

Republic of the Union of Myanmar



Low Volume Rural Road Design Manual

**Ministry of Construction
Department of Rural Road Development**

2020

Foreword

Low Volume Rural Roads (LVRR)s provide important links from homes, villages and farms to markets and offer the public access to health, education and other essential services. These roads also provide important links between rural communities and the main Myanmar road network.

There is a wealth of local and international information, experience and research that when utilised, can change past practices and thinking and provide Myanmar with an enhanced and affordable rural road network. To benefit fully from these advances and to see necessary improvements implemented on the ground, the Ministry of Construction, Department of Rural Road Development (DRRD) has in partnership with the UKAID-Funded ReCAP initiative commissioned this comprehensive national road design manual specifically for low volume roads.

Compilation of the documents was undertaken by H.P. Gauff Ingenieure GmbH & Co. KG -JBG- in close cooperation with technical specialists from DRRD and with the key input from representatives from the Ministry of Construction, other key ministries, local industry, national and local authorities and other relevant road projects funded by World Bank, ADB, KfW and JICA. Local experience was a vital component on the geometric, earthwork, drainage, pavement and safety issues for this volume.

This Manual has been structured in such a way that it can be easily updated and, in this context, can be considered a living document to be amended and improved as additional key research, information and experience becomes available.

On behalf of the Ministry of Construction and DRRD I would like to take this opportunity to thank the Department for International Development (DFID) of the United Kingdom, the ReCAP/AsCAP team for support in the development of the Myanmar Low Volume Rural Roads Design Manual. I would also like to extend my gratitude and appreciation to all of the industry stakeholders and participants who contributed their time, knowledge and effort during the development of the documents.

I trust that the Myanmar Low Volume Rural Roads manual will provide the essential information needed to guide our road asset managers and design engineers in the provision of an appropriate and sustainable rural road network.

His Excellency Han Zaw

Minister of Construction

Preface

Purpose

The purpose of the Manual is to serve as a nationally recognised document, the application of which is deemed to serve as a standard reference and ready source of good practice for the planning, investigation, design and construction of low volume rural roads (LVRR)s in Myanmar. In so doing, it will assist practitioners in developing the country's LVRR network in a cost effective, environmentally optimized and sustainable manner and hence support the Myanmar Government's objectives for rural development as defined in the National Strategy for Rural Roads and Access.

This Design Manual provides practical guidance to roads practitioners responsible for the design of low traffic earth, gravel or paved roads throughout Myanmar. The Manual has been drafted to be fully adaptable for use by different stakeholders, at national, state, township and local level administered by authorities, enterprises or communities.

How To Use This Manual

This manual is designed to help you locate information quickly and easily. Each Chapter contains the following information:

SECTION A: KEY PRINCIPLES

Chapter 1	Introduction
Chapter 2	Policy, Standards and Specifications
Chapter 3	The Approach to LVRR Design
Chapter 4	Myanmar Road Environments

SECTION B: DESIGN

Chapter 5	Ground Investigations
Chapter 6	Geometric Design
Chapter 7	Surfacing and Pavement Design
Chapter 8	Construction Materials
Chapter 9	Cross Drainage and Small Structures
Chapter 10	Earthworks
Chapter 11	Design Process

SECTION C: IMPLEMENTATION

Chapter 12	Construction
Chapter 13	Asset Management
Chapter 14	Technical Audit

Acknowledgements

We would like to acknowledge the contribution of the AsCAP partner DRRD and particularly the staff in the district and state offices of DRRD, project consultant staff of Rural Road and Access Project and Rural Development Program RRAP and RDP for all their assistance and sharing of information. We further thank all stakeholder organisations and development cooperation partners for their time and information shared.

