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MINISTRY OF RURAL DEVELOPMENT

RURAL ROAD MAINTENANCE TRAINING MODULES FOR FIELD ENGINEERS

Module-7
ROUTINE MAINTENANCE WORK METHOD

Ministry of Rural Development

RURAL ROAD MAINTENANCE TRAINING MODULES FOR FIELD ENGINEERS

Module-7

Routine Maintenance Work Method

This training module is produced through a collaborative effort between the International Labour Organization and the National Rural Road Development Agency under the technical assistance component of the World Bank supported Rural Roads Project-II of Pradhan Mantri Gram Sadak Yojana Project (PMGSY).

Contents:

- Deterioration and failure of roads
- Types of maintenance
- Routine maintenance activities
- Technology options for routine maintenance activities
- Routine maintenance priority
- Work methods

Learning Objective:

At the end of this Module you are expected:

- To be able to identify the cause of the deterioration of the road components
- To be aware of types of road maintenance
- To be able to identify best intervention options available for the routine maintenance activities
- How each of the routine maintenance activities are implemented
- What the performance indicators of each activities are.

Acknowledgement

The following publications were also used as reference materials:

- Managing Maintenance of Rural Roads in India, ILO/NRRDA, January 2015
- Building Rural Roads, Bjorn Johannessen, International labour Organization, ILO Regional Office for Asia and the Pacific, 2008
- A Practitioner's Guide to Rural Roads Improvement and Maintenance, International Labour Organization and Government of Ghana, 2014
- A Handbook for District Supervisors and Community Routine Maintenance Team for Routine Maintenance on District Roads, ILO/ UNDP, Indonesia, 2010
- Specifications for Rural Roads, Ministry of Rural Development, published by Indian Roads Congress, January 2014

Foreword

Pradhan Mantri Gram Sadak Yojana (PMGSY), was launched in December, 2000 as a special intervention of the Government of India with the broad objective of ensuring sustainable poverty reduction. The scheme aims to provide good quality all-weather single connectivity to every eligible habitation. Rural roads are a state subject under the Constitution and as such are the basic responsibility of the states. However under the PMGSY, the construction of good quality and well-engineered roads are fully funded by the central government. Maintenance of these roads is the responsibility of the states. The year 2013 saw the launch of PMGSY-II with the objectives of consolidating the existing rural road network and upgrading existing rural roads that provide connectivity to rural growth centres. PMGSY-II envisages sharing of construction costs between the Centre and the states with maintenance costs continuing to be funded fully by the states.

Over the last 14 years, the PMGSY has carved out a place for itself as a programme characterised by creation of good quality assets, effective management and technical proficiency by the National Rural Road Development Agency (NRRDA), along with capable state road agencies. For implementation and operations, the involved agencies have been supported with detailed documentation in the form of programme guidelines, an operations manual, standard bidding documents, specifications, a standard data book, a procurement and contracts management manual and the Quality Assurance Hand Book with support from the Indian Roads Congress. These documents have also contributed significantly towards effective implementation of PMGSY and even for mainstreaming good practices in other rural roads programmes being executed by the states from their own resources.

An area of concern has been lack of regular maintenance as per the “Programme Guidelines”. However, in recent years, there has been increased awareness and commitment to maintenance by the states. The tempo needs to be sustained and further accelerated.

Under the technical assistance component of the World Bank supported Rural Roads Project-II, the International Labour Organization (ILO), in collaboration with NRRDA has prepared a manual “Managing Maintenance of Rural Roads in India”. This initiated the execution of maintenance works and the development of these training modules for engineers and contractors associated with rural road maintenance works. To strengthen such activities in the participating states of RRP-II, a series of training of trainers workshops were arranged at national and state level based on the course material developed.

The training modules broadly cover the principles for maintenance management of rural roads, planning and execution of common maintenance interventions to ensure reliable transport services and safety to users and the local communities served by the rural roads, and arrangements for monitoring the performance of contractors engaged for the task.

I would like to acknowledge the support of all those associated with the development of these training modules, especially the ILO and its technical assistance team, Mr. Htun Hlaing, Mr. Bjorn Johannessen and the project's Rural Roads Maintenance Engineers. I would also place on record the valuable suggestions of my colleagues Ms. Manju Rajpal, IAS, (ex Director – RC), Mr. R. Basavaraja, Director NRRDA, Mr. S. S. Bhatia, Deputy Director, NRRDA, Mr. A. K. Sharma, Consultant World Bank and senior engineers as well as secretaries from State Governments in bringing the document to its present shape.

I sincerely believe, the training modules would be found useful for the states in their efforts to secure adequate maintenance of all rural roads, not merely the PMGSY roads and improve maintenance practices so that benefits of access continue to remain available for our rural people on a sustainable basis.

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Introduction to Training Modules

The purpose of this training manual is to provide technical management staff and contractors with appropriate guidelines for the effective management of road maintenance works. The training modules are based on the manual "Managing Maintenance of Rural Roads in India". These modules broadly cover the principles for maintenance management of rural roads, planning and execution of common maintenance interventions to ensure reliable transport services and safety to users and the local communities served by the rural roads. The arrangements for monitoring the performance of contractors engaged for the task are also covered in these modules.

This manual is broken down into the following categories composed of different modules:

Module 1: INTRODUCTION

Module 2: TECHNICAL CONSIDERATIONS AND IMPLEMENTATION ARRANGEMENTS

Module 3: FINANCING RURAL ROAD MAINTENANCE

Module 4: PLANNING, INSPECTION, REPORTING AND MONITORING

Module 5: APPROPRIATE SETTING OUT TECHNIQUES

Module 6: HAND TOOLS, EQUIPMENT & CONSTRUCTION MATERIALS

Module 7: ROUTINE MAINTENANCE WORK METHODS

Module 8: OCCUPATIONAL HEALTH & SAFETY, ENVIRONMENTAL ISSUES AND DECENT WORK

Module 9: CONTRACT MANAGEMENT

The trainer may decide to conduct a full course consisting of all the nine modules or may selectively conduct specific modules depending on the needs of the target group.

As a general advice the trainer should:

- **Encourage active participation**

  There is sometimes a tendency of the trainer to act like a teacher in school and to read or lecture directly from the course material. This behaviour should be avoided. Trainees remember information better if they participate actively in discussions and if there is a free exchange of views and of questions between everyone participating in the course.

- **Guiding the discussion**

  There are times during a discussion when everyone wants to speak at the same time. When such situations arise, the trainer should insist that the group listen to one person at the time. If one speaker hijacks the floor too long, the trainer needs to interrupt, pointing out that other participants may also want to speak.

- **Listen attentively**

  Equal attention should be paid to each speaker. Listen attentively and let the speaker understand that ideas and opinions expressed are both interesting and relevant. It is sometimes useful to take a brief note of participants' suggestions while they are speaking, noting them down on a flipchart or blackboard. A summary of these notes may prove useful for later discussions.

- **Emphasise important points**

  Each time the participants make an important point or expresses an interesting opinion, the trainer should draw the group's attention to it by repeating the idea in simple terms which are understood by the majority of the trainees.

- **Preparing the sessions**

  When trainees only listen to a description of how a particular job should be done, they are likely to forget what they heard. If however, they actually carry out the task concerned, they will remember how to do it. For this reason, every effort should be made to include as many practical exercises and demonstrations as possible, be they carried out on the worksite or in the training room. Practical sessions should always be carefully planned in advance.

- **Recapping**

  A discussion is more than just a conversation. A subject is discussed with an aim in mind. It may occasionally be worthwhile recapping the topic considered and recalling the aim of the discussion by intervening from time to time to give a brief summary of the main points dealt with so far.

- **Questioning**

  An important role of the trainer is to ensure that the atmosphere during training is sufficiently relaxed to allow participants to feel at ease to speak freely. Questions set by the trainer should not be regarded by the trainees as tests. Often there is no strict "right or wrong" answer to a question, except for mathematics. Questions should simply give your trainees the opportunity to put forward their individual points of view.

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Routine Maintenance Work Methods

7.1 INTRODUCTION

Road maintenance involves interventions or works required to keep the road, its structures and property within the road margins as near as possible to their as-constructed or rehabilitated condition.

Figure 1: *Typical road components*

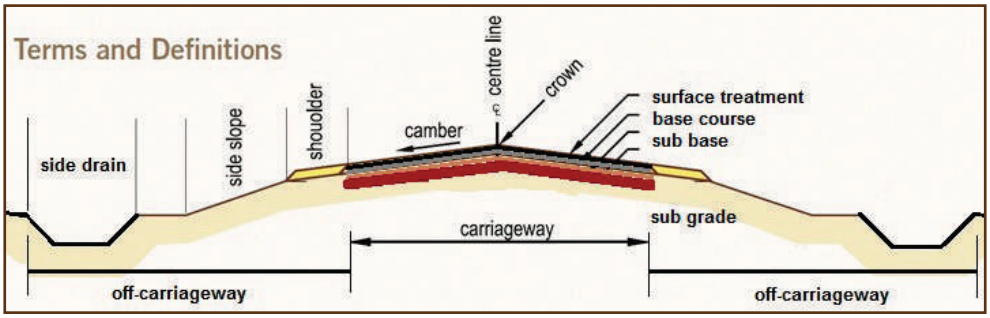


Table 1: *Camber and slope specification*

Surface Type	Camber	Side Slope
Rigid pavement (cement concrete)	2.0 ~ 2.5 %	1.5 : 1 to 2 : 1
Thin bituminous surfacing	3.0 ~ 3.5 %	
WBM / Gravel	3.5 ~ 4.0 %	
Earthen	4.0 ~ 5.0 %	

No borrow pits should be dug within 1.5m of the toe of the final section of the road embankment, after making due allowance for future development.

The purpose of road maintenance is to ensure that the road remains serviceable until the end of its design life. Maintenance therefore performs the important function of:

- Prolonging the life of the road by reducing the rate of deterioration (both on-carriageway as well as off-carriageway), thereby safeguard previous investments in construction and rehabilitation,
- Lowering the cost of operating vehicles on the road by providing a smooth running surface,
- Keeping the road open on a continuous basis by preventing it from becoming impassable.

The effective organisation of maintenance is based upon the concept of damage control. With timely interventions based on regular inspection of the road network, works are planned and carried out at an early stage to counter the detrimental effects of traffic and weather.

Water is the main culprit behind defects developing on the carriageway or the roadside. With a well-built road, a major function of the maintenance works is to ensure that the drainage system continues to operate effectively.

Although emphasis is always on preventive measures, there will still be damages that cannot be prevented. Minor repairs are therefore part and parcel of the regular maintenance activities.

7.2 DETERIORATION AND FAILURE OF ROADS

Before rectifying a defect, the underlying cause of the problem should be identified. In many cases therefore the corrective activity alone may not be enough, the underlying cause must also be dealt with. Road deterioration involves the worsening of roads over a period of time due to various causes. Deterioration leads to defects and subsequent failure of the road structure.

Water is the main contributor to the wear and damage of low-volume rural roads. It can be in the form of ground water, surface water (streams and rivers) or rain and can damage the road in several ways:

- by washing away soils (erosion and scouring),
- weakening the load bearing capacity of the road pavement,
- by depositing soils (silting) that obstruct the passage of water, or
- by washing away entire sections of the road and its structures.

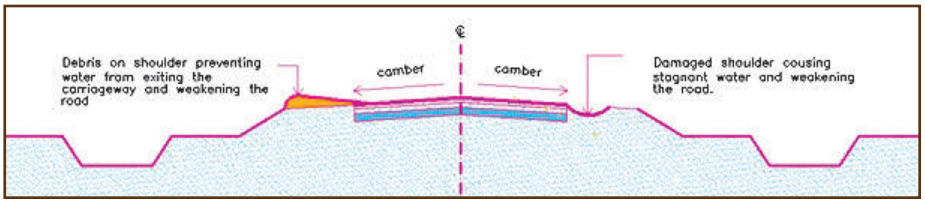
Damage and wear to the road can be reduced if the flow of water is controlled. Minor damages can easily be repaired as part of the regular maintenance provided to the road and its structures. If the flow of water is not properly managed, the deterioration of the road will be more serious and occur more rapidly. This leads to higher maintenance demands and in the worst cases result in serious damages that may obstruct the passage of traffic.

When carrying out drainage maintenance, it is important that the reasons for the damages are fully understood. When surveying, it is essential to establish the exact cause and effect of any drainage failures. The performance of the drainage system should therefore be observed during rainy periods, in order to obtain a realistic impression of the how, and how much, water is moving in the vicinity of the road. On this basis, good preventive measures can be made that hopefully reduce future maintenance demands - and increase the lifetime of the road.

7.2.1 Deterioration of the Carriageway and Shoulders (Surface Drains)

Drainage of the road surface is provided by shaping the carriageway with a camber or a cross slope. The combination of stagnant water on the road surface and traffic can quickly cause erosion of the road surface. Secondly, if surface water penetrates into the road body, it reduces the load bearing capacity of the pavement, which may cause further damage to the road. To avoid these problems, it is important to secure adequate drainage of the road surface.

