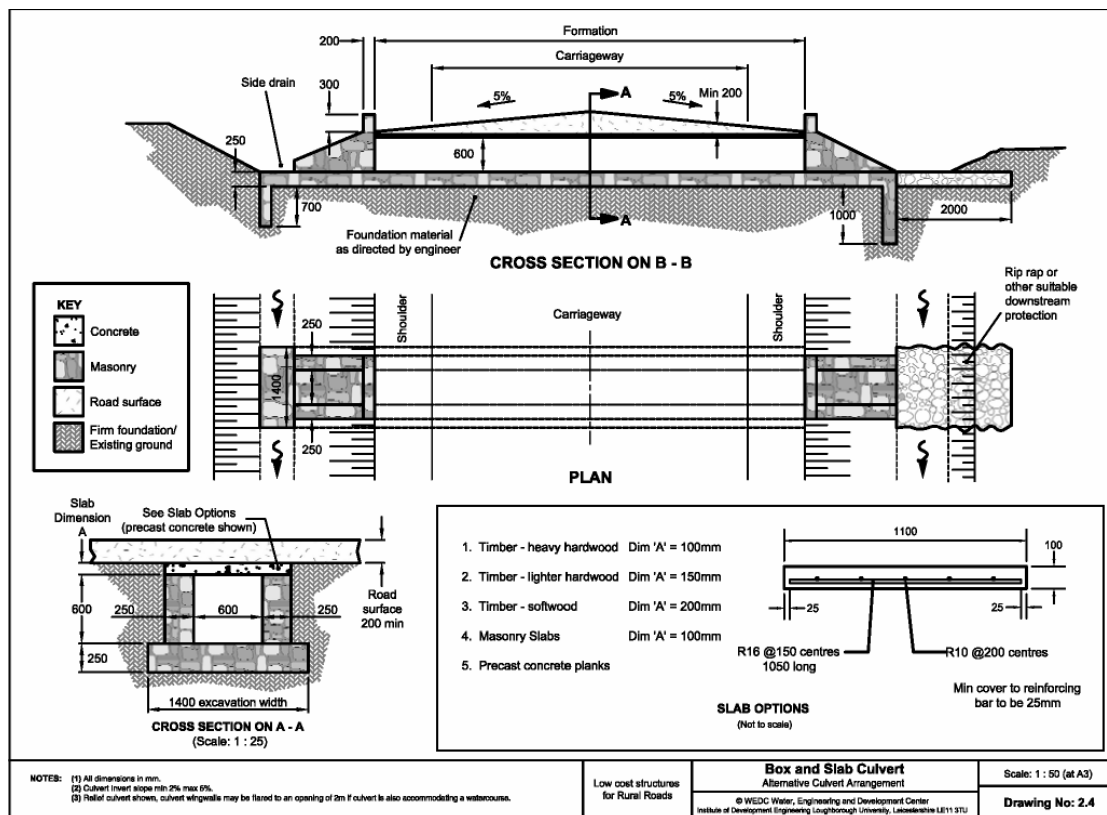
Notes about the Drawing and Bill of Quantities

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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