Abbreviations and Acronyms

\$	United States Dollar (US\$ 1.00 ≈ provide conversion to local currencies)
£	GBP – Great Britain Pounds (£ 1.00 ≈ MK 2,024.0)
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
ARRB	Australian Road Research Board
AASHTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
AfCAP	Africa Community Access Partnership
AfDB	African Development Bank
AFNOR	Association Française de Normalisation
ARI	Average Return Interval
AsCAP	Asia Community Access Partnership
ASTM	American Society for Testing and Materials
BMMS	Bridge Maintenance Management System
BoQ	Bill of Quantities
CPT	Cone Penetration Test (“Dutch” Cone)
CBR	California Bearing Ratio
CRD	Central Road Database
CRRN	Core Rural Road Network
CS	Cape Seal
DBM	Dry-Bound Macadam
DBST	Double Bitumen Surface Treatment
DCP	Dynamic Cone Penetrometer
DCS	Double Chip Seal
DDG	Deputy Director General
DEM	Digital Elevation Model
DFID	Department for International Development
DG	Director General
DoLIDAR	Department of Local Infrastructure Development and Agricultural Roads
DPBANRD	Department of Progress of Border Areas and National Races Development
DRD	Department of Rural Development (DOALI)
DRRD	Department of Rural Road Development (MoC)
DOB	Department of Bridges (MoC)
DOH	Department of Highways (MoC)
DOS	Double Otta Seal
DOT	Department of Transportation
ECD	Environmental Conservation Department
EOD	Environmentally Optimised Design

EHP	Eastern Highland Province
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
ENS	Engineered Natural Surface
EOD	Environmentally Optimised Design
esa	equivalent standard axles
FED	Final Engineering Design
FHWA	Federal Highway Administration
FMS	Flood Management System
FS	Feasibility Study
GIS	Geographical Information System
GM	Grading Modulus
GoM	Government of Myanmar
GPS	Global positioning system
GWC	Gravel Wearing Course
HPS	Hand-Packed Stone
IDF	Intensity Duration Frequency
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IFI	International Finance Institute
IMT	Intermediate Transport
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
LIC	Lower Income Country
LVR	Low Volume Road
LVRR	Low Volume Rural Road
LVRRDM	Low Volume Rural Road Design Manual
LWC	Low-Water Crossing
masl	meter above sea level
MCEA	Myanmar Construction Entrepreneur Association
MES	Myanmar Engineering Society
mesa	million equivalent standard axles
MLDM	Myanmar LVRR Design Manual
MOALI	Ministry of Agriculture, Livestock and Irrigation
MOBA	Ministry of Border Affairs
MoC	Ministry of Construction
MOECAF	Ministry of Environmental Conservation and Forestry
MONREC	Ministry of Natural Resources and Environmental
NASA	National Space Agency (USA)
NCDDP	National Community Driven Development Project

NCDP	National Comprehensive Development Plan
NEQG	National Environmental Quality Guidelines
NMT	Non-Motorised Traffic
NRC	Non-reinforced Concrete
NSRRA	National Strategy for Rural Road and Access
ORN	Overseas Road Note
PCU	Passenger Carrier Unit
PED	Preliminary Engineering Design
PFS	Pre-Feasibility
PMMS	Pavement Maintenance Management System
PMU	Project Management Unit
QA	Quality Assurance
QC	Quality Control
RAI	Rural Access Index
RAMS	Road Asset Management System
RDU	Research and Development Unit
ReCAP	Research for Community Access Partnership
RFP	Request for Proposal
RMMS	Routine Maintenance Management System
RRAP	Rural Road and Access Project (DRRD with ADB funding)
RTS	Road Transport Services
SBL	Sand Bedding Layer
SAD	Self-administered division
SADC	Southern African Development Committee
SANRAL	South African National Roads Agency
SAZ	Self-administered zone
SCS	Single Chip Seal
SBST	Single Bituminous Surface Treatment
SDAC	Standards of Decision-Making Across Cultures
SDG	Sustainable Development Goal
SE	Super-Elevation
SEACAP	Sustainable Energy Access and Climate Action Plan
SIS	Slurry Seal
SME	Small or Medium Enterprise
SMS	Safety Management System
SOS	Single Otta Seal
SPT	Standard Penetration Testing
SS	Sand Seal
STRM	Security Threat Response Manager (software)
SuM4ALL	Sustainable Mobility for All