Figure 2: *Deterioration of road caused by stagnant water*



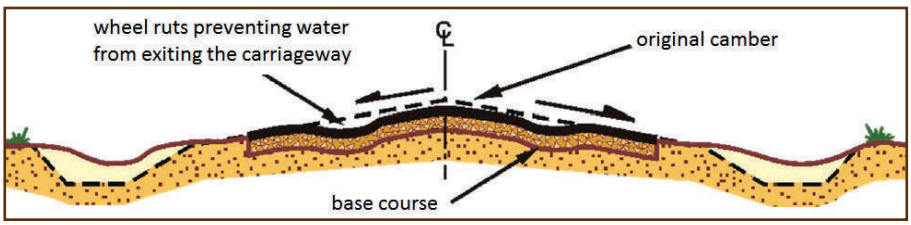
The road shoulders need to be maintained to their original shape and slope to allow for water to be drained off the road surface. Standing water at the edge of the road softens the shoulders and also causes water to penetrate the road pavement, resulting in loss of bearing capacity of the shoulders and the road carriageway.

Rural roads are often built with soft shoulders, i.e. the materials used for constructing the shoulders are not as strong as the pavement. Traffic may create wheel ruts on the shoulders, which in turn may trigger potholes and edge breaks on the road pavement.

Regular maintenance of the shoulders will reduce these problems. Maintaining a grass cover protects the shoulders from scouring and traffic.

Ruts are caused by the deformations in pavements with insufficient strength to cater for the prevailing traffic, mostly as a result of improper mix-design, weak pavement, intrusion of sub-grade clay into base course, poor compaction works or overloaded vehicles. It often takes place on roads with a high prevalence of heavy traffic for which the pavement was not designed. The longitudinal depressions resulting from rutting compromises the road camber, restricting water from being drained from the road surface.

Figure 3: *Degradation of carriageway*



Un-drained water penetrating the surface can further weaken the pavement leading to more deformations and finally breaking the surface.

Potholes are depressions found randomly distributed over the carriageway and shoulders. They occur on sections of the road where the road base has been exposed to high moisture levels due to cracks on the paved layer. The causes can be due to lack of proper bond between the bituminous surfacing and underlying WBM, insufficient bitumen content and too thinly laid bituminous wearing course. Potholes can also form if the shoulders are not well compacted during construction and sealed with good quality gravel.

In cold weather, the water in the ground freezes and thaws - this makes the ground expand and contract, and makes cracks in the road. Traffic running over the cracks breaks them open further and creates a pothole.

Potholes are a common surface defect on both paved and unpaved roads. They develop under the action of tyres, especially from heavy vehicles. For roads with a sound base course, they eventually develop when the surface seal is worn out. Potholes may develop earlier from cracks in the surface caused by pavement settlements resulting from inadequate load capacity or unstable fills or sub-grades.

Figure 4: *Potholes on gravel road*

Potholes increase rapidly in size during the rainy season when water collects inside the hole. Besides causing discomfort to the road users, potholes allow water to penetrate into the pavement, thereby compromising its load bearing capacity, which in turn accelerates the deterioration of the pavement and its surface.

Potholes often develop as a result of poor drainage of the base course. Blocked side drains or culverts, resulting in water penetrating the reason for such damages.

On roads with base courses consisting of water-bound Macadam, the reason for potholes can often be traced back to the use of inferior material. If the base was built using rounded aggregate, it will not achieve the necessary cohesive properties required to cater for heavy traffic.

Figure 5: *Potholes on a paved road*

Without the interlocking achieved with angular aggregate, there will be movements in the base course aggregate which breaks up the surface seal. Although this problem can appear on any road, it materialises more quickly on road sections with severe gradients.

The frequent occurrence of potholes can also be an indicator of a poorly performing base course or sub-grade.

Edge failures of paved roads are caused by weak materials used in shoulders and poor shoulder maintenance that leaves the surface of the road pavement higher than the adjacent shoulder. Edges are often more vulnerable to settlements due to shoulders consisting of poor materials or with poor drainage.

Figure 6: *Damaged road edge*

Figure 7: *Ravelling*

Ravelling is a process in which the surface layer loses its aggregate particles due to insufficient binder in the surface seal. This may take place when there is insufficient bonding with the underlying surface or from an uneven application of binder when applying a chip and spray seal. A poorly maintained spray bar with blocked nozzles or the incorrect adjustment of the height of the spray bar will produce an uneven application of binder. Equally, incorrect binder content in a surface premix may cause ravelling. Finally, ravelling can take place if the surface seal is poorly spread and compacted, construction during wet weather, excessively open graded mix and overheating of the binder or aggregate.

Figure 8: *Delamination*

Delamination is a result of poor bonding with the underlying surface or insufficient stability of the wearing course, resulting in a total loss of the surface seal. The loss of the surface seal may eventually lead to

the development of potholes unless the defect is addressed by patching or resealing the failed section.

Figure 9: *Cracks on pavement*

Cracks in the road surface can develop in various patterns and frequency. Most cracks are caused by movements or settlements in the underlying pavement layers as a result of poor materials or workmanship, instability of fills and shoulders or movements in the sub-grade. Settlements may also take place on aged pavements or as a result of traffic increases necessitating higher pavement standards. If left unattended, cracks develop into potholes, causing further damage to the pavement and its surface.

The frequency of cracks provides some indication of which layer of the pavement is causing the settlement. When there are less frequent cracks, the settlements are likely to originate from the deepest layers in the pavement, i.e. the sub grade or sub-base. Settlement cracks caused by insufficient pavement strength or unstable fills will reappear and can eventually result in a disintegration of the surface.

Figure 10: *Depressions*

Depressions are caused by the uneven settlement of the pavement layers often for the same reasons as when rutting occurs. Depressions are more common on older roads with limited pavement strengths and which is experiencing an increase in heavy traffic. Depressions on new roads are either a result of construction faults, using poor quality materials or when the drainage fails resulting in the pavement being saturated with water. Depressions can also develop as a result of differential movements at structures, often found at bridge and culvert approaches.

Bleeding is a result of excessive amounts of bitumen binder in the surface seal. The excess binder is forced to the road surface by the action of traffic. The spot where bleeding has occurred is soft and has a smooth surface. The “fat’ surface reduces skid resistance, especially when wet. In extreme cases the surface layer may separate and break away under the action of traffic.

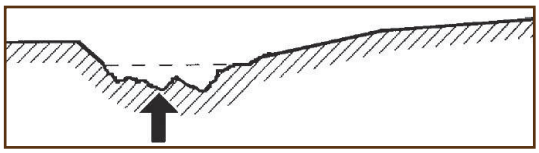
Figure 11: *Bleeding*

Figure 12: *Corrugations*

Corrugations are transverse wave patterns occurring on carriageway formed mainly during the dry season on gravel or earth roads on which high proportions of loose material exists. As the traffic passes, the loose material is pushed into regular lumps across the road forming deeper corrugations.

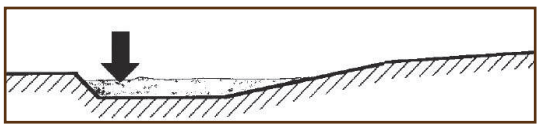
7.2.2 Deterioration of the Side Drains, Mitre Drains and Catchwater Drains

Figure 13: *Scouring in side drain*



Side drains collect water from the carriageway and surrounding areas and lead it to an exit point where it can be safely discharged. The side drains need sufficient capacity to collect all rainwater from the road carriageway and dispose of it quickly and in a controlled manner to minimise damage.

Figure 14: *Silting in side drain*



The main challenge in terms of maintaining good quality side drains is to control erosion and silting. Erosion is caused by large quantities of water travelling at high speeds. Soil erosion can be reduced by various design measures such as widening the side drains, installing scour checks, lining the side drains and by leading the water away from the road before it builds up a significant flow and speed.

Not properly maintained catch-water drains may start pooling water and reduce the stability of the slope and trigger landslides. The risk of silting can be reduced by maintaining a continuous downhill gradient with a clear outlet at the end.

7.2.3 Deterioration of the Side Slopes

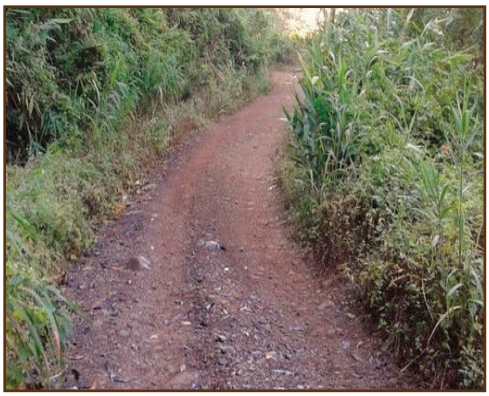
Slide slopes are prone to erosion by water. This may be caused due to poor construction on embankment fills, cut slope being too steep, properties of in-situ material of the soil, and loss of vegetation cover.

Figure 15: *Side slope erosion*

7.2.4 Deterioration due to Vegetation

Tall grass and bushes have a tendency to collect debris, which in turn may compromise the performance of the drainage system of the road. Excessive vegetation along the road also reduces the line of sight for traffic. Clearing vegetation in the road reserve is important in order to maintain good off-carriageway drainage. Removing bush and grass allows for the free flow of water on slopes and in drains.

Figure 16: *Vegetation on road side*



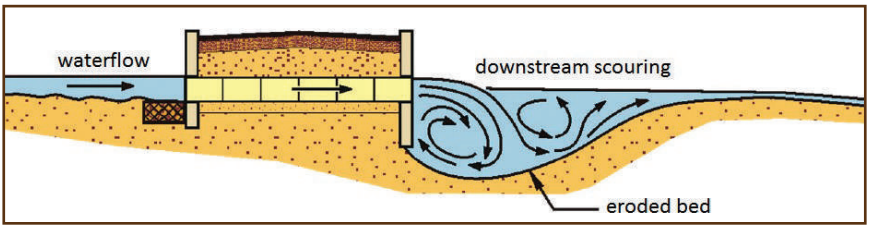
Grass on shoulders, side slopes and in drains should be cut, leaving the roots intact. Healthy growth of grass stabilises soils and provides these surfaces with good protection from soils eroding during extensive rains.

7.2.5 Deterioration due to Cross Drainage Structures

Culverts are the most common cross-drainage structure used on roads. Culverts are required in order to (i) allow natural streams to cross the road, and (ii) discharge surface water from drains and the areas adjacent to the road. If the culvert and cross drains are blocked, water pressure will build up on one side of the road resulting in flooding or failure of the road foundation. Finally it is also important that the discharge of water from any culvert does not cause any erosion to downstream slopes or properties.

Figure 17: *Blocked culvert*

Figure 18: *Downstream erosion from culvert outlet*



Therefore the following can be summarised as the main causes of damage to a road:

Water

The damaging effect of water may arise in the following ways:

- Stagnation of water in depressions (flat surfaces) on the road leading to infiltration into the lower (base) layers. As water infiltrates, it soaks and softens the gravel and base course, or the subgrade material causing the layers to fail by the punching effect of the traffic load.
- Scouring or erosion of the steep sections of the road by running water.
- In flat sections of road, runoff water in the drains will not be able to flow fast enough, resulting into settlement or deposition of silts in the drains, which normally build up to fill or block the drains.

Traffic

Traffic is the second main cause of road deterioration, and their damaging effect is as follows:

- Traffic load causes deformation of the roadway. Vehicles often follow the same wheel tracks along the road. These repeated loading results into deformation (ruts) along the carriageway.
- Material (gravel) loss through displacement by traffic. The higher the traffic the higher the rate of loss of gravel.
- Over time, traffic causes closely spaced ridges (corrugations) to form across the width of the road called corrugations.

Gradients (very steep or very flat)

The steepness or flatness of the road section will accelerate the deterioration of the road by effects of water above. Flat terrain or road sections cause stagnation of water on the surface or in drains thus accelerating failure of road as explained above. Steep grades accelerate the erosion process. When rehabilitation works in these deficient stretches are planned efforts be made to carry out remedial measures to achieve limiting gradient.

Table 2: *Road gradients for different type of terrains*

Terrain Type	Ruling Gradient	Limiting Gradient	Exceptional Gradient
Plain or rolling	3.3% (1 in 30)	5% (1 in 20)	6.7% (1 in 15)
Mountainous terrain, and steep terrain having elevation more than 3,000 m above the mean sea level	5% (1 in 20)	6% (1 in 16.7)	7% (1 in 14.3)
Steep terrain up to 3,000 m height above mean sea level	6% (1 in 16.7)	7% (1 in 14.3)	8% (1 in 12.5)

Poor pavement construction

The poor construction resulting from poor workmanship, material, inadequate level of construction and poor supervision result in weakness in the road pavement structure or drainage structures which will accelerate their deterioration and failure.

Vegetation

In flat areas, tall grass in side drains as well as on shoulders slows the speed of running water enabling silt to settle and deposit in and eventually block the water from draining freely. Tall grass, trees and bushes obstruct drivers view resulting into accident hazards especially around corners.

7.3 TYPES OF MAINTENANCE

Road Maintenance operations are usually grouped according to planning, organisational and funding arrangements. They can normally be categorised as either Routine, Periodic or Emergence maintenance operations.

Routine Maintenance required continually on every road whatever its engineering characteristics or traffic volume. Routine maintenance activities are usually small-scale, widely dispersed, and often performed using manual labour. The need for routine maintenance can to a large degree be forecasted and is scheduled at fixed times during the year.

Periodic Maintenance is carried out in addition to the routine maintenance and will need a more comprehensive overhaul of the road after a certain number of years. It involves more comprehensive and costly activities such as reshaping of the road surface, re-surfacing and major repair or reconstruction of cross-drainage structures and require more equipment and specialist skills. The periodic maintenance works would be scheduled at intervals of 3 to 7 years, depending on traffic levels, pavement type, geographical and weather conditions, quality of the road and the level of wear and tear.