	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

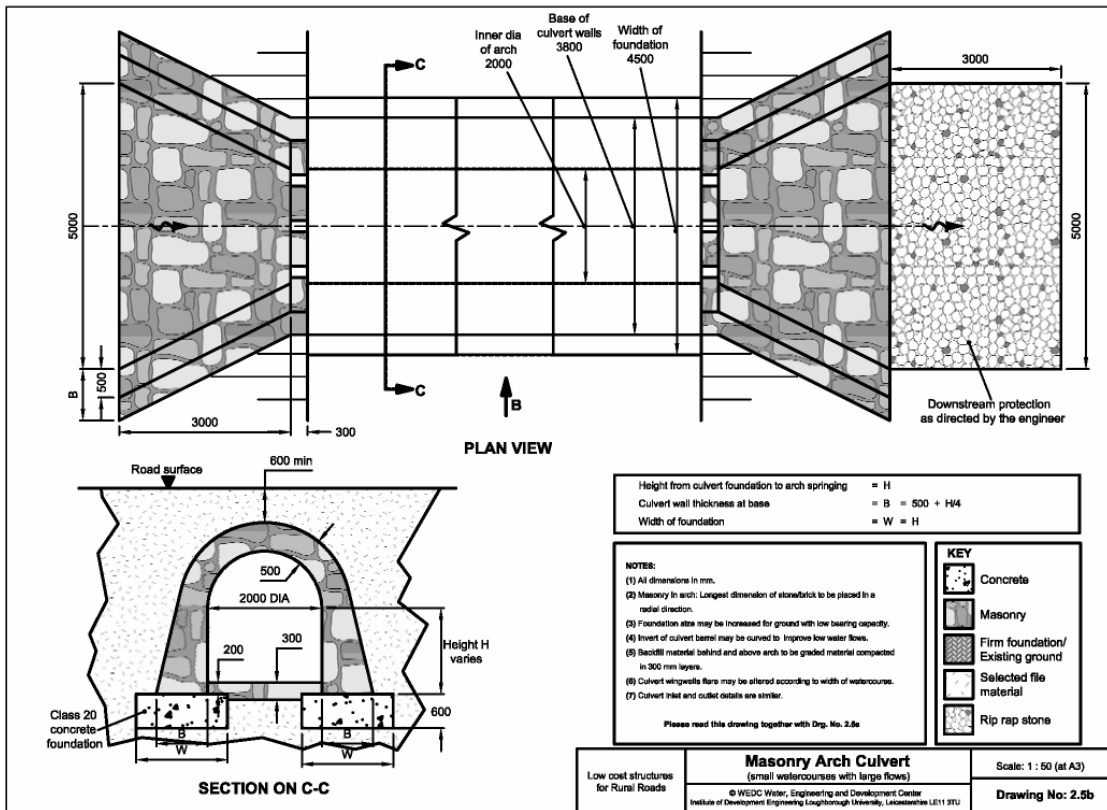
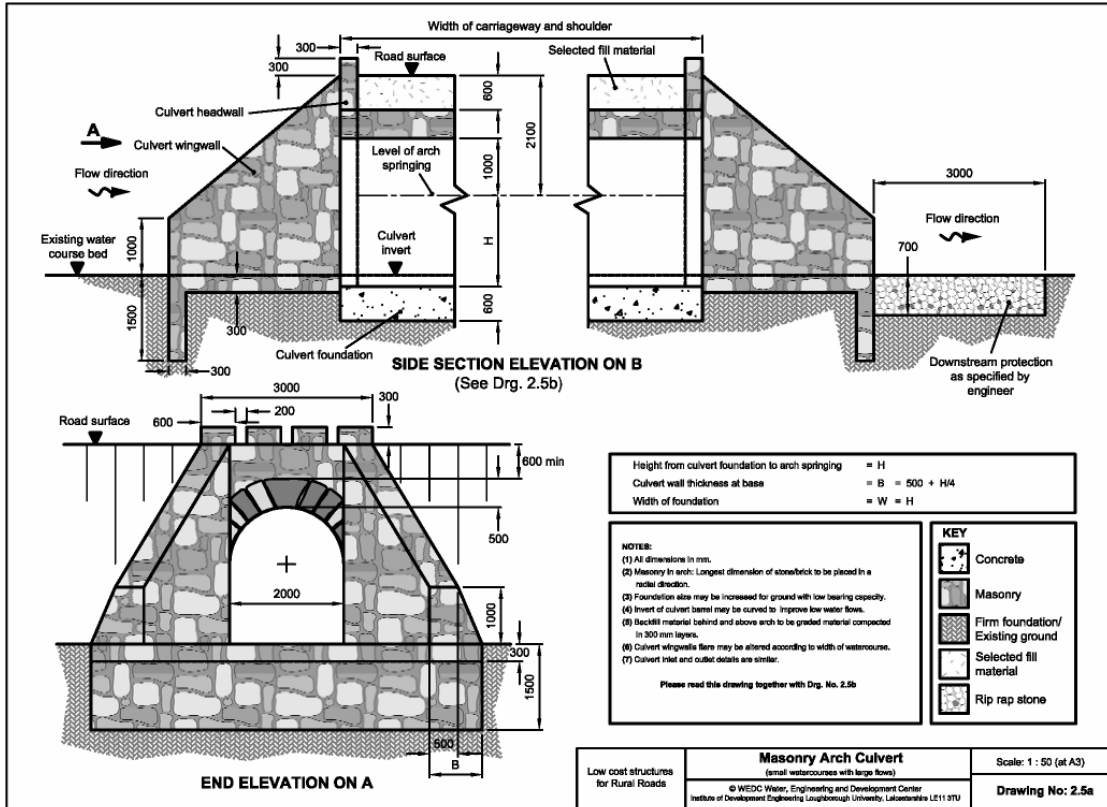
1. Drawing shows arch constructed from masonry. Corrugated steel sheets may be used (refer to Volume 1).

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				

DESIGN DRAWINGS AND BILL OF QUANTITIES

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				
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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