TAM	Technical Audit Team
TDC	Township Development Committee
TL	Team Leader
ToR	Terms of Reference
TRL	Transport Research Laboratory
UCS	Unconfined Compression Test
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)
USAid	United States Agency for International Development
VAR	Vent-Area Ratio
VDC	Village Development Committee
VOC	Vehicle Operating Costs
VEF	Vehicle Electric Flow
WB	World Bank
WBM	Water-Bound Macadam
WFB	Western Fold Belt
WHO	World Health Organisation
WLAC	Whole Life Asset Cost
WLC	Whole-Life Cost

Manual Updates

Significant changes to criteria, procedures or any other relevant issues related to new policies or revised laws of the land or that are mandated by the relevant national or state Ministry or Agency should be incorporated into the manual from their date of effectiveness.

Other minor changes that will not significantly affect the whole nature of the manual may be accumulated and made periodically. When changes are made and approved, new page(s) incorporating the revision, together with the revision date, will be issued and inserted into the relevant chapter.

The road sector is encouraged to not only to put into practice this initial version of the Myanmar Low Volume Roads Manual but to feed back to the MoC Director any suggestions for future updates.

Ministry of Construction, Department of Rural Road Development

LVRR Manual: Change Control

MANUAL UPDATE		<i>To be completed by DRRD</i>	
Chapter		Change Number	
Section Table Figure Page	Explanation	Modification	

GLOSSARY OF TECHNICAL TERMS

Aggregate (for construction)

A broad category of particulate material including sand, gravel, crushed stone, slag and recycled material that forms a component of composite materials such as concrete and pre-mix asphalt.

Apron

The flat invert of the culvert inlet or outlet.

Asphalt

A mixture of inert mineral matter, such as aggregate, mineral filler (if required) and bituminous binder in predetermined proportions (sometimes referred to as Asphaltic Concrete or Asphalt Concrete). Usually pre-mixed in a plant before transport to site to be laid and compacted. Expensive and usually only used on main roads. Also used as an alternative term for Bitumen in some regions, and may be a petroleum processing product or naturally occurring in deposits.

Atterberg Limits

Basic measures of the nature of fine-grained soils which identify the boundaries between the solid, semi- solid, plastic and liquid states.

Basin

A structure at a culvert inlet or outlet to contain turbulence and prevent erosion.

Berm

A low ridge or bund of soil to collect or redirect surface water.

Binder, Bituminous

Any bitumen based material used in road construction to bind together or to seal aggregate or soil particles.

Binder, Modified

Bitumen based material modified by the addition of compounds to enhance performance. Examples of modifiers are polymers, such as PVC, and natural or synthetic rubbers.

Bitumen

A non-crystalline solid or viscous mixture of complex hydrocarbons that possesses characteristic agglomerating properties, softens gradually when heated, is substantially soluble in trichlorethylene and is usually obtained from crude petroleum by refining processes. Referred to as Asphalt in some regions.

Bitumen, Cutback

A liquid bitumen product obtained by blending penetration grade bitumen with a volatile solvent to produce rapid curing (RC) or medium curing (MC) cutbacks, depending on the volatility of the solvent used. After evaporation of the solvent, the properties of the original penetration grade bitumen become operative.

Bitumen, Penetration Grade

That fraction of the crude petroleum remaining after the refining processes which is solid or near solid at normal air temperature and which has been blended or further processed to products of varying hardness or viscosity.

Bitumen emulsion

A mixture of bitumen and water with the addition of an emulsifier or emulsifying agent to ensure stability. Conventional bitumen emulsion most commonly used in road works has the bitumen dispersed in the water. An invert bitumen emulsion has the water dispersed in the bitumen. In the former, the bitumen is the dispersed phase and the water is the continuous phase. In the latter, the water is the dispersed phase and the bitumen is the continuous phase. The bitumen is sometimes fluxed to lower its viscosity by the addition of a suitable solvent.

Bitumen Emulsion, Anionic

An emulsion where the emulsifier is an alkaline organic salt. The bitumen globules carry a negative electrostatic charge.

Bitumen Emulsion, Cationic

An emulsion where the emulsifier is an acidic organic salt. The bitumen globules carry a positive electrostatic charge.