Emergency Maintenance responds to occasional, unforeseen events such as landslides, washouts, large trees or debris on the road and broken drainage structures. Emergency maintenance can be categorised into (i) temporary restoration works, re-opening safe passage on the road, and (ii) permanent restoration, securing the stability of the road and reinstating all its components to its former (or a better) condition.

7.4 ROUTINE MAINTENANCE

This Module covers only the Routine Maintenance of Rural Roads.

These are normally small-scale operations with limited resource requirements and are usually performed regularly on a section of road. Routine maintenance consists of relatively simple activities mainly performed by labour, except grading, which may be a mechanised operation.

Routine maintenance activities are further defined as either cyclic or reactive, although the distinction between these terms is not always very clear.

Cyclic activities are performed at predetermined intervals throughout the year purely as a preventive measure because of events we know will occur (e.g. cleaning drains before and during seasonal rainfall).

Reactive activities are performed in response to a triggering condition that requires action before the problem gets out of hand (e.g. blocked culvert, crack sealing and pothole patching).

Maintenance activities are also categorised based on where the works are located:

Off-carriageway works consist of maintaining shoulders and drains, including repairs to drainage and other structures in the roadside area, side slopes and all surface areas within the road reserve. Most off-carriageway maintenance is normally a routine activity, although occasionally some major overhauls are required.

On-carriageway works relate to road pavement and surface repairs. This work mainly consists of maintaining a good running surface on the road, free from any obstructions and damage and with the necessary camber or cross-fall to secure proper surface drainage.

In terms of securing a long life for rural roads, the most important type of maintenance is related to protecting the drainage system - most of which is found outside the carriageway. On highways, where traffic volumes are more intense, a substantial amount of resources are also used to maintain the carriageway surface. Compared to highways, rural roads receive low levels of traffic and pavement works constitute a smaller proportion of the maintenance required. For these roads, the maintenance priorities are more linked to the provision and upkeep of the drainage system.

7.4.1 Technology options for Routine Maintenance Activities

Management in charge of maintenance needs to be aware of the technology options available to them for the performance of the various maintenance operations. Table 3 gives an overview of maintenance activities as defined above as well as the potential for carrying out the various activities using labour or equipment.

The conclusion that can be drawn from this table is that a good amount of common maintenance activities and in particular routine works can be carried out without extensive mobilisation of equipment and materials. This is important to take notice of because it implies that many crucial maintenance activities are uncomplicated and can be easily organised.

Table 3: *Technology options for road maintenance activities*

Technology Options		
Activity	Suitable for:	
	Labour	Equipment
Routine - cyclic		
Grading (unpaved)	Impracticable	Good
Vegetation control	Good	Fair
Drain cleaning	Good	Fair
Cleaning of culverts and bridges	Good	Impractical
Painting and white washing road furniture	Good	Fair
Litter removal	Good	Poor
Sweeping (paved)	Good	Good
Routine – reactive		
Pothole patching	Good	Fair
Crack sealing	Good	Poor
Local sealing	Fair	Poor
Edge repair	Good	Fair
Joint repair	Good	Fair
Kerb repair or replacement	Good	Fair
Shoulder repair	Good	Fair
Restore rain cuts	Good	Fair
Side drain repair, incl. building scour checks	Good	Poor

Minor repair of drainage structures	Good	Poor
Sign repair or replacement	Good	Poor
Guard rail repair	Good	Poor
Retaining wall/breast wall/gabion repair	Good	Poor
Periodic – maintenance		
Fog spray	Fair	Good
Slurry seal	Fair	Good
Premix Carpet with Seal Coat	Fair	Good
Chip seal	Fair	Good
Regravelling	Good	Good
Renew road markings	Good	Good

7.4.2 Routine Maintenance Priority

Critical elements of the drainage system, such as culverts and drains, need particular attention. Priority is therefore given to the removal of obstacles, debris and silt blocking water from exiting the road in a controlled manner. Erosion channels should be repaired before the next rains deepen and widen them. All these tasks require regular inspection.

The priority activities may differ from area to area according to the prevailing conditions. Roads through mountainous areas are prone to landslides and washouts during intense rains and need regular inspections during this period. Equally, in flood prone areas, the proper functioning of cross-drainage structures is vital to the protection of the road embankment from overtopping and washouts.

When priorities are set, the climatic conditions must be considered. Certain activities are more important during the rainy season while others are best carried out during the dry periods of the year. Obviously, good management of the roads would suggest that the drainage system is in good order before the rains commence. During the rainy season, it is crucial to ensure that the drainage functions as intended. Concrete and bitumen works is best carried out during the dry season.

For each of the climate seasons, different maintenance activities will have a certain priority. *(For example, grass cutting in the road reserve during the rainy season does not make sense when at the same time the ditches and culverts are left unattended and are becoming seriously silted.)*

Table 4 below provides a list of priorities for routine maintenance according to the weather seasons.

Table 4: *Priority of routine maintenance activities according to season*

Routine Maintenance Priorities			
Season	**Priority**	**Activity**	**Where**
Before the rains	1	• clean culverts and other cross-drainage	off-carriageway
	2	• clean side drains and mitre drains	off-carriageway
	3	• clean and repair shoulders	off-carriageway
	4	• repair erosion on side slopes and in drains	off-carriageway
	5	• patch potholes and seal cracks	on-carriageway
	6	• white wash road furniture	off-carriageway
During rains	1	• inspect and remove obstacles from roadway and drains	on/off carriageway
	2	• clean culverts and other cross drainage	off-carriageway
	3	• clean side drains, cut-off and mitre drains	off-carriageway
	4	• repair side drain erosion	off-carriageway
End of rains	1	• repair erosion on shoulders, side slopes and in drains	off-carriageway
	2	• repair retaining walls	off-carriageway
	3	• cut grass and clear bush	off-carriageway
Dry season	1	• repair drainage structures	off-carriageway
	2	• repair road shoulders and surface edges	on/off carriageway
	3	• patch potholes and seal cracks	on-carriageway

7.5 ROUTINE MAINTENANCE WORK METHODS

Routine maintenance of Rural Roads can be carried out by local labours for off-carriage work activities and on-carriageway work activities are carried out by experience contractors. Each of these activities are described as Job Sheet under Annex 1.

7.6 OCCUPATION HEALTH AND SAFETY AT WORKPLACE

Maintenance works essentially need to adhere to the same safety regulations as when carrying out construction works. This applies to both equipment and workers on site as well as in relation to third parties such as traffic passing on the road and people and property in the vicinity of the work sites. Workers on site need to be instructed about potential hazards and issued the necessary protective gear thereby reducing the risks of accidents.

Many road maintenance operations are potentially dangerous both to the maintenance workers and to the road users. There is clear evidence that accident rates increase on road sections where works are taking place - as compared to when the road is in good order and free from any obstructing work activities. To reduce the risk of accidents where road works take place, it is necessary to install adequate safety measures.

There is considerable scope for improving safety practices on road works sites and this also applies when maintenance is carried out on rural roads. Most measures to improve safety at work sites are inexpensive to implement and are often a matter of setting minimum standards and enforcing these. A key to improving safety therefore lies with the client and its supervisory staff and introducing appropriate procedures for enforcing standard safety measures as part of the regular inspection routines.

The person in charge of a work site needs to ensure that all risks are minimised by:

- providing adequate traffic signs and protection at the location where works are taking place. Where necessary, traffic should be stopped during the placement or removal of temporary signs;
- arranging for safety vests and appropriate protective gear to be worn by the workers;
- ensuring that all plant and vehicles are parked off the carriageway or behind protective barriers and signs, when not in use;
- ensuring that no materials are left in a dangerous location and that the road adjacent to the worksite is kept clean and swept of any debris arising from the maintenance work;
- taking proper precautions when handling dangerous substances e.g. hot bitumen, corrosive or poisonous substances;
- protecting all excavations for the benefit of all road users, equipment and workers;
- ensuring that all operators are trained in the correct operation of their equipment;
- informing operators and labourers alike of the potential risks of and procedures for working with or close to machinery;
- making sure that traffic control operations are properly organised and that road users are not unnecessarily delayed;
- ensuring all ladders or scaffolding used in bridge maintenance are securely fixed;
- placing proper warning signs and taking appropriate measures to protect unfinished work on the carriageway or shoulder;
- ensuring that all sites are left tidy and cleared of debris when the work is completed.

7.6.1 Signs and Safety Equipment

When working on the roadside or carriageway, traffic from both directions must be alerted. The following signs and barriers are useful for this purpose:

- reversible 'Stop / Go' signs
- speed limit signs (30 km/hr)
- 'Men working' signs
- 'No overtaking' signs
- 'Road narrows' sign
- 'End of restriction' signs
- lane closure barriers and
- traffic cones

These signs should be available as many as required. In addition to reflective vests, workers should be issued with various personal protective equipment depending on the work being undertaken, such as gloves, helmets, boots, overalls, dust masks, goggles and ear muffs.

Figure 19: *Road signs used in maintenance works*

7.6.2 Temporary Signposting

Temporary signs should be placed well ahead of the site from both directions to warn traffic and reduce the speed, both for work on the roadside and in the carriageway. It is important to install sufficient measures to ensure that the speed of traffic is reduced before it arrives at the work site.

At the work site, all damages to the road which pose a danger to the traffic should be properly marked so that the traffic is guided away at a safe distance. Equally, the traffic should be properly separated from where works take place. The work site needs to be protected so that the traffic does not pose any danger to the workers, materials or equipment.

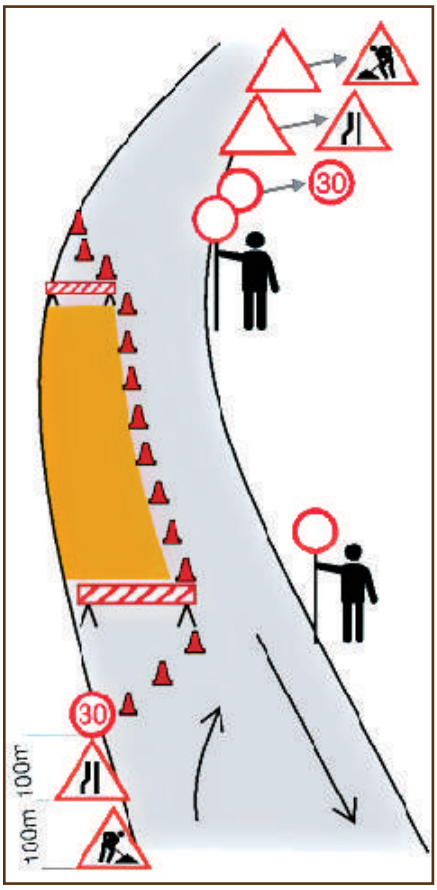
Simple and inexpensive safety equipment such as traffic cones can improve safety for both the road users as well as the maintenance workers. Cones are useful for (i) alerting the traffic of road works ahead, (ii) guiding the traffic into diversions and (iii) keeping traffic at a safe distance from the work site. Cones are easy to place and can be quickly moved when the works progress to another location.

Passing traffic pose a major risk to the safety of workers on road maintenance sites. It is therefore important that maintenance workers are clearly seen by the traffic. Work uniforms or vests in clear bright colours should be worn at all times on work sites to protect the workers from passing traffic.

When carrying out surface works on rural roads, traffic needs to be guided into a single lane and meeting traffic needs to be regulated only allowing traffic to pass in one direction at the time. The most common method of regulating traffic on rural roads is to employ flagmen with stop/go signs at both ends of the diversion.

On narrow roads, traffic may need to be halted for an extended period of time when major pavement works takes place. When this takes place, the road users need to be alerted already at the start of the road, also providing information on when the road will be reopened.

Figure 20: *Placement of temporary road signs*



ANNEX 1: ROUTINE MAINTENANCE JOB SHEETS

The Job Sheets are grouped according to off-carriageway and on-carriageway maintenance works. However, maintenance of paved shoulders and laybys are covered under on-carriageway maintenance since the activities remain the same on all paved areas.

The reference of Specification is based on SPECIFICATIONS FOR RURAL ROADS, Ministry of Rural Development, published by Indian Roads Congress, First revision January 2014.

JOB SHEET
ROUTINE MAINTENANCE WORKS

GENERAL ROAD INSPECTION AND REMOVAL OF OBSTACLES

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-00.01	**General road inspection and removal of obstacles**
Specification Code:		Inspect the drainage, roadside areas and carriageway along the road to ensure there are no critical damages or obstructions.
Unit of Measurement:	km	

SCOPE AND PURPOSE

- Inspect the drainage, roadside areas and carriageway on the complete length of the road to ensure there are no critical damages or obstructions. If critical damages have occurred, it should be reported immediately to the responsible road authority.
- Objects such as fallen trees, rocks, boulders or bushes blocking the carriageway or the drainage system should be removed and safely disposed of at a distance sufficiently far away from the road at a predetermined location as per the direction of the Engineer. *(Removal of soils due to erosion and silting is covered by a separate activity)*
- Obstructions, if they are not removed on a regular basis, may cause blockages in the drainage system leading to damage of the road and roadside areas.
- Obstructions can also be hazardous to the road users.

PROCEDURE

- The inspection is carried out on foot or on bicycle taking note of any obstructions.
- Culverts and side drains must be inspected on foot.
- Report any critical damages observed to responsible authority.
- Small objects that can easily be carried away should preferably be removed immediately at the time of the inspection.

