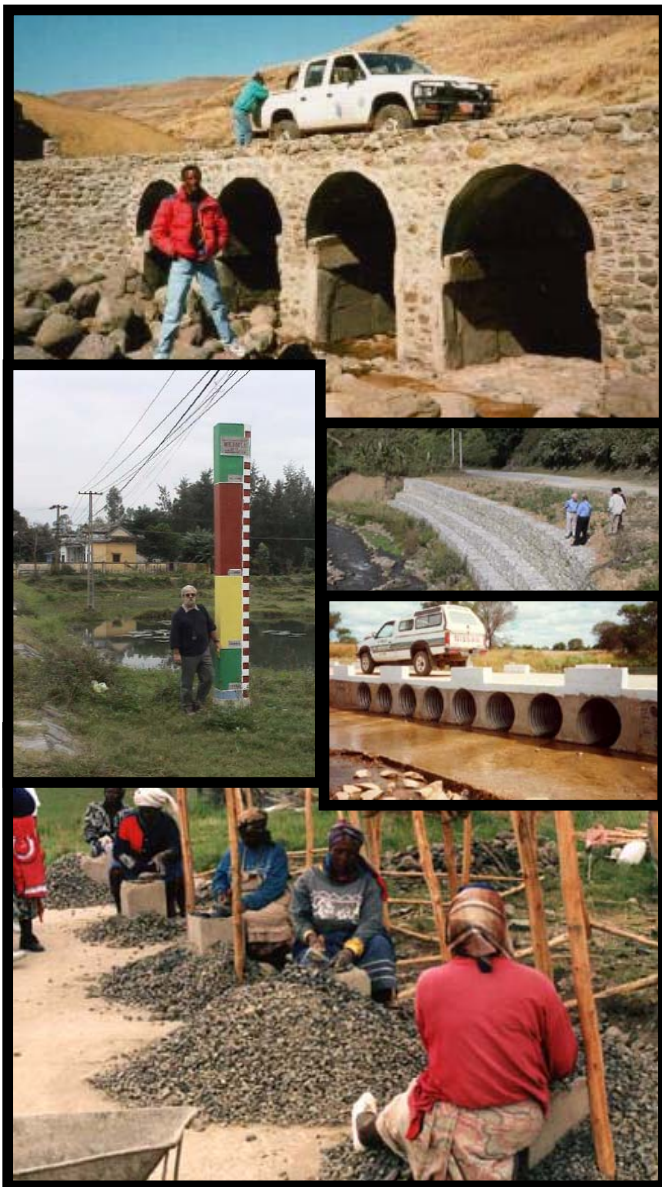




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## Low Cost Structures for Rural Roads: A Practical Planning, Design, Construction & Maintenance Guide



*Final Draft  
for Comment*



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Final Draft English Version for comment  
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# **Low Cost Structures For Rural Roads**

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

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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 and affordable techniques, standards and specifications into everyday practice, academic curricula and training.

**This draft version of the document is being web-posted by gTKP ( [www.gtkp.com](http://www.gtkp.com) ) to invite comments and contributions from practitioners. Please correspond before 30 September 2009 with Rob Petts, Theme Champion, Rural Transport, gTKP: [rob.petts@gtkp.com](mailto:rob.petts@gtkp.com)**

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## Glossary

The list below contains the engineering words along with their meanings as they have been used in the manual. Words in italics are also listed in the glossary.

Abutment	The support for a bridge which supports the deck and retains the material forming the approach embankments.
Aggregate	Stone, sand, gravel or other inert material forming the major constituent of concrete. Fine aggregate is less than 5mm in diameter, coarse aggregate is greater than 5mm in diameter.
Approach embankments	The earthworks that carry a road to a bridge, culvert or other structure
Apron	The flat area at the inlet and outlet of a culvert or the area of the watercourse bed which is protected downstream of a structure.
Arch bridge	A structure which supports a road over a gap, which consists of a curved beam spanning between the abutments.
Barrel	1. The main part of an arch which supports the fill material. 2. The pipe or box part of a culvert which contains the water.
Bearing	The connection between the bridge deck and abutment or pier. Bearings allow the deck to move slightly eg. due to thermal expansion.
Bill of Quantities	A list of all the materials, labour, supervision, transport and other requirements required to build a structure, which enables a total cost of the structure to be calculated.
Bio-engineering	The use of vegetation in engineering design to protect natural terrain and man-made structures from the problems associated with soil erosion
Block(s)	Blocks are uniformly sized masonry units, made from aggregates and cement and designed to satisfy standards requiring a minimum crushing strength.
BoQ	Bill of Quantities
Brick(s)	A rectangular masonry unit made of baked clay, typically with dimensions 225 x 112.5 x 75mm.
Bridge	A structure with a span of 3 metres or more which permits the crossing of a watercourse (or another road or railway etc.) consisting of abutments and a deck. Bridges may also have wingwalls, approach embankments and pier(s). [This manual considers bridges with spans up to 10m]
Carriageway	The part of the road that is normally driven over by vehicles.
Catchment area	The area drained by a watercourse.
Causeway	Similar to a vented drift. Causeways tend to be longer than vented drifts and have a larger number of openings
Cement	A grey powder which is one of the constituents of concrete
Cofferdam	A temporary dam to exclude water from a submerged area allowing construction or maintenance work to be carried out.
Concrete	A manmade material which has the same properties as stone and is made from cement, aggregate and water.
Contours	Lines on a map which join points of the same height.
Cover	1. The thickness of fill material between the top of a culvert pipe or arch and the road. 2. The thickness of concrete between its outside face and a