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

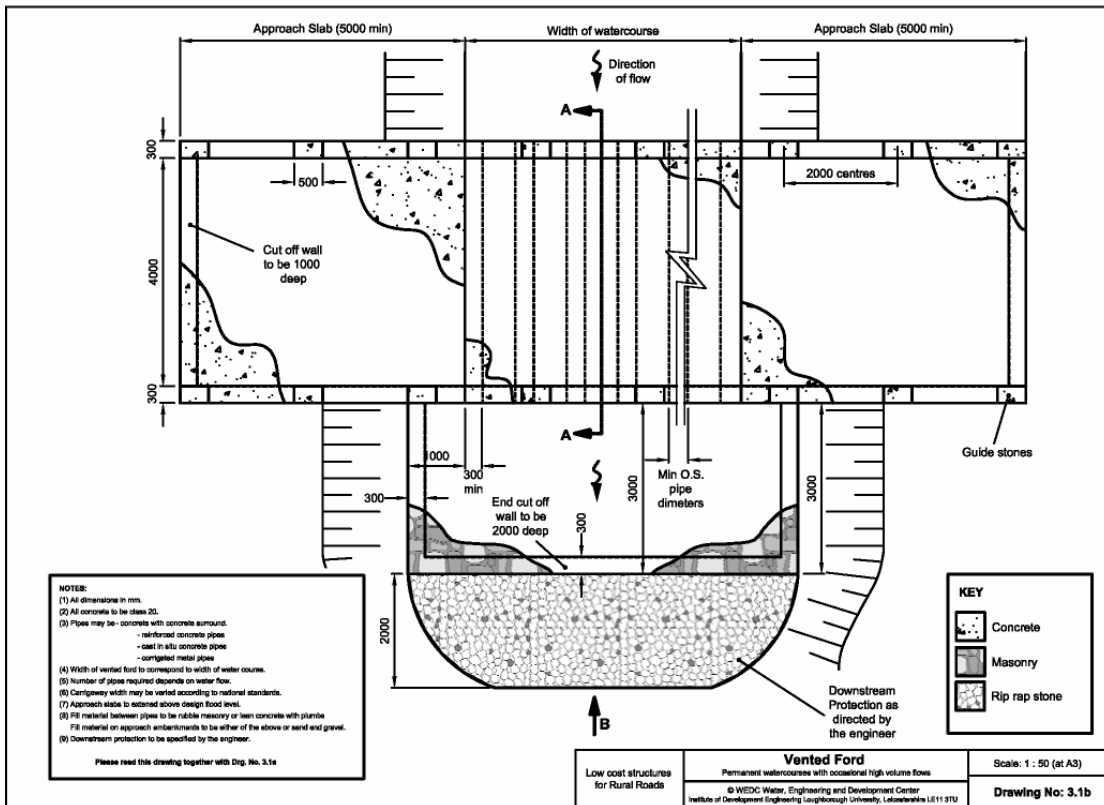
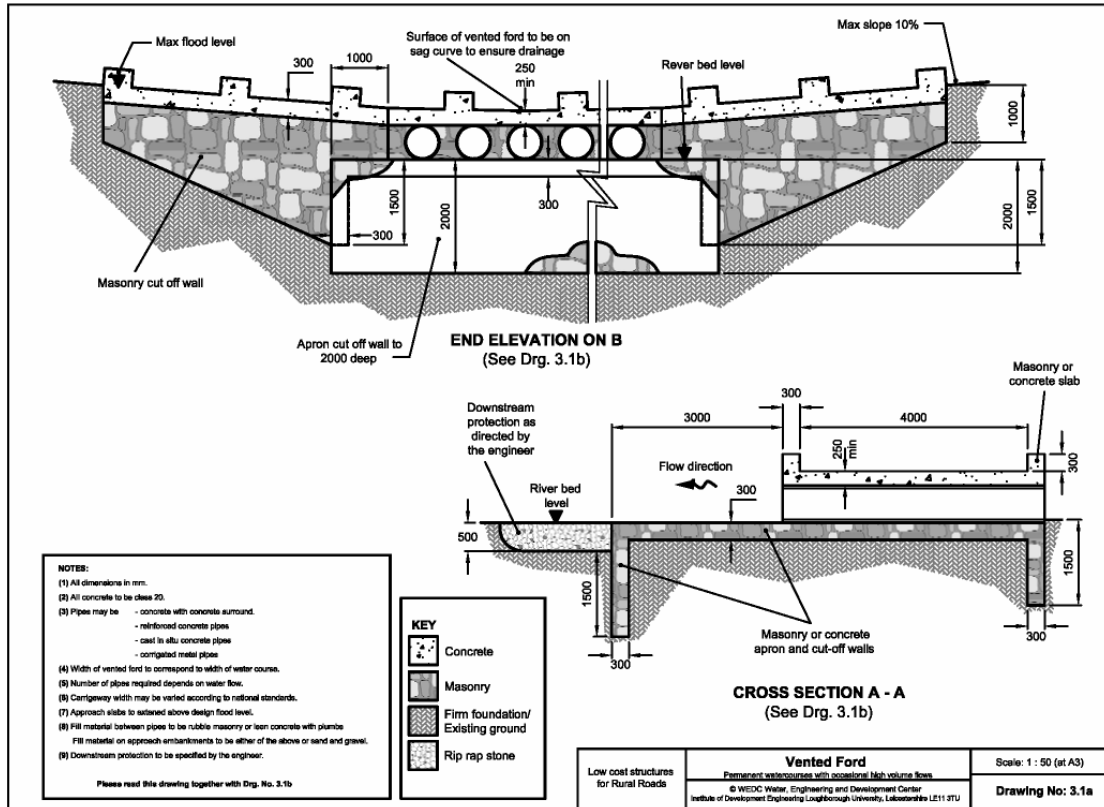
1. Road level on the drawing is shown approximately 300mm above the top of vent pipes. The road level may be raised by increasing the height of vented drift sides and fill over pipes if dictated by specific site conditions.

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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

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				
	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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



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.