- Where materials used for construction or agricultural purpose by local people is deposited on the road or which are blocking the drains, request the obstruction are remove. If the said materials are not removed by the next inspection, inform relevant authority possibility in writing.
- In the case of landslides, report to the other maintenance team members as soon as possible and proceed to remove these together with the team.
- In the case of water flowing onto the road or undermining road structures, correct if possible, otherwise inform the other maintenance team members.
- The deposited material should not affect the drainage system, vehicle or pedestrian transit, cultivated land, houses, canals or streams. Where necessary, the removed material should be transported to a suitable dumping site.
- Garbage should be collected in bags and deposited in an appropriate location.

Note:

- Inspection should be done frequently and specifically after heavy storm.
- This activity is performed as individual task system.

QUALITY ASSURANCE

- Ensure the inspection of the entire road is done on regular basis and after each heavy storm.

ENVIRONMENTAL

- When disposing of obstacles on the spot, disposal should be adhered to in order to avoid littering.

HEALTH AND SAFETY

- The inspector should at all times wear reflective clothing for his safety from passing vehicles.
- If inspection on foot is required, ensure the bicycle is parked off the carriageway and preferably at the outer end of the shoulder.

LABOUR

- Semi-skilled Labour

MATERIAL

- Not required

TOOLS AND EQUIPMENT

- Measuring tape
- Shovel
- Pickaxe
- Machete/cutlass
- Reflective clothing
- Raincoat
- Hard hat
- Bicycle
- Wheelbarrow
- *If possible a mobile phone*

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Inspection of road and removal of minor obstacles	20 km/wd		Inspection by bicycle
	10 km/wd		Inspection by foot

PERFORMANCE INDICATOR

The road pavement, shoulders and drains are free of debris. Any urgent issues encountered are written down in the notebook, relevant authority (the Engineer and/or the maintenance team) is informed and corrected.

JOB SHEET
ROUTINE MAINTENANCE WORKS

OFF-CARRIAGEWAY MAINTENANCE

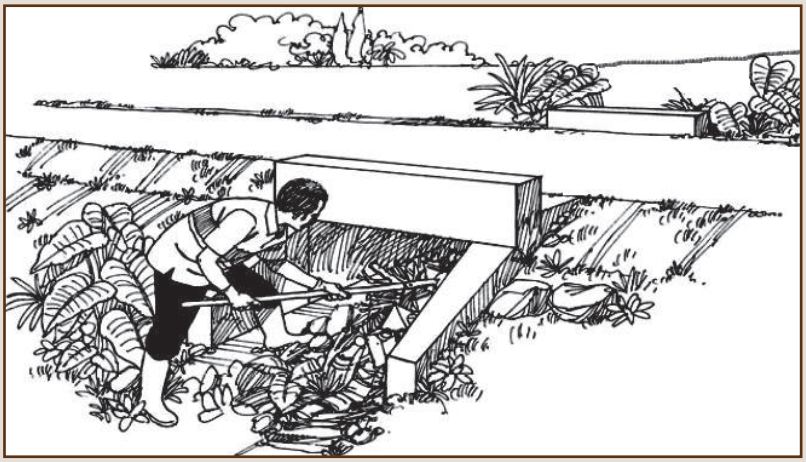
JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.01	**Off-carriageway maintenance**
Specification Code:	1909	Cleaning culvert, inlets and outlets
Unit of Measurement:	m^3	

SCOPE AND PURPOSE

- The culvert openings and catch water pits shall be cleared and cleaned of debris, sand and silt, vegetation without causing damage to any part of the structure. Cleared materials should be disposed of as directed by the Engineer.
- When water flows slowly through the aperture of a culvert, it often deposits sediment which if not removed, will cause water to overtop and damage the carriageway and the structure. Culverts need to be cleaned on a regular basis to avoid blockage and causing overflows with associated weakening of the road pavement and erosion damage. Drifts must be cleared for similar reasons, although they are less prone to sedimentation and blockage.

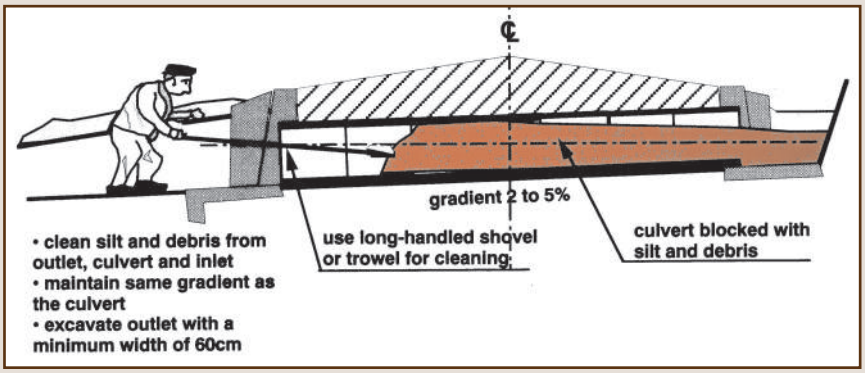
PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.



- This activity shall only proceed after grass cutting/bush clearing on the same section of road have been completed, inspected and approved. Grass is cut short leaving the roots to provide soil erosion protection.

- The aperture shall be cleaned of all sediment such as earth, stones, vegetation, branches, garbage, etc.
- The bottom of the inlet, catch-water pit and outlet channels shall be cleaned of silt and debris to a flat bottom width not less than the width of the culvert opening. A long handled shovel is useful for excavating material from the culvert pipes.
- The gradient of the inlet and outlet channels bottom shall be checked by boning rods or ranging rods and line levels and re-cut to ensure a continuous slope of not less than 1% to avoid silting.
- Side slopes of the inlet and outlet channels shall be reshaped and trimmed to provide smooth stable slopes.
- All matter cleared from the culverts should be safely deposited at least 3m clear of the road and the drainage system downhill from the road if possible to prevent it from being washed back into the drains. If need be, the soils and debris can be temporarily placed at the roadside until suitable means of transport is arranged for its deposit at a safe/appropriate location.



- If the outlet channel is located on the steep downhill slope, erosion protection shall be required such as stone check dams or gabion baskets.
- On completion of work, the culvert, including the inlet and outlet drains, should allow for free flow of water.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed before the onset of and during the monsoon.
- This activity is best performed under task work or daywork system depending on the situation.

QUALITY ASSURANCE

- Ensure that culvert opening and catch-water pit are clear of debris, sand and silt including growth of vegetation at inlet and outlet.
- Ensure the level of the drains are correct so that water will flow through the culvert and away from the exit.
- Ensure the deposited material should not affect the drainage system, vehicle or pedestrian transit, cultivated land, houses, canals or streams.

ENVIRONMENTAL

- Avoid littering the surrounding area and farmland.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- The workers should wear protective overall, boots and gloves.
- Care should be taken when clearing inside culverts because snakes can be present.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor (part time)
- Labour

MATERIAL

- Not required

TOOLS AND EQUIPMENT

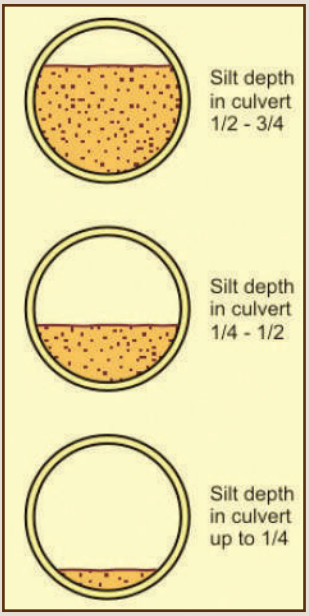
- Shovel
- Shovel long handle
- Grass cutter
- Hoe
- Cutlass/Machete
- Basket
- Wheel barrow

LABOUR TASK RATE

Payment is based on the amount of materials blocking the culverts and measured by the degree to which the culvert pipes are blocked. The following task rates are recommended for single and multiple pipe culverts using 0.6 m and 1.0 m diameter culvert rings:

Pipe diameter	Task difficulty – Silt in culvert				Remarks
	Up to ¼	Up to ½	Up to ¾	Over ¾	
600 mm	4 rows/wd	1 row/wd	2 wd/row	3 wd/row	Task up to 7.5m length culverts
1000 mm	2 rows/wd	2 wd/row	3.5 wd/row	5 wd/row	

If the culvert pipe is longer than 7.5 metres, new tasks need to be calculated using the above rates as the basis for the calculations. Similarly, if other pipe diameters are used, new rates need to be calculated based on the new internal area of the culvert pipe.



PERFORMANCE INDICATOR

The culverts, the inlets and outlets are clear and drain freely.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.02	**Off-carriageway maintenance**
Specification Code:	1909/1910	Clearing debris at bridges and causeways
Unit of Measurement:	m^3	

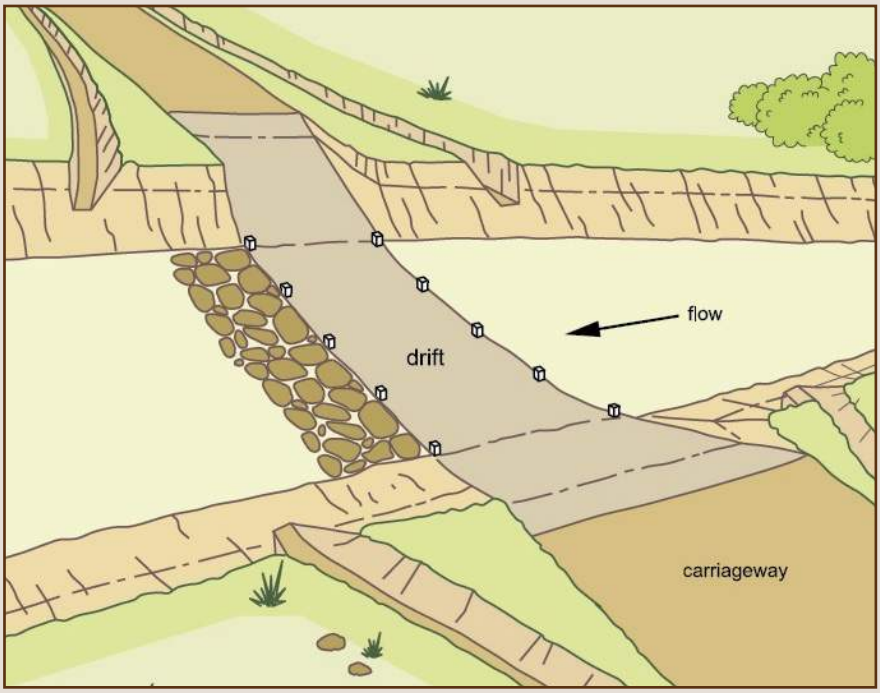
SCOPE AND PURPOSE

- Clear silt, debris and litter around the structure, its abutments and piers and for a minimum distance of 25m both upstream and downstream thereby allowing water to flow freely and unhindered.
- If waterways under bridges and causeways are not regularly cleared they may eventually become blocked, causing high water levels in other parts of the drainage system with associated weakening of the road pavement and erosion damage. Finally, the blockage may lead to serious damages to the bridge itself.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.

- All matter should be removed clear of the river and the drainage system to prevent it from being washed back into the waterway. If need be, the soils and debris can be places temporarily at the roadside until it is transported to a deposit in a safe location.



- Side slopes of the inlet and outlet channels shall be reshaped and trimmed to provide smooth stable slopes directing water into the bridge.
- Remove sand and silt from causeway bed and dispose of away from the water channel or as instructed by the Engineer.

- Inform the relevant authority or the Engineer if any damaged is found on the structure.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed before the start of the monsoon period and after heavy rainfalls.
- This activity is best performed under daywork system.

QUALITY ASSURANCE

- Ensure that the level of the drains are correct so that water will flow through freely and away from the exit.
- Ensure the deposited material should not affect the drainage system, vehicle or pedestrian transit, cultivated land, houses, canals or streams.
- Ensure the guide posts are clearly visible and if broken or missing inform the Engineer.

ENVIRONMENTAL

- Do not dispose of materials scattered all over the area and on the shoulder. It should be disposed of at safe location or as directed by the Engineer.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- The workers should wear protective overall, boots and gloves.
- Care should be taken when clearing inside culverts because snakes can be present.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor (part time)
- Labour

MATERIAL

- Not required

TOOLS AND EQUIPMENT

- Shovel
- Pick/Mattock
- Grass cutter
- Hoe
- Cutlass/Machete
- Basket
- Wheel barrow

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Removal of loose debris such as boulders, branches, etc.	1.5 m^3/wd		
Excavation and removal of clay and silt	2.5 m^3/wd		

PERFORMANCE INDICATOR

- The drift, the inlets and outlets are clear and drain freely.
- The area below the bridges is clear and water can flow freely.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.03	**Off-carriageway maintenance**
Specification Code:	1908	Clearing, cleaning, reshaping, deepening and erosion repairs to side drains, mitre drains and catch-water drains
Unit of Measurement:	m	

SCOPE AND PURPOSE

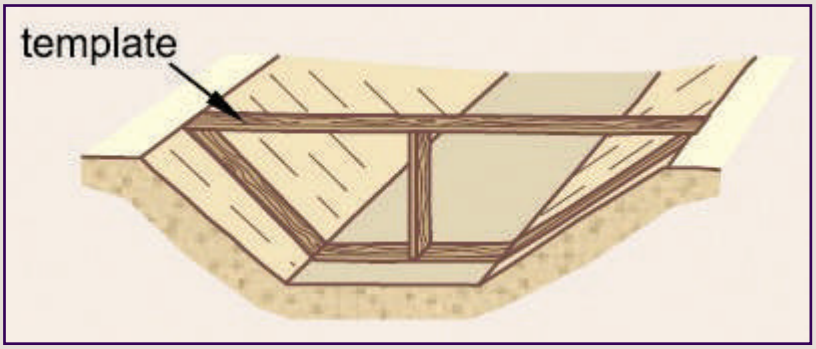
- Cleaning of debris and siltation from side ditches and turnouts/mitre-drains, catch-water drains including minor reshaping to restore bottom level and gradient in order to ensure free flow of water collected from the roadway. These drains should retain its intended cross sections and grades as directed by the Engineer.