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	reinforcement bar.
Culvert	A small structure which allows water to flow under a road. Culverts are usually up to 1.2m in diameter and may be round, square or arched.
Dead load	The weight of a structure including any items fixed to it.
Debris rack / grill	An open structure built upstream of a culvert, drift or bridge to collect debris (eg. driftwood) and thereby prevent clogging of the road structure.
Deck	A part of a bridge which spans between abutments or piers and is driven on by traffic.
Design flood	The highest water level used for the design of a structure which has a certain return period.
Discharge	The amount of water which flows past a point in a watercourse in a given time.
Downstream protection	Engineering work carried out in a watercourse to prevent scour or erosion.
Dressed (stone)	Quarried stone that has been shaped into rectangular blocks.
Drift	A simple structure, constructed from imported materials, which provides vehicles with a firm surface to drive through a watercourse.
Embankment	An earth bank which supports a road above the normal ground level.
Falsework	Temporary boards or sheets and other materials used to support the bottom of concrete during hardening eg. on the deck of a bridge.
Flood	When the water level in a watercourse rises due to heavy rain. (Flood in this manual should be taken to mean the design flood).
Ford	A structure constructed from the existing watercourse bed to improve the ability of vehicles to drive across the watercourse.
Formwork	1. Temporary boards or sheets and other materials used to contain concrete and produce its final shape during hardening. 2. Temporary boards or sheets used to provide support and give arches their shape during construction.
Foundation	The lowest part of a structure on which the rest of the structure is constructed. Foundations are usually under the ground.
Gabion	Stone filled wire cage. Gabions can be used for retaining walls, abutments and downstream protection.
Headwall	A wall at each end of a culvert pipe used to hold up the soil.
High flood	The highest flood that is known to have occurred in a watercourse.
Invert	The floor of a culvert or channel.
Invert slab	See <i>drift</i>
Irish bridge	See <i>drift</i>
Kerb	A stone or step at the edge of the carriageway.
Large bore culvert	A culvert with a diameter of greater than 1m.
Live load	A temporary load on a structure eg. pedestrian or vehicle.
Low level water crossing	Drift, splash, causeway or vented ford.
Masonry	A generic term used to describe the following materials; <i>bricks, blocks, dressed stone, random stone, rubble.</i>
Mass concrete	Concrete without any reinforcing steel.
MFL	Maximum Flood Level
Mortar	Mortars are composed of clean sand and a binding agent and are used to bond masonry units together.
Outfall	The point where a culvert or channel discharges water.
Overtopping	When water flows are greater than the capacity of a channel or culvert, water will flow onto surrounding ground, above the channel.
Parapet	The protective barrier, wall or railing at the edge of a bridge deck or other structure.

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Permeability	The rate at which water (or other liquid) will flow through the soil.
Pier	A wide column or wall used to support long bridge decks.
Pile	A long thin pole driven into the ground, used as a foundation. Piles can be made from timber, steel or concrete. (the use of piles is not covered in this manual).
Piped drift	See <i>vented ford</i>
Plasticiser	A plasticiser is an additive to the mortar used in small quantities to improve the workability of the mix or to achieve the same workability with less water, thus improving both strength and durability.
Plum	A large stone put into mass concrete to reduce the volume of cement required.
Pozzolanic	A material which when mixed with water displays similar properties to cement.
Prestressed (concrete)	A method of increasing the strength of concrete using high strength steel bars (not covered in this manual).
Random stone masonry	Masonry constructed from stones as they came from the quarry with minimal dressing.
Reinforcement (concrete)	Steel rods or mesh placed into mass concrete to increase the strength of concrete.
Reno mattress	A long wide, flat <i>gabion</i> .
Retaining wall	A wall used to hold back soil.
Return period	The average time between two storms producing the same design flood
Rip-rap	Stones, generally between 5 and 100kg, used to protect a watercourse from scour.
Road inventory	A list or database of all the structures on the road network, which allows planning of inspection and maintenance.
Rubble masonry	See <i>Random stone masonry</i> .
Running board	Boards which are fixed to the bridge deck in the direction of traffic flow, on which the vehicle wheels run. They provide protection to the floor planking from wear and tear from heavy vehicles.
Runoff	Water which flows over the ground as a result of rain
Scour	The deepening and/or widening of a watercourse or channel due to erosion by flowing water.
Settlement	Small movements (downwards) of part or all of a structure due to compression of the ground below.
Shuttering	The part of formwork that is actually in touch with the concrete.
Soffit	The highest part of an arch shape eg. in a culvert pipe.
Splash	As <i>ford</i>
Springing	The ends of the curve of an arch.
Substructure	All the parts of a bridge except the deck and associated items (see superstructure).
Superstructure	The deck, beams, parapets and other items associated with the deck of a bridge.
Surcharge	Material placed above and behind a <i>retaining wall</i> which has the effect of applying a horizontal load on the wall.
Topography	The characteristics of land in terms of elevation, slope and orientation.
Trial pit	A pit dug to determine the ground conditions at a proposed structure site.
Vented ford / drift	A low level structure built across streams or rivers with openings to allow water to pass through. After heavy rain additional water may flow over the top of the structure submerging the roadway.
Watercourse	A natural drainage channel in which water may or may not be



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	flowing.
Watershed	An imaginary line along a ridge between two catchment areas, from which water flows away in both directions.
Watertable	The level at which the ground is fully saturated with water.
Waterway	An artificial (manmade) channel designed to carry water.
Weep holes	Small openings (often pipes) in the bottom of retaining walls and abutments to allow drainage of water from behind a structure, reducing the pressure on that structure.
Whole life cost	The total cost of a structure which includes: design, construction, regular and periodic maintenance.
Wingwall	A retaining wall at the end of a bridge abutment to support the embankment fill.