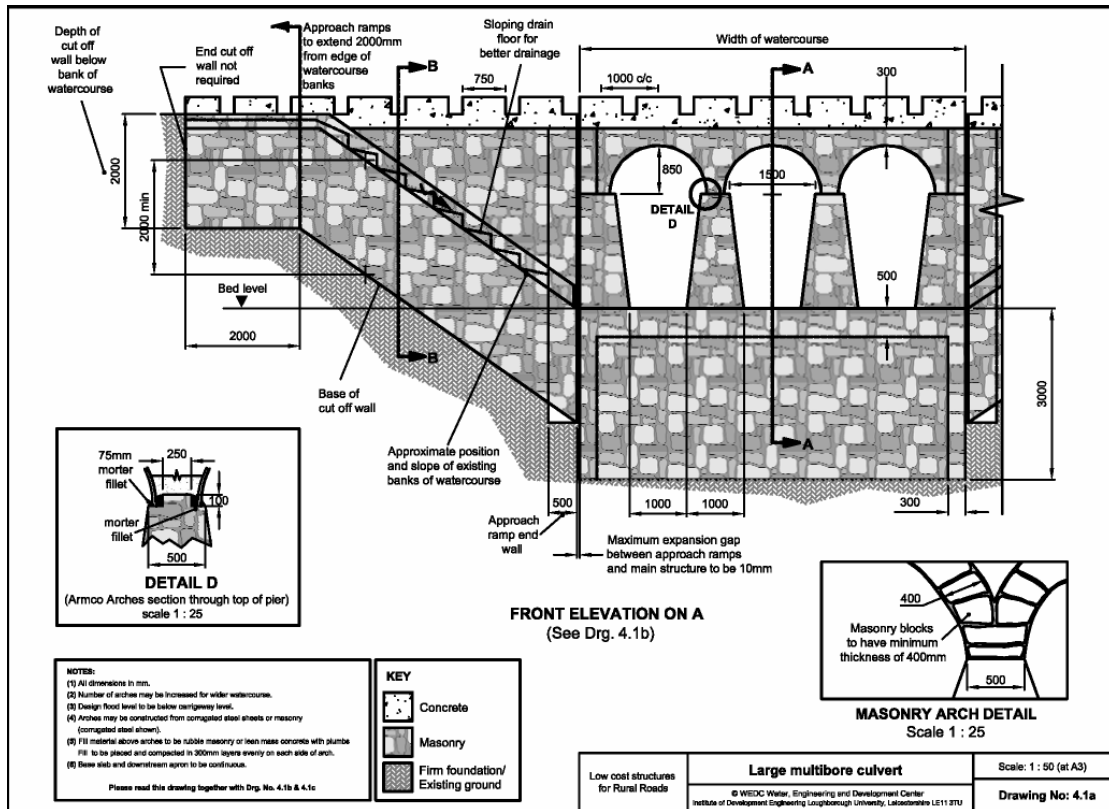
Preliminaries	Unit	Quantity	Rate	Cost
See previous sheet				
		Preliminaries Total		
Materials	Unit	Quantity	Rate	Cost
1. Lean Concrete for blinding				
Cement	50 kg bag			
Sand	m ³			
Aggregates	m ³			
2. Stone masonry (approach ramps)				
Stone	m ³			
Cement	50 kg bag			
Sand	m ³			
3. Stone masonry (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				

DESIGN DRAWINGS AND BILL OF QUANTITIES

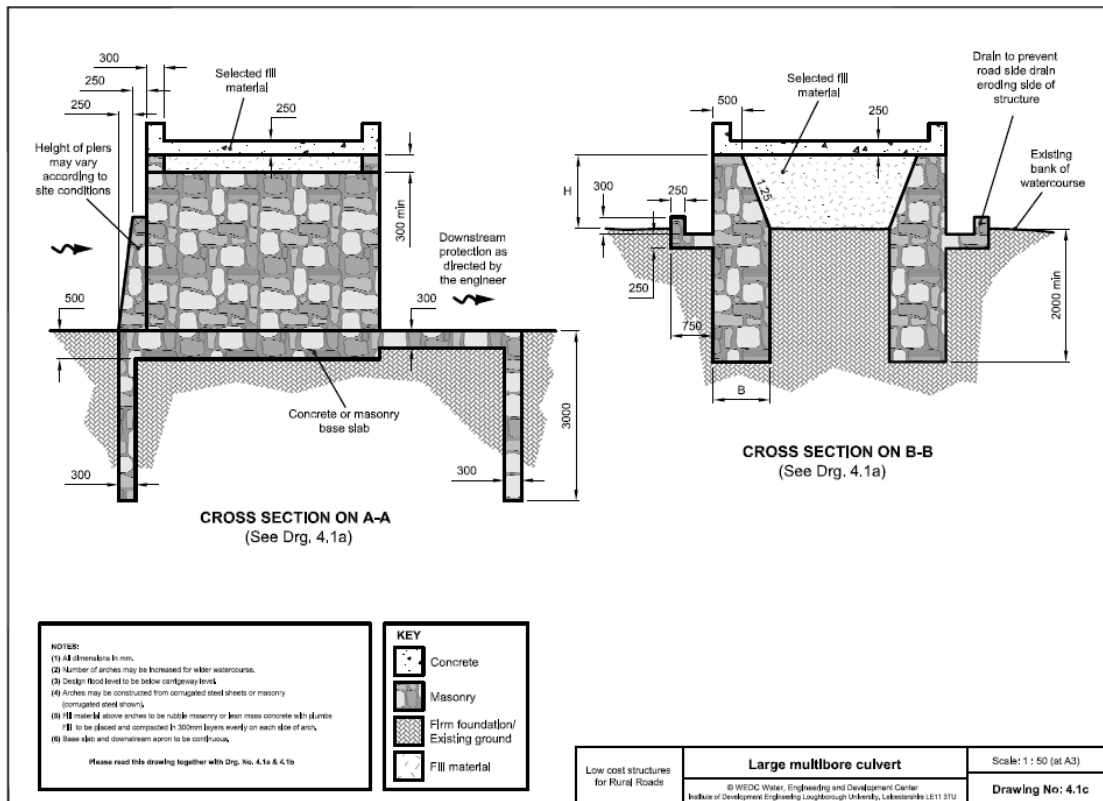