- Unless cleared regularly drains will eventually become blocked and cause water levels to rise with associated weakening of the road pavement and causing erosion damage.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- This activity shall only proceed after grass cutting/bush clearing on the same section of road have been completed and inspected.

- The ditches shall be cleaned of soil/silt and debris to a minimum depth of 30cm below edge of roadway and to a flat bottom width of minimum 40 cm or as directed by the Engineer.
- The gradient of the ditch bottom shall be checked by boning rods or ranging rods with line levels and reshaped to ensure a continuous slope of not less than 1% to the ditch outlet including turnouts and cross drainage structures. *(refer to Module 5.2.8 on how to check the gradient using line level)*
- If the slope is more than 4%, scour checks will be needed where the soil is prone to erosion.
- Unlined drainage ditches shall be reshaped and trimmed to provide smooth stable side slopes to retain their intended cross sections as directed by the Engineer. A drain template shall be used to check the cross section of the drain.



- Lined drainage ditches shall be cleaned by manual labour taking care not to damage the lining of the drain.
- The removed material should be deposited at the road side, downhill from the road if possible.
- Residual gravel removed from side ditches shall be separated from vegetative matter using manual labour and suitable materials spread onto the shoulders.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed before the onset of and during the raining season.
- This activity is performed best as task system.

QUALITY ASSURANCE

- Ensure that the ditch dimensions (width and depth) are as per the design or as instructed by the Engineer.
- The ditch invert gradient must be checked for compliance at all points. It is very important that the ditch invert slopes are accurately constructed as errors may lead to ponding of water in the drains.
- The side slope must be checked for correctness or to intended cross sections using a slope template and a spirit level.
- Ensure that once the drains are cleaned, they have a flat base and have a constant slope for flow of water and no dips where water can settle.

ENVIRONMENTAL

- If drains are not cleared properly, water can overtop and discharge onto farmland or cause erosion elsewhere.
- The excavated material deposited should not affect the drainage system, vehicle or pedestrian transit, cultivated land, houses, canals or streams. Where necessary, the removed material should be transported to a suitable dumping site.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers must be well spaced to limit the risk of injury each other.
- In extremely dry areas, dust reduction measures (e.g. dampening the soil with water) must be considered if unhealthy levels of dust are suspected and/or provide dust masks to workers.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor (part time)
- Labour

MATERIAL

- Not required

TOOLS AND EQUIPMENT

- Spade
- Hoe
- Shovel
- Mattock
- Wheel barrow
- Basket
- Ditch template

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Cleaning of side drains and mitre drains			Task related to drained ditches without any standing water
- for moist and loose soils	2.5 m^3/wd		
- for average soil condition	2.0 m^3/wd		
- for hard and dry soils	1.75 m^3/wd		

Because the size of the drains vary from one area to the other, the supervisor should use the above guide to work out the task rate in linear metres based on the percentage or depth of silting that needs to be cleared in the drains. To simplify measurement payment is usually made based on linear metres of drain cleaned.

PERFORMANCE INDICATOR

The drainage ditches are clear and there is no setting/ponding of water.

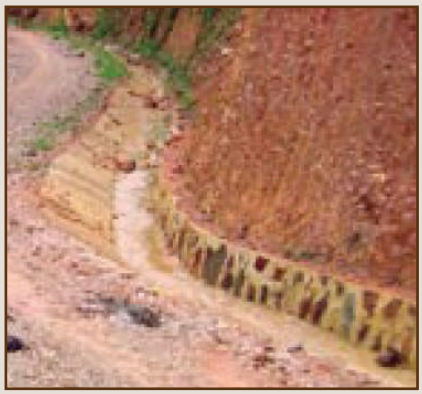
JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.04	**Off-carriageway maintenance**
Specification Code:	1908	Repair of damaged drain lining
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- This activity includes provision of construction materials and repair of damaged drain lining to its intended shape and specification as directed by the Engineer.
- If regular repairs to the existing drain linings is not done the water will undermine the remaining lining and resulting in weakening of the road pavement and causing erosion damage.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- Area of the repair work shall be prepared to a firm base by placing gravel compacted in 150mm layers before the placement of stone or concrete slabs.
- If the original lining was done using stone masonry work, the spaces between the stones shall be filled with 1 : 3 (cement : sand) mortar.
- Before the mortar is applied the surfaces of the stones shall be cleaned of any dirt and then moistened.



- The mortar shall be worked into the pitching to ensure that all spaces between the stones are completely filled with mortar to the depth of the stone pitching.
- After placing of the mortar the stones shall be thoroughly brushed so that their top surfaces are exposed. The finished surface shall present an even, tight and neat appearance with no stones protruding more than 25mm from the design line.
- The pitching shall be cured for at least 4 days.

- Where required, weep holes shall be formed in the pitching as shown in the Drawings or as directed by the Engineer.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed during the dry season.
- This activity is performed best as daywork system.

QUALITY ASSURANCE

- Ensure that the repair works are as per the original design or as instructed by the Engineer.
- Ensure to cover the area with damp jute bags and watered daily as curing of the concrete work.

ENVIRONMENTAL

- Ensure that the working area is fenced off from the children that are coming to play during the off working hours.
- All unused stones and sand should be removed or moved to other construction site and not left behind on completion of the work.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers should be provided with protective clothing such as gloves and boots and helmets.
- Workers should not be exposed to the risk of soil collapsing if in deep channel.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor (part time)
- Mason
- Labour

MATERIAL

- Cement
- Sand
- Water
- Stone or brick

TOOLS AND EQUIPMENT

- Trowel
- Chisel
- Head pan
- Shovel
- Hammer
- Straight edge
- Spirit level
- Mason line

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Repair of drain lining			1 mason + 1 labour
Stone masonry work including preparation of stone and mortar but excluding collection of stones	4 m^2/wd		

PERFORMANCE INDICATOR

The drain lining is repaired to specification and curing done.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.05	**Off-carriageway maintenance**
Specification Code:		Repair and replace scour checks
Unit of Measurement:	numbers	

SCOPE AND PURPOSE

- To repair, replace damaged or severely eroded scour checks and construction of new scour checks using wooden stakes and/or boulders as directed by the Engineer.
- Scour checks are barriers constructed in side drains with erosion resistant aprons on the downstream side. The principle is to convert an inclined drain into a series of steps to reduce the water velocity that can create erosion inside the drains.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- This activity shall only proceed after ditch maintenance activities on the same section of road have been completed, inspected and approved.
- The scour checks shall be repaired or replaced according to the gradient of the drain.
- The gradient must be checked before the construction of the scour checks. *(Refer to Setting out Module 5.2.8 for method*

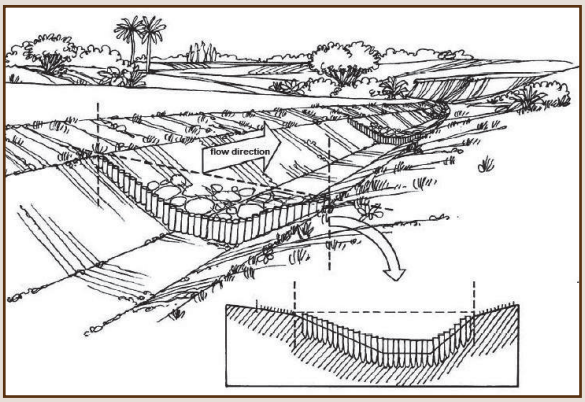
on how to check the gradient). Unless otherwise directed by the Engineer, the following spacing shall be used:

at 4% they are not required (they may be necessary in soil that is easily eroded)

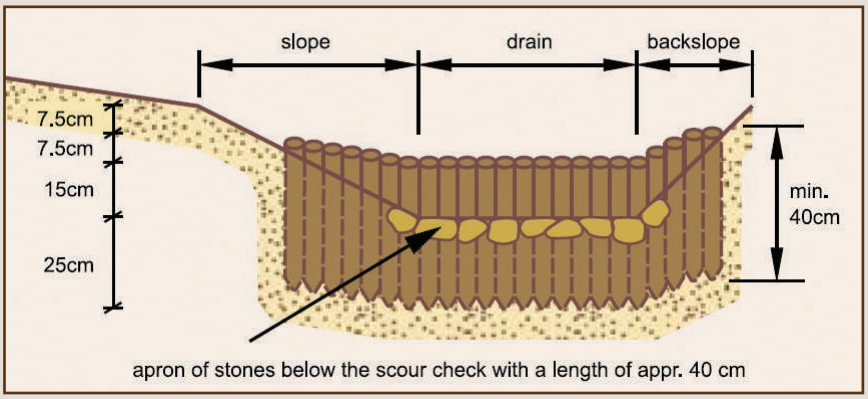
at 5% the spacing shall be 20 metres

at 8% the spacing shall be 10 metres

at 10% the spacing shall be 5 metres



- Scour checks shall be constructed from masonry, bamboo, stones or timber as directed by the Engineer.
- A slot shall be excavated across the ditch to 10cm below ditch invert level to accommodate for stones and boulders.
- Boulders shall be placed downstream as an apron to avoid scouring from the force of water overflowing the scour check.



apron of stones below the scour check with a length of appr. 40 cm

- Waste material shall be removed at least 1m clear of the back slope of the ditch or removed and spread thinly in a suitable area where it cannot be washed back into a drain.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed during the dry season.
- This activity is performed best as task system.

QUALITY ASSURANCE

- Ensure that the repair works are as per the original design or as instructed by the Engineer.
- Check scour check intervals are related to drain slope.
- In case there are still sign of erosion in the drain although the interval are correct according to specification, construct intermediate scour checks.

ENVIRONMENTAL

- Avoid cutting trees to construct scour checks that are of economic or social value to the community.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers should be provided with protective clothing such as gloves and boots and helmets.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor (part time)
- Labour

MATERIAL

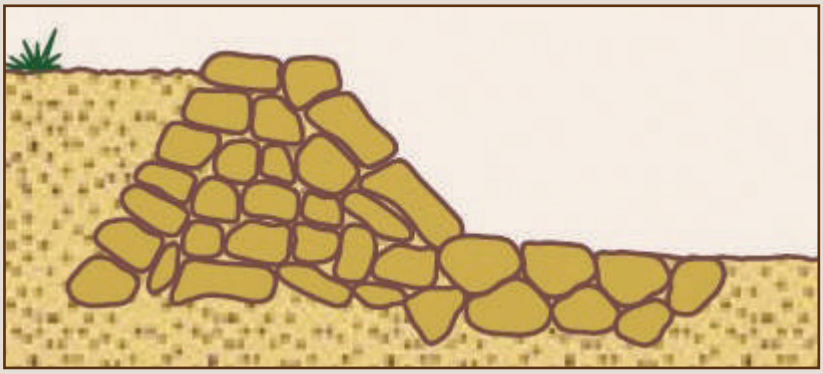
- Stone
- Stakes

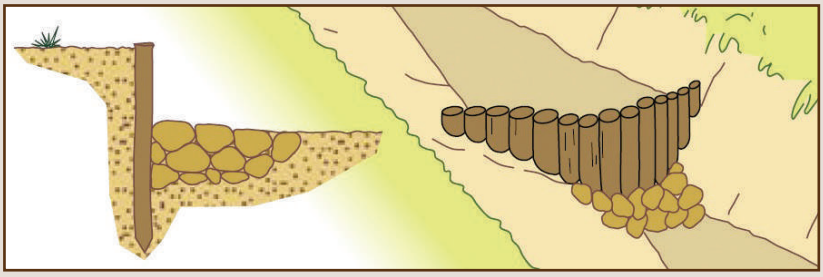
TOOLS AND EQUIPMENT

- Sledge hammer
- Pick
- Mason hammer
- Shovel
- Cutlass/Machete
- Tape measure
- *Line level and builders line*
- *Ranging rods or profile boards*

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Construction of scour checks only	4 ~ 8 Nos/wd		Excluding stone/ stakes collection
Stone collection	2 ~ 3 m^3/wd		
Cutting of stakes for scour checks	80 Nos/wd		





PERFORMANCE INDICATOR

Scour checks provided where required or as per the Engineers instruction.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.06	**Off-carriageway maintenance**
Specification Code:	1902	Repair rain cuts and minor slips on embankment side slopes
Unit of Measurement:	m^3	

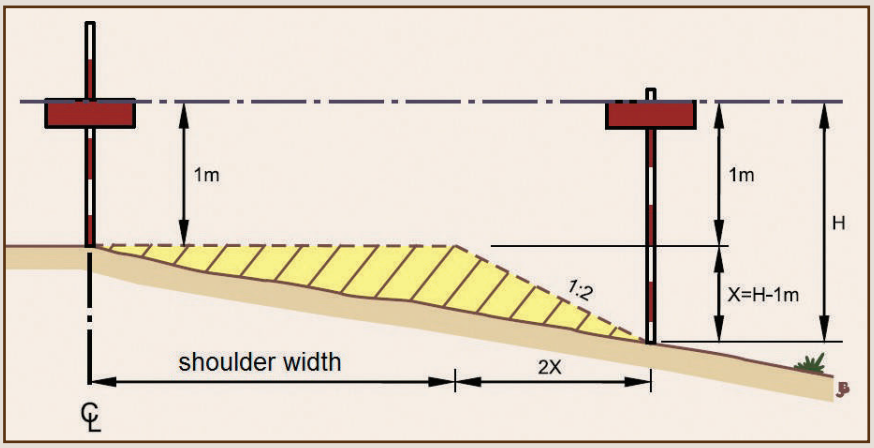
SCOPE AND PURPOSE

- The work shall consist of earth work for restoration of rain cuts in embankments side slopes.
- Slips and erosion gullies in the side slopes are often associated with rutting (on gravel roads) and/or build-up of material on the shoulders preventing the surface water from the carriageway from draining freely off along the shoulders. When the amount of water builds up, it will find an exit point which is then badly eroded. This activity should therefore normally be preceded by (first removing the cause) reshaping the shoulders and filling in ruts.