Bitumen Emulsion Grades

- Premix grade: An emulsion formulated to be more stable than spray grade emulsion and suitable for mixing with medium or coarse graded aggregate with the amount smaller than 0.075mm not exceeding 2%.
- Quick setting grade: An emulsion specially formulated for use with fine slurry seal type aggregates, where quick setting of the mixture is desired.
- Spray grade: An emulsion formulated for application by mechanical spray equipment in chip seal construction where no mixing with aggregate is required.
- Stable mix grade: An emulsion formulated for mixing with very fine aggregates, sand and crusher dust. Mainly used for slow-setting slurry seals and tack coats.

Black Cotton Soil

An expansive clay found widely in the North East of the country that expands and loses most of its strength when wetted.

Blinding

- (a) A layer of lean concrete, usually 5 to 10 cm thick, placed on soil to seal it and provide a clean and level working surface to build the foundations of a wall, or any other structure.
- (b) An application of fine material e.g. sand, to fill voids in the surface of a pavement or earthworks layer.

Brick (fired clay)

A hard durable block of material formed from burning (firing) clay at high temperature.

Bridge

A structure usually with a span of 5 metres or more, providing a means of crossing above water, a railway or another obstruction, whether natural or artificial. A bridge consists of abutments, deck and sometimes wingwalls and piers, or maybe an arch.

Camber

The road surface is normally shaped to fall away from the centre line to either side. The camber is necessary to shed rain water and reduce the risk of passing vehicles colliding. The slope of the camber is called the Crossfall. On sharp bends the road surface should fall directly from the outside of the bend to the inside (superelevation).

Cape Seal

A multiple bituminous surface treatment that consists of a single application of binder and stone followed by one or two applications of slurry.

Carriageway

The road pavement or bridge deck surface on which vehicles travel.

Cascade

A drainage channel with a series of steps, sometimes with intermediate silt traps or ponds, to take water down a steep slope.

Catchpit

A manhole or open structure with a sump to collect silt.

Catchwater Drain

See **Cut-off**.

Causeway or Vented Drift

Low level structure constructed across streams or rivers with openings to permit water to pass below road level. The causeway may become submerged in flood conditions.

Cement (for construction)

A dry powder which on the addition of water (and sometimes other additives), hardens and sets independently to bind aggregates together to produce concrete. Cement can also be used to stabilise certain types of soil. Cement is also sometimes used as a fine filler in bituminous mixes.

Chippings

Clean, strong, durable pieces of stone made by crushing or napping rock. The chippings are usually screened to obtain material in a small size range.

Chip Seal, Single

An application of bituminous binder followed by a layer of stone or clean sand. The stone is sometimes covered with a fog spray.

Chip Seal, Double

An application of bituminous binder and stone followed by a second application of binder and stone or sand. The second seal usually uses a smaller aggregate size to help key the layers together. A fog spray is sometimes applied on the second layer of aggregate.

Chute

An inclined pipe, drain or channel constructed in or on a slope.

Cobble Stone (Dressed stone)

Cubic pieces of stone larger than setts, usually shaped by hand and built into a road surface layer or surface protection.

Coffer Dam

A temporary dam built above the ground to give access to an area which is normally, or has a risk of being, submerged or waterlogged. Cofferdams may be constructed of soil, sandbags or sheet-piles.

Collapsible soil

Soil that undergoes a significant, sudden and irreversible decrease in volume upon wetting.

Compaction

Reduction in bulk of fill or other material by rolling or tamping.

Complimentary Interventions

Actions or initiatives that are implemented through a roads project which are targeted toward the communities that lie within the influence corridor of the road and are intended to optimise the benefits brought by the road and to extend the positive and mitigate the negative impacts of the project.

Concrete

A construction material composed of cement (most commonly Portland cement, but occasionally using other available cementitious materials such as fly ash and slag cement), aggregate (generally a coarse aggregate such as gravel or crushed stone plus a fine aggregate such as sand), water, (and sometimes chemical admixtures to improve performance or for special applications).

Concrete Block Paving

A course of interlocking or rectangular concrete blocks placed on a suitable base course and bedded and normally jointed with sand.