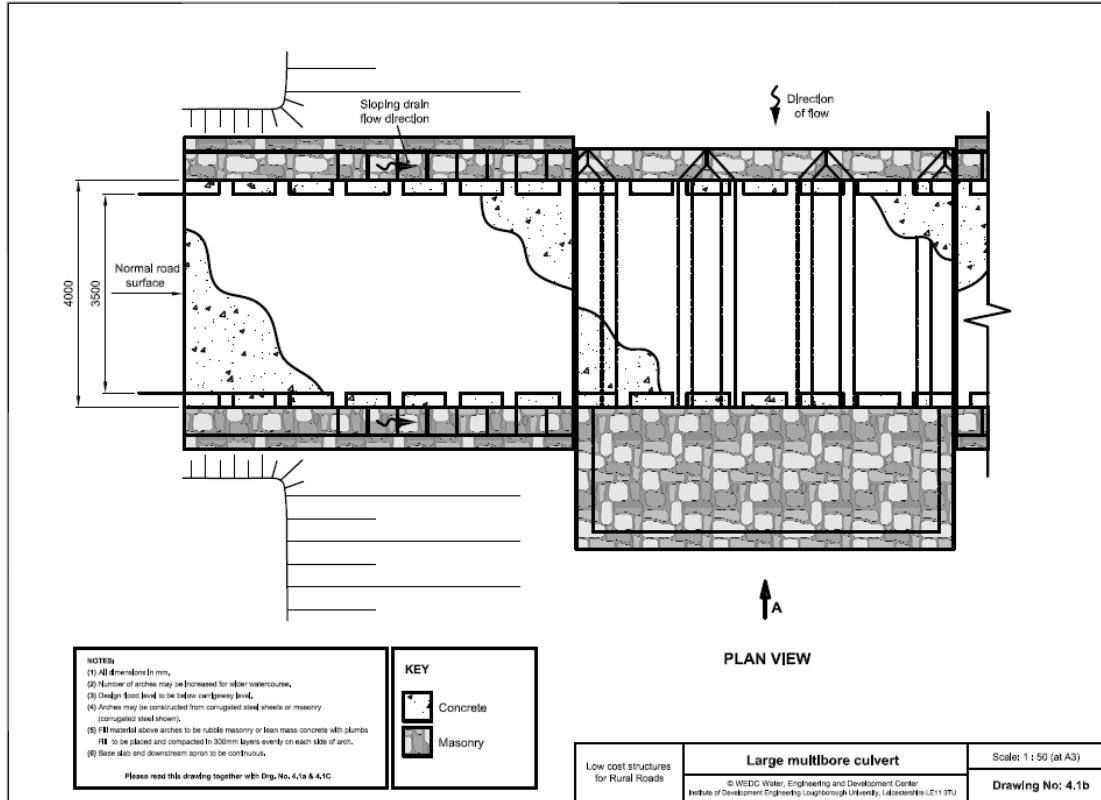
Excavation of watercourse and banks	m ³			
Mix, place and compact blinding concrete	m ³			
Construct masonry apron and cut off walls	m ³			
2. Construction of approach ramp walls				
Excavation of watercourse banks	m ³			
Mix, place and compact blinding concrete	m ³			
Construct approach ramp side and 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 of 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				