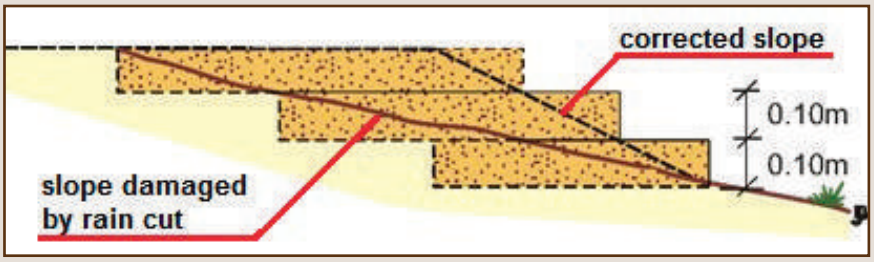
- Damages to side slopes may also take place as a result of too steep slope gradients or poorly compacted fills. Steep slopes can be adjusted to achieve a gentler slope. If there is no available space, the alternative is to build a short retaining wall (extra work).
- Slips and erosion gullies can threaten the stability of embankments and must be repaired before any further damage occurs. The eroded material can lead to silting of drains, blockages of cross-drainage structures and damage to surrounding lands.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- Clear the area affected by rain cuts of all loose soil and then provide benching. A level bench should be formed at the base of the slip or gully and compacted with hand rammers. The width of benches should be at least 300mm and should extend continuously for a sufficient length, the height of benches being 100mm.



- Fresh layers not thicker than 100mm are then successively placed and compacted on top of the bench following the contour of the side slope.



- Fill material should be at or close to the optimum moisture content. *(refer to Module 6.8.4 on how to check this on site)*
- As a guide the compaction can be checked when no visible imprints from hand rammer are present.
- Fill material should preferably be a graded soil containing a certain amount of clay to act as a binder. If suitable is not available on site it may have to be transported.

- Finally the repair is cut to shape and all surplus material removed from site to a safe location away from the drainage system.
- Newly formed slopes are easily damaged by runoff surface water and animals. Therefore it should be protected from erosion by planting grass which is a separate activity.
- Remove the road traffic signs on completion of work.

Note:

- Slips should be repaired as a matter of priority. Erosion gullies must be repaired at the end of the rainy season or as directed by the Engineer.
- This activity is best performed under task work system.

QUALITY ASSURANCE

- Ensure that the finished work conforms to the specified alignment, levels and slopes.
- Do not use any soil for restoring rain cuts, which does not meet the requirements for suitability as a fill material.
- Ensure the fill material is compacted in layers.

ENVIRONMENTAL

- If material was borrowed along the sides of the embankment, make sure it does not become a pond of stagnant water where mosquitos can breed, especially when it is located close to human settlement.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers should be provided with protective clothing.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor (part time)
- Labour

MATERIAL

- Water
- If needed suitable fill material

TOOLS AND EQUIPMENT

- Shovel
- Pick/Mattock
- Hoe
- Hand rammer
- Basket
- Wheel barrow
- Watering can
- Ranging rods
- Line level
- String
- Pegs
- Tape measure

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Fill suitable soil and compact in layers in			
- moist and loose soils	2.5 m^3/wd		
- average soil condition	2.0 m^3/wd		
- hard and dry soils	1.75 m^3/wd		

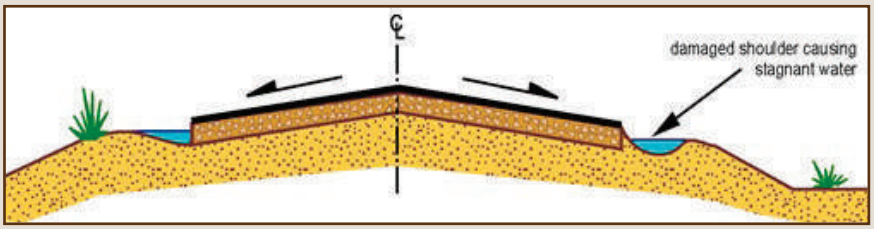
PERFORMANCE INDICATOR

The rain cuts and slopes are well reconstructed and compacted as to the original design.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.07	**Off-carriageway maintenance**
Specification Code:	1903	Earthen shoulder repair
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- The work of maintenance of earthen shoulder shall include making up the irregularities/loss of material on shoulder to design level and cross-fall by adding fresh approved selected soil and compacting it with appropriate equipment or hand rammer as per the requirement as directed by the Engineer.
- This includes repair of erosion gullies and potholes on the shoulders and compacting the road shoulder to the height of the road surface in order to avoid damage to vehicles and to ensure that the road pavement is not undermined.
- Traffic use the shoulders when meeting other vehicles and for parking. Road shoulders serve to give stability to the pavement and side slopes, and form part of the surface drainage. Poor drainage on shoulders causes stagnant water to soften the shoulders and pavement, leading to further damages. Often, damages are caused by poor material used on the shoulders and/or a lack of proper drainage on the shoulders. Potholes and erosion gullies on shoulders are also safety hazards, particularly at high speed.
- High shoulder drops often occur in areas where vehicles are stopping and wear off the shoulder material. Erosion of the shoulders is the most common cause of edge breaks on the pavement. If the shoulders are not kept intact at the level of the surfacing, the edge of the surfacing will start to break off and more extensive repairs are required.



PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- Wherever extra soil is required to be added, the shoulder shall be stripped and loosened to receive fresh soil to the shoulder.
- Load and transport selected material from a suitable excavation site to the section of road being maintained. Preferably material of the same quality as the road base or gravel wearing course should be used.
- Backfill with suitable material in layers of 100mm before compaction. Repeat this to the level of the surfacing (paved roads) or gravel wearing course (gravel roads).
- Granular material needs to be at optimum moisture content when compacted. *(refer to Module 6.8.4 on how to check moisture content on site)*
- The compacted shoulder should be finished to the required cross-fall (normally 5%) in accordance with drawing or as per instructed by the Engineer.
- Remove any leftover material, depositing it at the road side, downhill from the road if possible. The deposited material should not affect the drainage system, vehicle or pedestrian transit, cultivated land, houses, canals or streams. Where necessary, the removed material should be transported to a suitable dumping site.
- Remove the road traffic signs on completion of work.

Note:

- Shoulders are normally repaired at the end of the rainy season.
- This activity is best performed under task work system.

QUALITY ASSURANCE

- Ensure that the finished work conforms to the specified alignment, levels and slopes.
- Do not use any soil for restoring rain cuts, which does not meet the requirements for suitability as a fill material.
- Ensure the fill material is compacted in layers.

ENVIRONMENTAL

- If material was borrowed along the sides of the embankment, make sure it does not become a pond of stagnant water where mosquitos can breed, especially when it is located close to human settlement.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- A first aid kit must be readily available on site for any emergency.

LABOUR

- Supervisor (part time)
- Labour

MATERIAL

- Water
- If needed suitable fill material

TOOLS AND EQUIPMENT

- Shovel
- Pick/Mattock
- Hoe
- Hand rammer
- Basket
- Wheel barrow
- Watering can
- Ranging rods
- Straight edge
- String
- Pegs
- Tape measure

LABOUR TASK RATE

Payment of works are based on the volume of material added to the shoulders, at the following task rates:

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Fill suitable soil and compact in layers in			
- moist and loose soils	2.5 m^3/wd		
- average soil condition	2.0 m^3/wd		
- hard and dry soils	1.75 m^3/wd		
Maintenance of the shoulders	75 m^2/wd		

PERFORMANCE INDICATOR

The road shoulder is free of potholes, correct cross fall and less than 5 cm below the road pavement.

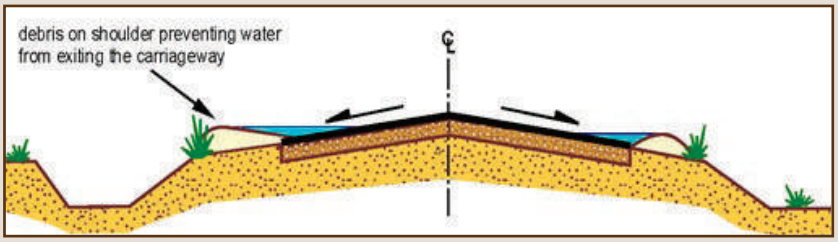
JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.08	**Off-carriageway maintenance**
Specification Code:	1903	Reshape shoulder
Unit of Measurement:	m^2/m^3	

SCOPE AND PURPOSE

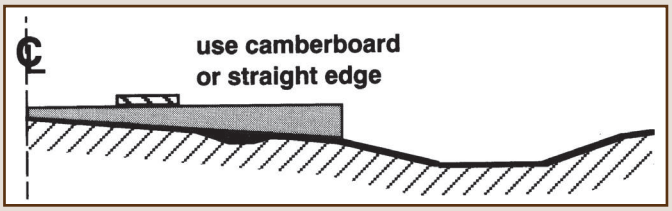
- Removing excess material on the shoulders (e.g. windblown sand and silt, material from a gravel carriageway that has accumulated on the shoulders)
- Excess material on the shoulders blocks run-off from the carriageway. Water then ponds on the edge of the road and penetrates and softens the pavement and shoulders and cause pavement and shoulder failures.
- Larger amounts of water tend to find an outlet at some point and can cause the development of erosion gullies and slips.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- Scarifying and removing material down to the correct level of the shoulders with a cross-fall at least equal to the camber of the carriageway.



- A camber board or straight edge can be used to check the finishing of the shoulder.



- This activity is best carried out with hoes and shovels, taking care not to dig too deep into the shoulders.
- The resulting surface shall be uniform and compacted.
- The loose material shall be collected in heaps and carted away to a safe location where it cannot be washed back into the drainage system. If need be a vehicle is used to transport the material to a safe deposit.
- Remove the road traffic signs on completion of work.

Note:

- This activity is done before the onset of the rains.
- This activity is best performed under task work system.

QUALITY ASSURANCE

- Ensure that the finished work conforms to the specified alignment, levels and slopes.
- Ensure the shoulder is compacted after levelling.

ENVIRONMENTAL

- If material was borrowed along the sides of the embankment, make sure it does not become a pond of stagnant water where mosquitoes can breed, especially when it is located close to human settlement.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- A first aid kit must be readily available on site for any emergency.

LABOUR

- Supervisor (part time)
- Labour

MATERIAL

- Not required

TOOLS AND EQUIPMENT

- Shovel
- Pick/Mattock
- Hoe
- Hand rammer
- Basket
- Wheel barrow
- Straight edge
- String
- Pegs
- Tape measure

LABOUR TASK RATE

Unit of measurement: m^2 or metres of road length. The following task rates are recommended:

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Fill suitable soil and compact in layers in			
- moist and loose soils	2.5 m^3/wd		
- average soil condition	2.0 m^3/wd		
- hard and dry soils	1.75 m^3/wd		
Maintenance of the shoulders			
- in area of shoulder	75 m^2/wd		

PERFORMANCE INDICATOR

The road shoulder is free of potholes, correct cross fall and less than 5 cm below the road pavement.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.09	**Off-carriageway maintenance**
Specification Code:	1915	Cutting of tree branches and shrubs
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- Cutting of tree branches and shrubs from roadway including disposing of all cuttings to suitable locations as directed by the Engineer.
- Overgrown vegetation interferes with the drainage of water off the road into the drains and can cause accidents with people and animals due to reduced sight distance and visibility of road users. It also avoid structural damage of the road due to expansion of roots.