Counterfort Drain

A drain running down a slope and excavated into it. The excavation is partly or completely filled with free draining material to allow ground water to escape.

Cribwork

Timber or reinforced concrete beams laid in an interlocking grid, and filled with soil to form a retaining wall.

Crossfall

See **Camber**

Crushed Stone

A form of construction aggregate, typically produced by mining a suitable rock deposit and breaking the removed rock down to the desired size using mechanical crushers, or manually using hammers.

Curing

The process of keeping freshly laid/placed concrete moist to prevent excessive evaporation with attendant risk of loss of strength or cracking. Similarly with cement or lime stabilised layers, the measures to minimise moisture loss during the initial period of strength development.

Cut-off/Catchwater Drain

A ditch constructed uphill from a cutting face to intercept surface water flowing towards the road.

Debris Rack or Grill

Grill, grid or post structure located near a culvert entrance to hold back floating debris too large to pass through the culvert.

Deck

The part of a bridge that spans between abutments or pier supports, and carries the road traffic.

Design speed

The assessed maximum safe speed that can be maintained over a specified section of road when conditions are so favourable that the design features of the road govern the speed.

Dispersive soil

Soil in which the clay particles detach from each other and from the soil structure in the presence of water and go into suspension.

Distributor

A vehicle or towed apparatus comprising an insulated tank, usually with heating and circulating facilities, and a spray bar capable of applying a thin, uniform and predetermined layer of binder. The equipment may also be fitted with a hand lance for manual spraying.

Ditch (Drain)

A long narrow excavation designed or intended to collect and drain off surface water.

Drainage

Interception and removal of ground water and surface water by artificial or natural means.

Drainage Pipe

An underground pipe to carry water.

Dressed Stone

See **Cobble Stone**

Drift or Ford

A stream or river crossing at bed level over which the stream or river water can flow.

Dry-bound Macadam

A pavement layer constructed where the voids in a large single-sized stone skeleton are filled with a fine sand, vibrated in with suitable compaction equipment.

Earth Road

See **ENS**.

Embankment

Constructed earthworks below the pavement raising the road above the surrounding natural ground level.

ENS (Engineered Natural Surface)

An earth road built from the soil in place at the road location, and provided with a camber and drainage system

Expansive soil

Typically clayey soil that undergoes large volume changes in direct response to moisture changes.

Filler

Mineral matter composed of particles smaller than 0.075mm.

Flow Spreader

A structure designed to disperse the flow at the outfall of a ditch or drain to minimise the risk of erosion downstream.

Fog Spray/Seal

A light application of diluted bitumen emulsion to the final layer of stone of a reseal or chip seal, or to an existing bituminous surfacing as a rejuvenating maintenance treatment.

Ford

See **Drift**

Formation

The shaped surface of the earthworks, or subgrade, before constructing the pavement layers.

Gabion

Stone-filled wire or steel mesh cage. Gabions are often used as retaining walls or river bank/bed scour protection structures.

Geocells

Typical cellular confinement systems are made with ultrasonically-welded high-density polyethylene (HDPE) or Novel Polymeric Alloy strips that are expanded on-site to form a honeycomb-like structure which may be filled with sand, soil, rock or concrete. Used in construction for erosion control, soil stabilisation on flat ground and steep slopes, channel protection, and structural reinforcement for load support and earth retention.

Gravel (Construction Material)

A naturally-occurring, weathered or naturally transported rock within a specific coarse particle size range. Gravel is typically used as a pavement layer in its natural or modified condition, or as a road surface wearing course. Suitable gravel may also be used in a graded gravel seal in appropriate circumstances.

Hand Packed Stone

A layer of large, angular broken stones laid by hand with smaller stones or gravel rammed into the spaces between stones to form a road surface layer.

Incremental paving

Road surface comprising small blocks such as shaped stone (setts) or bricks, jointed with sand or mortar.

Intermediate Equipment

Simple or intermediate equipment, designed for low initial and operating costs, durability and ease of maintenance and repair in the conditions typical of a limited-resource environment, rather than for high theoretical efficiency. It is preferable if the equipment can also be manufactured or fabricated locally/regionally.