DESIGN DRAWINGS AND BILL OF QUANTITIES

3. Staff allowances				
Supervisor	Man / day			
Artisan	Man / day			
		Total Other Costs		
Cost Summary		Cost		
Preliminaries				
Materials				
Labour				
Other Costs				
Total construction cost				



DESIGN DRAWINGS AND BILL OF QUANTITIES



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

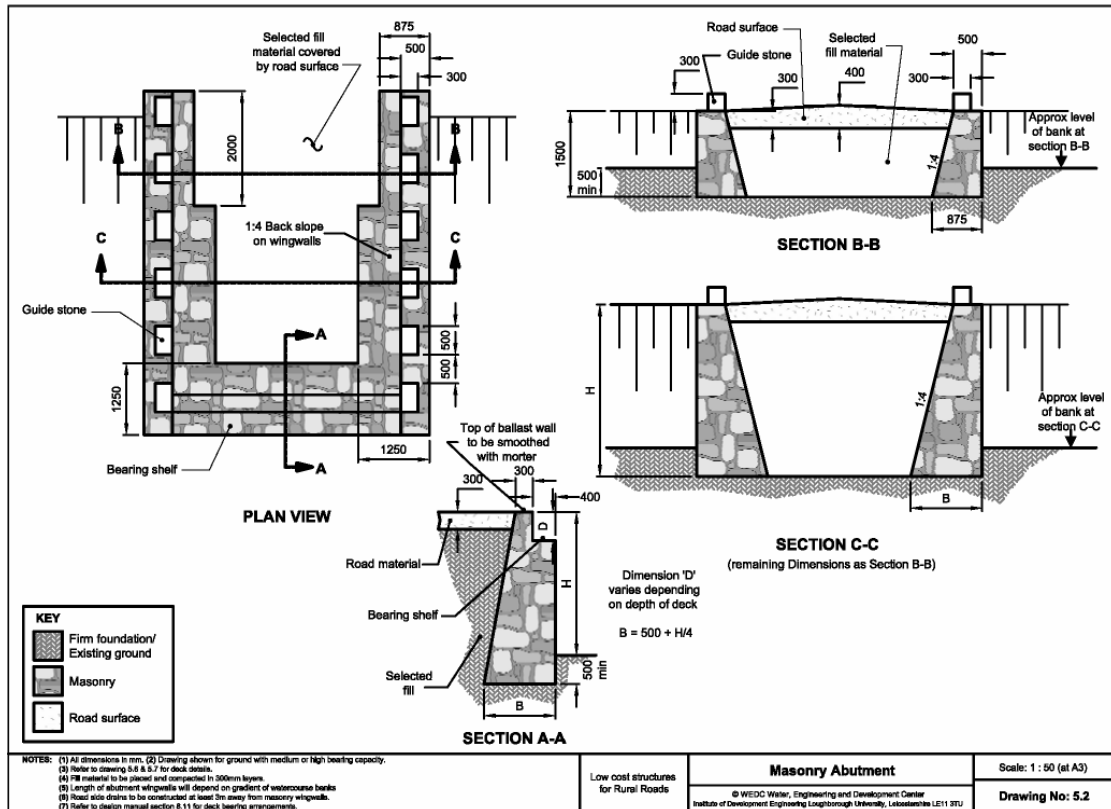
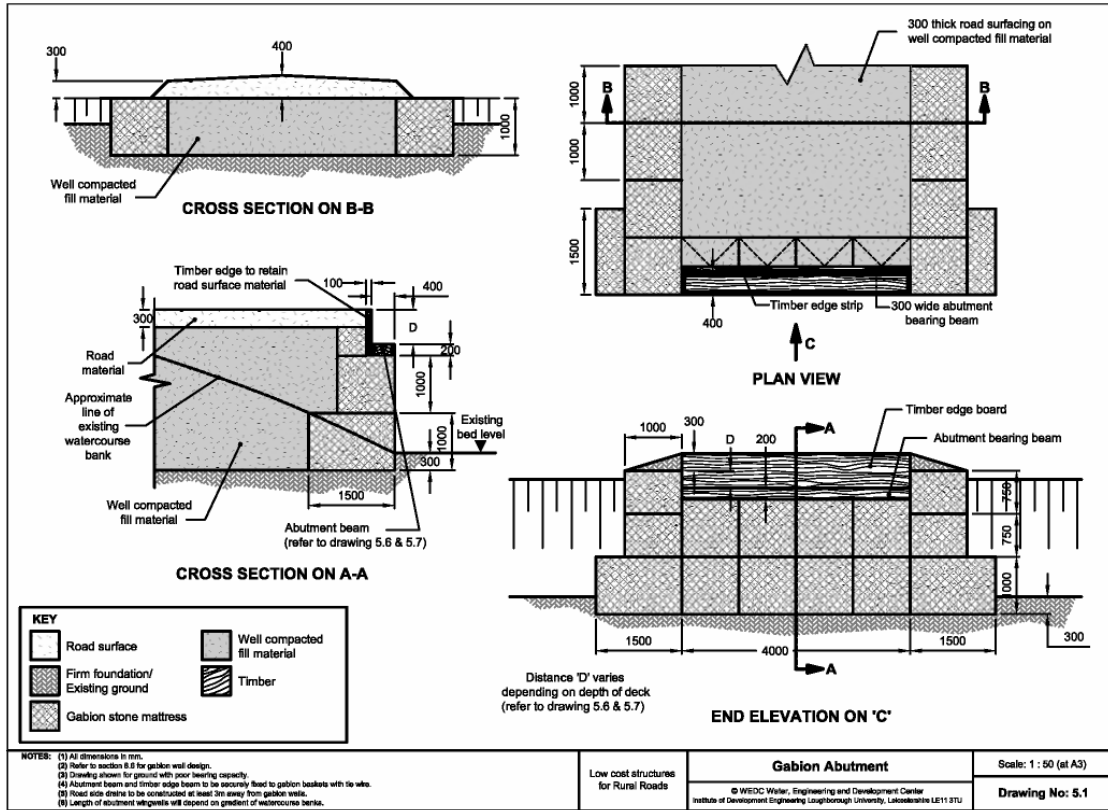
1. Suitable for use as a high or low level abutment.
2. Dimensions of specific gabion baskets should be determined according to the site.
3. Following construction, gabion baskets can be covered in soil and grass planted to prevent theft of basket wire.

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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

	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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