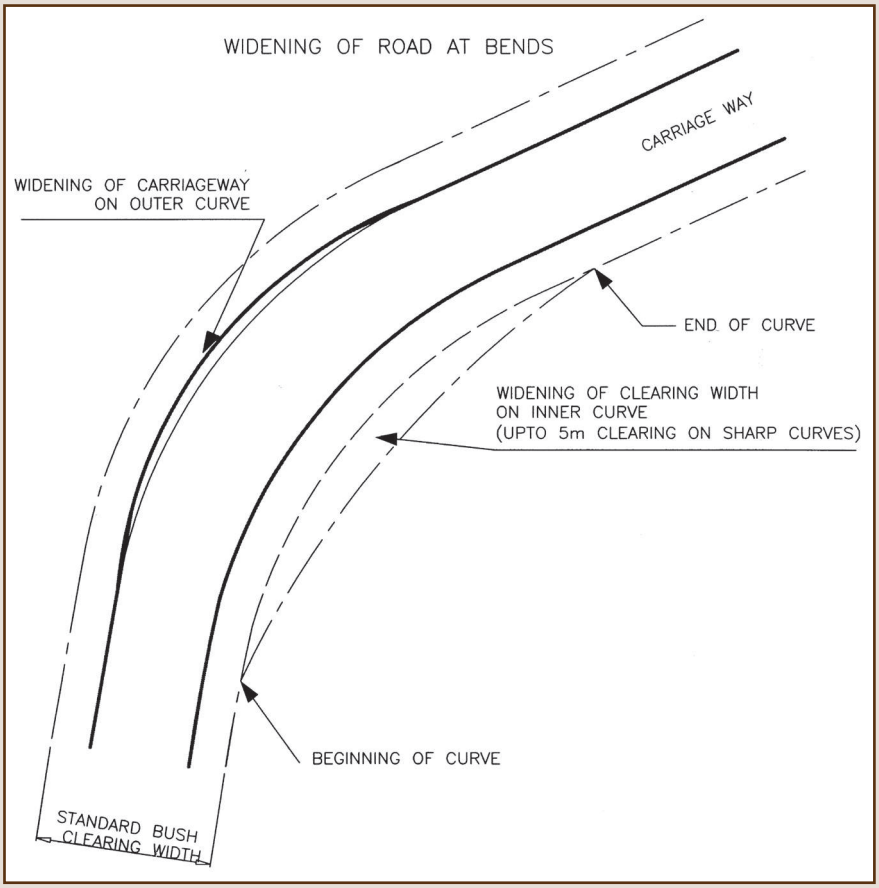
PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users. Where the tree branches are going to be cut, traffic should be temporary stopped to avoid branches falling over moving traffic.

- Cut all branches of trees extending above the roadway as to provide a clear height of 5m above the road surface and shoulders. The

width to be cleared on straight road sections and outer curves shall be 1m beyond the back slope of side drain, or as directed by the Engineer.

- The width to be cut on inside of curves shall be sufficient to ensure unobstructed sight distance.



- Remove all cuttings and dispose of at least 3m from the edge of the road carriageway and well cleared of any drainage channels or suitable location as directed by the Engineer.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed before and at the end of the raining season.
- This activity is performed as group work under daywork system.

QUALITY ASSURANCE

- Ensure the cuttings are done according to the specification or per the Engineer's instruction.
- Ensure the bushes are uprooted to avoid from re-growing and structural damage to the road foundation.
- Ensure the cuttings are disposed of away from the drainage channels as per the Engineer's instruction.

ENVIRONMENTAL

- Proper disposal should be adhered to in order to avoid littering.
- Bush shall not be removed by burning. Where burning of debris is necessary, care must be taken to prevent fire spreading outside the cleared width. Water and/or sand must be readily available at the site when burning is to be carried out.
- Care must be taken to avoid damage to protected flora, historical monuments and other heritage sites.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Ensure all ladders or scaffolding used in tree branch removal are securely fixed and one labourer is holding the ladder while another labour is climbing up and cutting the branches.
- When using the rope to remove branches from tree, ensure that the length of the rope is longer than the height of the tree. This will allow the gang pulling the rope to be well clear of the tree branches as it falls.
- Workers shall have safe working distance and not work too close to each.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor
- Labour (in gang of at least 3 workers)

MATERIAL

- Not required

TOOLS AND EQUIPMENT

- Bush knife
- Bow saw
- Cutlass/machete
- Rope
- Ladder
- Wheel barrow
- Boots
- Gloves
- Hard hat
- Overall
- *Chainsaw (if necessary)*

LABOUR TASK RATE

The following task rate is for estimating purpose only. Actual work done is paid by numbers of trees/shrubs cleared or by daywork.

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Cutting of tree branches and shrubs			
- for medium vegetation	150 m^2/wd		
- for thick vegetation	100 m^2/wd		
Note: Medium = needs bush knife and bow saw; Thick = needs axe or chainsaw			

PERFORMANCE INDICATOR

The tree branches and shrubs does not impede visibility or normal vehicle transit, especially in corners or dangerous sections, and the road reserve is free of garbage.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.10	**Off-carriageway maintenance**
Specification Code:	1915	Trimming of grass and weeds
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

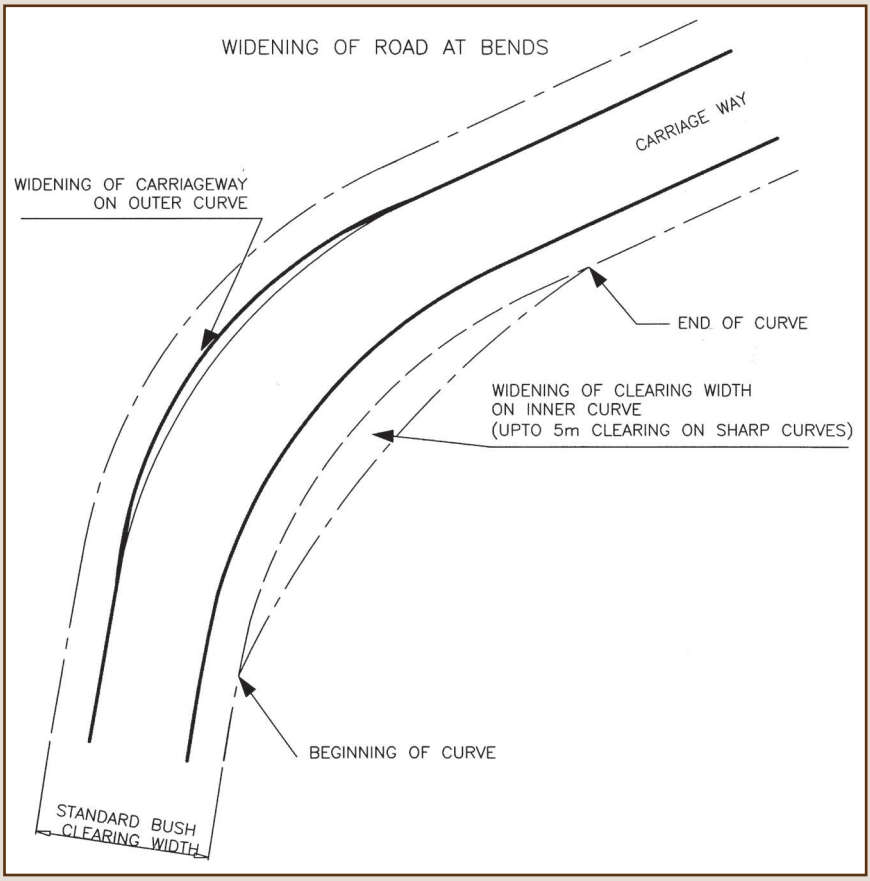
- Trimming of grass and weeds from roadway or within the road reserve including disposing of all cuttings to suitable locations as directed by the Engineer.
- Overgrown vegetation interferes with the drainage of water off the road into the drains and can cause accidents with people and animals due to reduced sight distance and visibility of road users. However, the grass roots should not be removed (grubbing) to protect from erosion in the drains and slopes.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- Cut all grass and other vegetation (not grubbing) from the shoulders, side drains, mitre drains and culvert inlet and outlet channels, to height not exceeding 5cm from the ground. The grass should not be allowed to grow taller than 10cm at all times.

- The grass should be cut to a width of 3m measured from the road shoulder break point or 1.5m each side of the center-line of culvert inlet or outlet or mitre drain.
- Where no side drains exist, i.e. on road embankments, the clearing works should cover the area from the pavement edge (or centre of the road for earth and gravel road) to the foot of the embankment or to the paddy water level on both sides of the roadway.
- The width to be cut on inside curves shall be sufficient to ensure good visibility as directed by the Engineer.

- All vegetative matter, shall be removed to a distance of at least 3m from the edge of the road carriageway and well clear of any drainage channels. On rolling and hilly terrain, the debris must be disposed outside the cleared width on the lower side of the road to avoid them being washed back into the drains. In some situations the debris may also be piled and burnt in a controlled manner.



- Remove the road traffic signs on completion of work.

Note:

- This activity is performed before and at the end of the raining season.
- This activity is performed best as group task system. However, individual task can also be assigned.

QUALITY ASSURANCE

- Ensure the trimming is done according to the specification or per the Engineer's instruction.

- Ensure the grass are not grubbed but only trimmed to avoid erosion of the slopes.
- Ensure the cuttings are disposed of away from the drainage channels as per the Engineer's instruction.

ENVIRONMENTAL

- Proper disposal should be adhered to in order to avoid littering.
- Chemicals should not be used to get rid of grass.
- Avoid using burning (fire) as a method of bush clearing.
- Where burning of debris is necessary, care must be taken to prevent fire spreading outside the cleared width. Water and/or sand must be readily available at the site when burning is to be carried out.
- Care must be taken to avoid damage to protected flora (vegetation), historical monuments and other heritage sites.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers must be well spaced (especially when working in gangs) to limit the risk of injury each other.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor
- Labour

MATERIAL

- Not required

TOOLS AND EQUIPMENT

- Grass cutter
- Rake
- Shovel
- Bush knife
- Wheel barrow
- Basket
- Overall
- Boot

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Trimming of grass and weeds			
- for light vegetation	200 m^2/wd		
- for dense vegetation	150 m^2/wd		
Note: Light = needs grass cutters; Dense = may need bush knife in some areas			

PERFORMANCE INDICATOR

The vegetation is kept at a height less than 10cm at all times and does not impede visibility or normal vehicle transit, especially in corners or dangerous sections, and the road reserve is free of garbage.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-01.11	**Off-carriageway maintenance**
Specification Code:	1915	Planting grass for erosion protection
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- The activity includes furnishing and planting turf and sods, achieving a healthy stable covering of grass which will maintain its growth in any weather.
- This is to prevent erosion of the material in which it is planted and stability of side slopes and embankments.
- The term “grass” includes turf and sods and may include plants of other types capable of giving effective erosion protection.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.

- Sodding or turfing is done by planting sods or turf to give a continuous cover over the whole area. Grass is planted with its root system substantially undamaged, well buried in firm material, and packed around with moist earth in which it has grown.
- Grass is planted at such time and the work carried out in such a way that when the final inspection take place, all areas to be grassed are substantially covered with healthy, well established, firmly rooted grass and the planted area is free from erosion channels.
- This may involve watering, preserving, protecting and replacing grass and such other work as may be necessary to keep it in a satisfactory condition to prevent erosion and to present a dense and uniform appearance.
- Temporary protection may have to be made to stop animals uprooting the planted grass.

- Regular watering may also be need for the survival of the planted grass.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed on completion of slope and erosion repairs or as directed.
- This activity is performed best as task system.

QUALITY ASSURANCE

- Ensure the grass are planted correctly and will survive.
- If turfing, ensure they are anchored well onto the slopes.

ENVIRONMENTAL

- Care must be taken to avoid damage to protected flora (vegetation), historical monuments and other heritage sites.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers must be well spaced (especially when working in gangs) to limit the risk of injury each other.
- A first aid kit must be readily available on site at all times.

LABOUR

- Supervisor
- Labour

MATERIAL

- Water if needed for watering grass

TOOLS AND EQUIPMENT

- Hoe
- Shovel
- Watering can
- Basket
- Boot

LABOUR TASK RATE

Payment shall be for the area of turfed or sodded surface. The standard task rate is as follows:

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Grass planting	20 m^2/wd		

PERFORMANCE INDICATOR

All areas to be grassed are substantially covered with healthy, well established, firmly rooted grass and the planted area is free from erosion channels.

JOB SHEET
ROUTINE MAINTENANCE WORKS

ON-CARRIAGEWAY MAINTENANCE

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.01	**On-carriageway maintenance**
Specification Code:	1906	Light grading of unsealed roads (gravel roads)
Unit of Measurement:	km or m^2	

SCOPE AND PURPOSE

- The surface of gravel roads are graded to remove corrugations, shallow ruts and potholes and minor defects to maintain and restore a smooth riding surface of the camber.
- Maintaining a proper camber of minimum 5 to 6 % on gravel roads is crucial to their performance and will drastically reduce development of potholes, ruts and shoulder erosion.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- The gravel road surface to be graded shall be prepared by patching of large potholes or depressions and draining out areas of standing water.

- No material shall be imported as part of this activity.
- The work can be carried out by motor grader, tractor mounted grader blade or by manual labour.
- When using a machine, the grading should start at the shoulders on each side bringing the material to the middle of the road to maintain the camber.
- The grader blade should only correct minor imperfections in the surface and not dig down into the pavement.
- If the work is carried out by labour, the same principle applies. Hand tools, mainly hoes and rakes, are used to scarify surface imperfections and level the surface working from the shoulders towards the centre of the road.

- Light grading should only be carried out when the surface is moist allowing for compaction of the loose surface material under traffic.
- Remove the road traffic signs on completion of work.

Note:

- This activity is performed at regular interval as directed by the Engineer. The interval depends on the traffic level and road surface condition.
- This activity is best performed using motorized grader or tractor-towed grading.

QUALITY ASSURANCE

- Ensure the grading is done starting from the edge of road towards the centre in longitudinal passes.
- The material brought from the edge should not contain any organic/ unsuitable materials.
- Ensure this activity is carried out in a manner not to lose surface material.

ENVIRONMENTAL

- The activity can generate dust if the road surface is dry.
- Clean up the site after construction.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers should wear dusk masks.