Invert

The lowest point of the internal cross-section of a ditch, pipe or culvert.

Labour Based Construction

Economically efficient employment of as great a proportion of labour as is technically feasible throughout the construction process to produce the standard of construction as demanded by the specification and allowed by the available funding

Labour Intensive Construction

Works using large numbers of labourers with the prime objective of creating temporary or permanent employment, often with achieving sustainable and durable infrastructure as a secondary concern.

Layby

An area adjacent to the road for the temporary parking of vehicles.

Lime

Lime is a material derived from the burning of limestone or chalk. It is normally obtainable in its 'hydrated' form (slaked) as Calcium Hydroxide. It can be used for the drying, improvement and stabilisation of suitable soils, as an anti-stripping agent in the production of bituminous mixes and as a binder in masonry or brick work mortars.

Local Resources

These can be human resources, local government, private, NGO, and community institutions, local entrepreneurs such as contractors, consultants, industrialists and artisans, local skills, locally made or fabricated intermediate equipment, local materials such as local produced aggregates, bricks, timber and marginal materials, locally raised finance or provision of materials or services in kind.

Local Resource Based Road Works aim to deliver the maximum benefits to local communities and development.

Low Volume Road

Roads carrying less than 300 motor vehicles per day and up to approximately 1 million equivalent standard axles over their design life.

Macadam

A mixture of broken or crushed stone of various sizes (usually less than 3cm) laid to form a road surface layer. Bitumen macadam uses a bituminous binder to hold the material together. Tarmacadam uses tar for the same purposes. Bound macadam is usually expensive for use on LVR.

Manhole

Accessible pit with a cover forming part of the drainage system and permitting inspection and maintenance of underground drainage pipes.

Margins

The right of way or land area maintained or owned by the road authority or owner.

Mitre Drain (Turn Out Drain)

A drain that leads water away from the Side Drains to the adjoining land.

Otta Seal

A carpet of graded (natural gravel or crushed rock) aggregate spread over a freshly sprayed hot bituminous 'soft' (low viscosity) binder and rolled in with heavy roller.

Outfall

Discharge end of a ditch or culvert.

Parapet

The protective edge, barrier, wall or railing at the edge of a bridge deck.

Pavé

See **Sett**

Paved Road

A paved road is a road with a Stone, Bituminous, Brick or Concrete surfacing.

Pavement

The constructed layers of the road on which vehicles travel.

Penetration Macadam

A pavement layer made from one or more applications of coarse, open-graded aggregate (crushed stone, slag, or gravel) followed by the spray application of bituminous binder. Usually comprising two or three applications of stone each of decreasing particle size, each grouted into the previous application before compaction of the completed layer.

Permeable Soils

Soils through which water will drain easily e.g. sandy soils. Clays are generally impermeable except when cracked or fissured (e.g. 'Black Cotton' soil in dry weather).

Prime Coat

A coat of suitable bituminous binder applied to a non-bituminous granular pavement layer as a preliminary treatment before the application of a bituminous base or surfacing. While adhesion between this layer and the bituminous base or surfacing may be promoted, the primary function of the prime coat is to assist in sealing the surface voids and bind the aggregate near the surface of the layer. Not to be confused with **Tack Coat**.

Reinforced Concrete

A mixture of coarse and fine stone aggregate bound with cement and water and reinforced with steel rods or mesh for added strength.

Reseal

A surface treatment applied to an existing bituminous surface.

Rejuvenator

A material which may range from a soft bitumen to petroleum which, when applied to reclaimed asphalt or to existing bituminous surfacing, has the ability to soften aged, hard, brittle binders.

Riprap

Stones, usually between 5 to 50 kg, used to protect the banks or bed of a river or watercourse from scour.

Roadbase and Sub-base

Pavement courses between surfacing and subgrade.

Road Maintenance

Suitable regular and occasional activities to keep pavement, shoulders, slopes, drainage facilities and all other structures and property within the road margins as near as possible to their constructed or renewed condition. Maintenance includes minor repairs and improvements to eliminate the cause of defects and avoid excessive repetition of maintenance efforts.