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

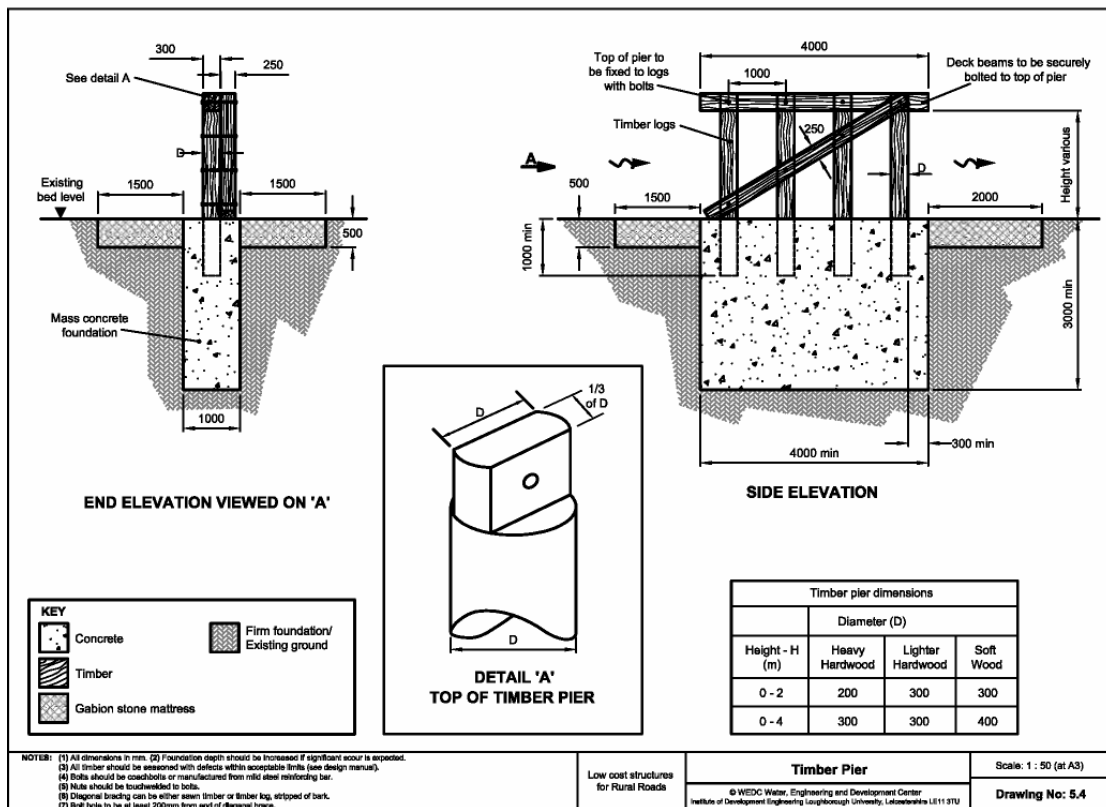
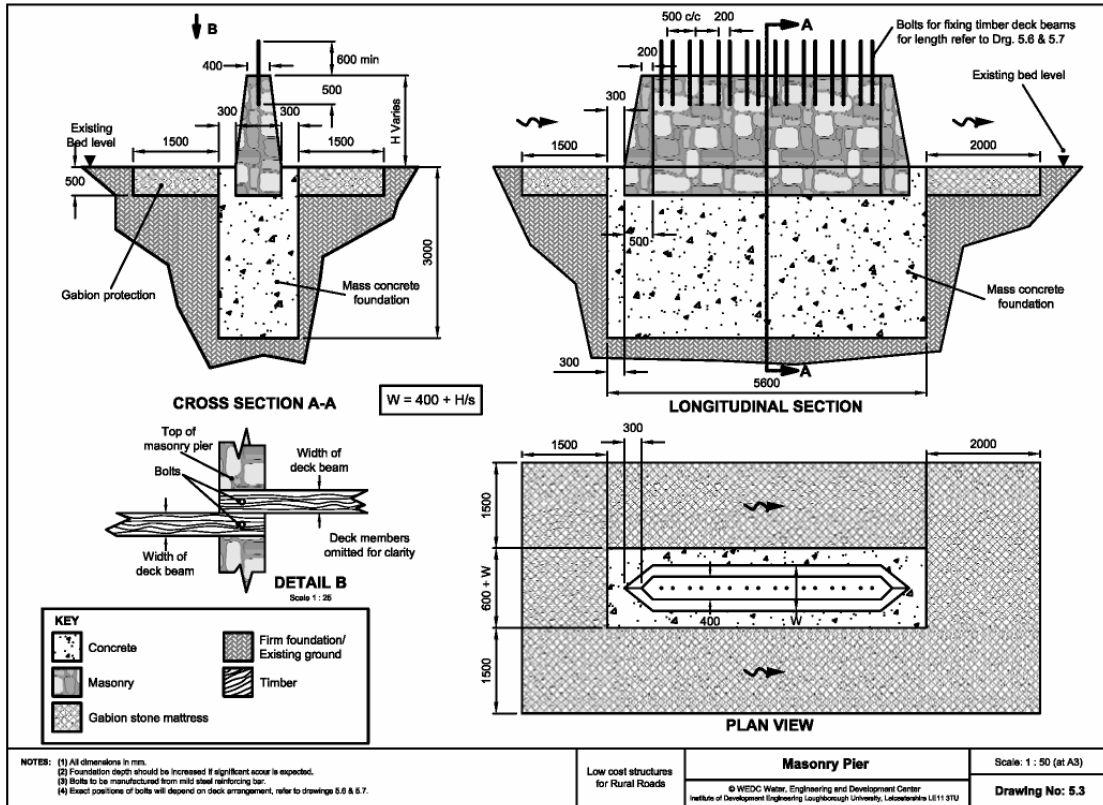
1. Bolts shown in the top of the pier are for fixing timber beams. The exact position will depend on the deck arrangement.
2. The construction of the foundation and pier may require significant temporary work to divert the water flow, which could significantly increase cost.

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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



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				
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.			