Roadway

The portion within the road margins, including shoulders, for vehicular use.

Scarifying

The systematic disruption and loosening of the top of a road or layer surface by mechanical or other means.

Scour -Defect:

Erosion of a channel bed area by water in motion, producing a deepening or widening of the channel.

Scour Checks

Small checks in a ditch or drain to reduce water velocity and reduce the possibility of erosion.

Scuppers

Drainage pipes or outlets in a bridge deck.

Seal

A term frequently used instead of "reseal" or "surface treatment". Also used in the context of "double seal", and "sand seal" where sand is used instead of stone.

Selected layers

Pavement layers of imported selected gravel or soil materials used to bring the subgrade support properties up to the required structural standard for placing the sub-base or road base layer.

Sett (Pavé)

A small piece of hard stone trimmed by hand to a size of about 10cm cube used as a paving unit.

Shoulder

Paved or unpaved part of the roadway next to the outer edge of the pavement. The shoulder provides side support for the pavement and allows vehicles to stop or pass in an emergency.

Site Investigation

Collection of essential information on the soil and rock characteristics, topography, land use, natural environment, and socio-political environment necessary for the location, design and construction of a road.

Slope

A natural or artificially constructed soil surface at an angle to the horizontal.

Slurry

A mix of suitably graded fine aggregate, cement or hydrated lime, bitumen emulsion and water, used for filling the voids in the final layer of stone of a new surface treatment or as a maintenance treatment (also referred to as a slurry seal).

Slurrybound Macadam

A surfacing or pavement layer constructed where the voids in single-sized stone skeleton are filled using bituminous slurry.

Sods

Turf but with more soil attached (usually more than 10 cms soil thickness).

Soffit

The highest point in the internal cross-section of a culvert, or the underside of a bridge deck.

Spray Lance

Apparatus permitting hand-application of bituminous binder at a desired rate of spread through a nozzle.

Squeegee

A small wooden or metal board with a handle for spreading bituminous mixtures by hand.

Stringer

Longitudinal beam in a bridge deck or structure.

Sub-base

See **Roadbase**.

Subgrade

The native material or earthworks formation underneath a constructed road pavement.

Sub-Soil Drainage

See **Underdrainage**.

Surface Dressing

A sprayed or hand applied film of bitumen followed by the application of a layer of stone chippings, which is then lightly rolled.

Surface Treatment

A general term incorporating chip seals, slurry seals, micro surfacing, or fog sprays.

Surfacing

The road layer with which traffic tyres make direct contact. Consists of wearing course, and sometimes a base course or binder course.

Tack Coat

A coat of bituminous binder applied to a primed layer or to an existing bituminous surface as a preliminary treatment to promote adhesion between the existing surface and a subsequently applied bituminous layer.

Tar Binder

A binder made from processing coal.

Template

A thin board or timber pattern used to check the shape of an excavation.

Traffic Lane

The portion of the carriageway usually defined by road markings for the movement of a single line of vehicles.

Transverse Joint

Joint normal to, or at an angle to, the road centre line.

Turf

A grass turf is formed by excavating an area of live grass and lifting the grass complete with about 5 cm of topsoil and roots still attached.

Turn Out Drain

See **Mitre Drain**.

Underdrainage (Sub-Soil Drainage)

System of pervious pipes or free draining material, designed to collect and carry water in the ground.

Unpaved Road

A road with a soil or gravel surface.

Vented Drift

See **Causeway**.

Waterbound Macadam

A pavement layer constructed where the voids in a large single-sized stone skeleton are filled with a fine sand, washed in by the application of water.

Wearing Course

The upper layer of a road pavement on which the traffic runs and is expected to wear under the action of traffic. This applies to gravel and bituminous surfaces.

Weephole

Opening provided in retaining walls or bridge abutments to permit drainage of water in the filter layer or soil layer behind the structure. Weepholes prevent water pressure building up behind the structure.

Windrow

A ridge of material formed by the spillage from the end of the machine blade or continuous heap of material formed by labour.

Wingwall

Retaining wall at a bridge abutment to retain and protect the embankment fills behind the abutment.