DESIGN DRAWINGS AND BILL OF QUANTITIES

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

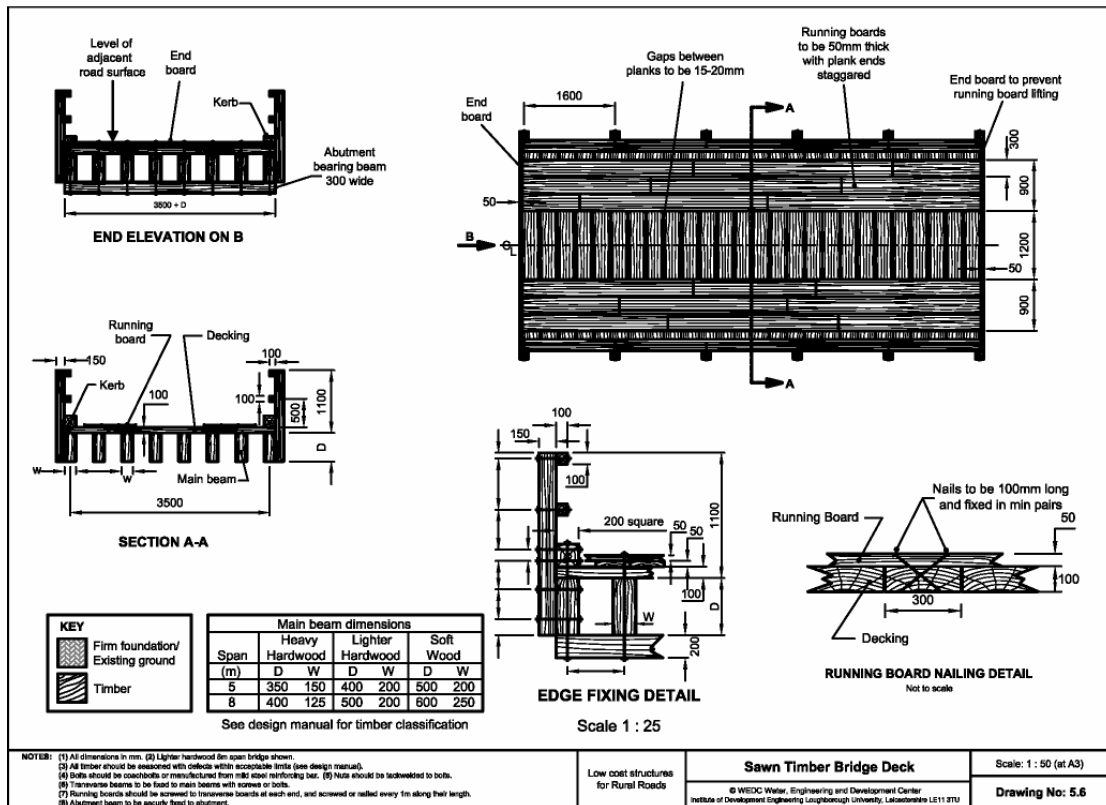
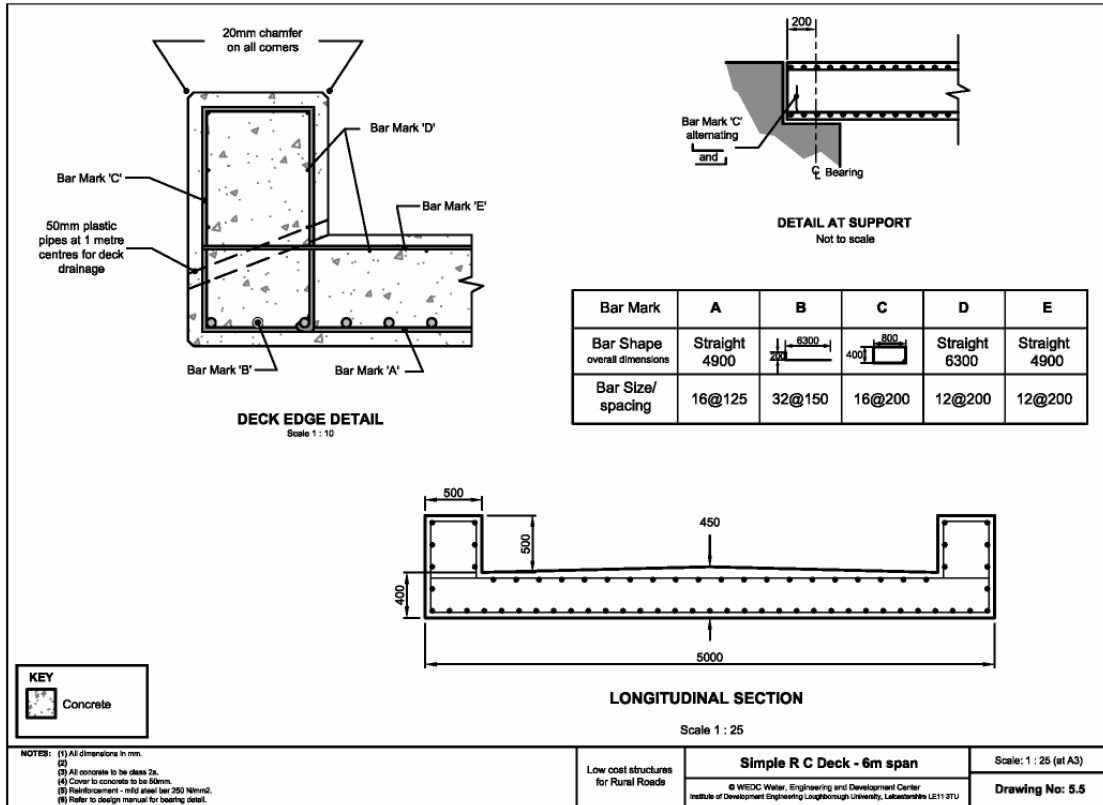
1. The drawing shows the use of mild steel reinforcing bars which have a yield strength of at least 250N/mm².
2. For longer spans refer to ORN 9

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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

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				

DESIGN DRAWINGS AND BILL OF QUANTITIES



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				
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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

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			

DESIGN DRAWINGS AND BILL OF QUANTITIES

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				

DESIGN DRAWINGS AND BILL OF QUANTITIES