LABOUR

- Supervisor
- Labour

MATERIAL

- No material is required unless working in dry season water may be needed

TOOLS AND EQUIPMENT

- Hoe
- Shovel
- Watering can
- Basket
- Dusk mask
- Grader or tractor-towed grader

LABOUR TASK RATE

Payment shall be for the area graded measured on basis of km of road grader. If only small section is required and done by labour, the measurement shall be in area expressed as m^2. The standard task rate for labour is as follows:

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Removal of corrugations / reshaping	75 m^2/wd		

PERFORMANCE INDICATOR

The road surface is free of corrugations and standard camber slope is restored as instructed by the Engineer.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.02	**On-carriageway maintenance**
Specification Code:	1904–1906	Bituminous pavement repair including filling of potholes and patch repairs
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

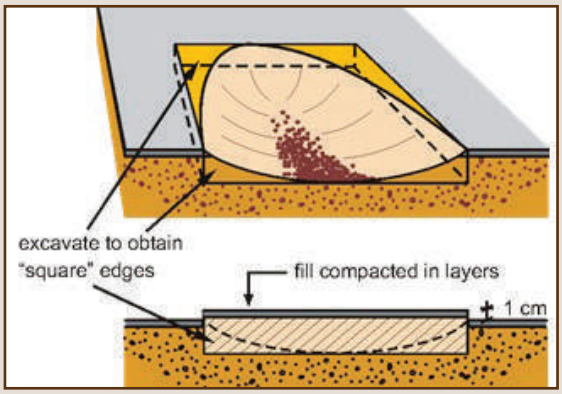
- Pavement repairs include: Pothole repairs - patching on paved roads; Repair of deep ruts and depressions (rut depth > 50 mm); Repair of edge failures; Repair of isolated spots with crocodile cracking.
- The work shall include the removal of all failed material in pavement courses up to the affected depth including the root cause of failure, the trimming of the compacted excavation to provide firm vertical faces; back filling of excavated area in layers to the specification as per the original construction; application of prime/tack coat on the base and the sides of excavations prior to placing of any bituminous materials and compact, trimming and finishing of the surfaces of all patches to form a smooth continuous surface, level with the surrounding road.
- Potholes (depth > 25mm) are not only a nuisance to road users, but constitute traffic hazards particularly on paved roads where speeds tend to be higher. If left unrepaired potholes collect water and combined with traffic accelerates the wear of the road surface. Finally when water penetrates the road surface layer, it reduces the bearing strength leading to extensive damages to the pavement.

PROCEDURE

The same basic techniques are used for all of these repairs.

- Set up road traffic signs to warn the road users.
- Stockpile approved material on a clean surface for the repairs near to the work site, but out of the way of traffic.

- Mark a rectangle around the spot to be repaired making sure the whole problem area is covered.
- Cut out and remove all the material inside the rectangle down to a firm, dry layer. Trim the sides of the excavation to be straight and vertical. Trim the bottom of the hole to be flat and horizontal, then thoroughly cleaned with compressed air or any method approved by the Engineer and compact it. Cutting the surface layer can be done by hand tools such as a pickaxe, mattock or chisel and hammer. Make sure that there is no water in the pothole when it is filled.
- In case the pot hole is to be filled with bituminous macadam layer, the area of pot hole shall be tacked or primed, preferably with a bitumen emulsion depending upon whether the lower area is bituminous or granular in nature. The sides, however, will be painted with tack coat material (Rapid setting bitumen emulsion Gr RS - 1). The use of cut back bitumen (medium curing grade) for tack coat is restricted only for sites at sub-zero temperature or for emergency applications.



- In case WBM Gr 3 material is used to fill the pot holes, type B screening to completely fill the interstices to be applied gradually over the surface and then sprinkling of water and rolling is done.
- Place the fill material (with a loose thickness not exceeding 75mm) of at least the same type and quality as in the original pavement layer like WBM Grading 3 or BM and compact it with a heavy hand rammer until no more settlement is achieved .
- Pot holes repaired with WBM or BM are then covered with 20MM premix carpet and sealed with seal coat type B to prevent penetration of water and compacted with vibratory roller.
- The bituminous mix used in final layer (20mm PMC) is spread slightly proud of the surface, so that after rolling and secondary compaction from traffic, the surface shall be flush with adjoining surface.
- The patches in bituminous pavement having depth < 25 MM are also treated with 20/25 mm premix carpet and sealed with seal coat type B and compacted as explained in previous para.

- In case of shallow pavement repairs, hot or cold premix asphalt can be used.
- The last layer, prior to compaction, must have an excess thickness of about 1/5 of the depth of the layer to allow for settlement on compaction.
- If the surface is made from a thick asphalt concrete, the last layer can be hot/cold premix of approximately the same compacted thickness, also this with a final level just proud of the surrounding surface. The repair must still be sealed to prevent penetration of water.
- Remove unused material and clean up the site.
- Remove the road traffic signs on completion of work.

Note:

- This activity is done during the dry season or as directed by the Engineer.

QUALITY ASSURANCE

- Ensure to dig out all failed materials and soils that are saturated with water.
- Ensure the back fill with approved suitable material and compacted in layers.
- Ensure the patched material is protruding 1/5 of the total depth of the excavation hole to allow for secondary compaction by traffic. Ensure the last layer is approximately the same compacted thickness, also this with a final level just proud of the surrounding surface.

ENVIRONMENTAL

- Clean up all unused spoils on the site after repairs.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers should wear boots, gloves and overall when handling bituminous materials.

LABOUR

- Supervisor
- Labour

MATERIAL

- Aggregate Gr 3
- Bitumen emulsion
- Water
- Paraffin for cleaning
- Pre-mix material BM / PMC / Sand seal coat

TOOLS AND EQUIPMENT

- Hand rammer
- Spade
- Pick/mattock
- Watering can
- Basket
- Broom
- Gloves
- Boots
- Overall
- Mask
- Compacting equipment

LABOUR TASK RATE

Payment shall be for the total area of potholes. The standard task rate is as follows:

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Pothole filling (WBM)	4 m^2/wd		
Pothole filling (BM)	4 m^2/wd		
20mm PMC patching	10 m^2/wd		

PERFORMANCE INDICATOR

All potholes have been filled with suitable approved materials which have been fully compacted and unsuitable/degraded materials disposed.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.03	**On-carriageway maintenance**
Specification Code:	1906	Carriageway repair including filling of potholes and minor reshaping of gravel roads
Unit of Measurement:	m^2	

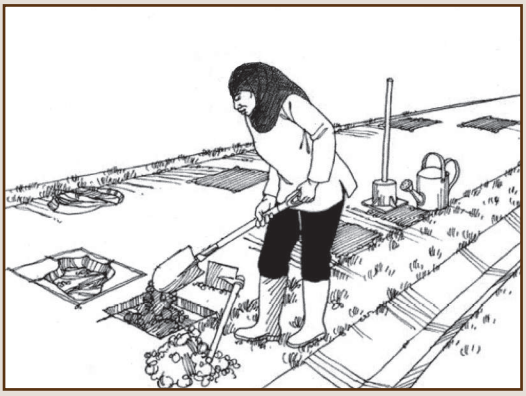
SCOPE AND PURPOSE

- Carriageway repairs on gravel surface include: Pothole repairs - patching on gravel roads; Repair of deep ruts and depressions (rut depth > 50 mm); Repair of edge failures; and Reshaping of carriage way.
- The work shall include the removal of all failed material in gravel and base courses up to the affected depth including the root cause of failure, the trimming of the compacted excavation to provide firm vertical faces; back filling of excavated area in layers to the specification as per the original construction; trimming and finishing of the surfaces of all patches to form a smooth continuous surface, level with the surrounding road.
- Potholes (depth > 25mm) are not only a nuisance to road users, but constitute traffic hazards. If left unrepaired potholes collect water and combined with traffic accelerates the wear of the road surface. Finally when water penetrates the road surface layer, it reduces the bearing strength leading to extensive damages to the pavement.

PROCEDURE

The same basic techniques are used for all of these repairs.

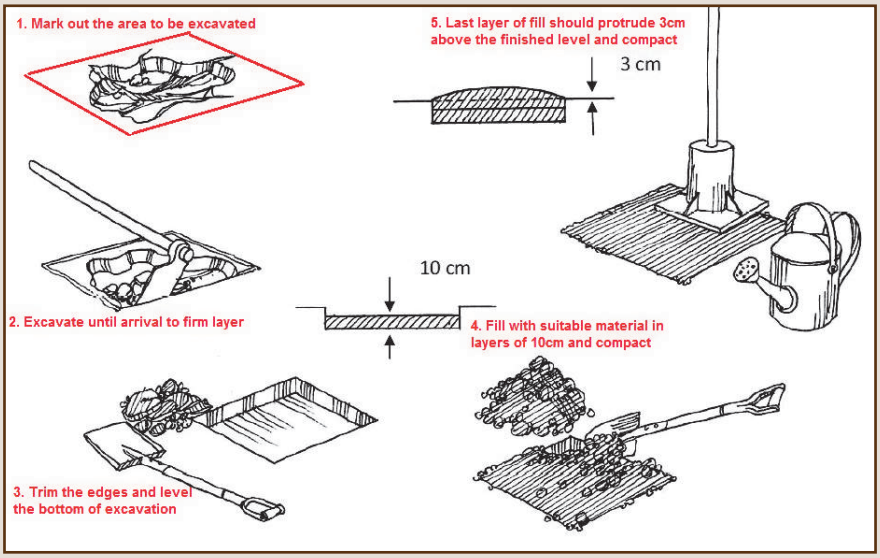
- Set up road traffic signs to warn the road users.
- Stockpile approved material on a clean surface for the repairs near to the work site, but out of the way of traffic.
- Mark a rectangle around the spot to be repaired making sure the whole problem area is covered.



- Cut out and remove all the material inside the rectangle down to a firm, compacted material layer. Trim the sides of the excavation to

be straight and vertical. Trim the bottom of the hole to be flat and horizontal. Make sure that there is no water in the pothole when it is filled.

- On gravel roads, potholes can be repaired with crusher run mixed with appropriate proportions of plastic material to satisfy the specifications for wearing course gravel



- Compact each layer (i.e. maximum of 10 cm for each layer) with a heavy hand rammer until no more settlement can be achieved.
- The last layer, prior to compaction, must have an excess thickness of about 1/5 of the depth of the layer to allow for settlement on compaction.
- Remove unused material and clean up the site.
- Remove the road traffic signs on completion of work.

QUALITY ASSURANCE

- Ensure to dig out all failed materials and soils that are saturated with water.
- Ensure the back fill with approved suitable material and compacted in layers.
- Ensure the patched material is protruding 1/5 of the total depth of the excavation hole to allow for secondary compaction by traffic. Ensure the last layer is approximately the same compacted thickness, also this with a final level just proud of the surrounding surface.

ENVIRONMENTAL

- Clean up all unused spoils on the site after repairs.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.

LABOUR

- Supervisor
- Labour

MATERIAL

- Gravel
- Water

TOOLS AND EQUIPMENT

- Hand rammer
- Watering can
- Pick/mattock
- Compacting equipment
- Wheel barrow if necessary for hauling fill material
- Spade
- Basket
- Boots

LABOUR TASK RATE

Payment shall be for the total volume filled of potholes. The standard task rate is as follows:

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Pothole filling including transport of fill material within 100m hauling distance	1.5 m^3/wd		
Pothole filling including transport of fill material from 100 to 200 m hauling distance	1.2 m^3/wd		
Pothole filling including transport of fill material from more than 200m hauling distance	1.0 m^3/wd		

PERFORMANCE INDICATOR

All potholes have been filled with suitable approved materials which have been fully compacted and unsuitable/degraded materials disposed.

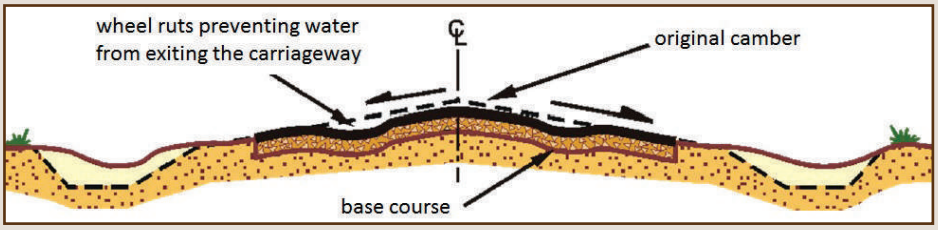
JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.04	**On-carriageway maintenance**
Specification Code:	1904	Repair of minor ruts and depressions on bituminous roads
Unit of Measurement:	m^3	

SCOPE AND PURPOSE

- Filling of minor ruts and depressions on paved roads (10mm < rut depth < 50mm).
- Minor ruts and depressions are often associated with cracks. Water in the ruts and depressions will penetrate into and weaken the pavement and accelerate the pavement deterioration.

PROCEDURE

Minor ruts and depressions are best repaired with cold mix asphalt produced on site in the exact quantity needed. Repairs should only be carried out in dry weather. Although cold mix asphalt tolerate some humidity, it will be ruined if exposed to rain before the emulsion has broken and set. Alternatively, hot pre-mixed asphalts produced in advance can be used. These are more sensitive to humidity, requiring the good weather and dry surfaces when the repair is carried out.



- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- The depressions are first swept out by hand using brush ensuring that the surface is clean and dry.
- The surface area of the depression should be marked with a chalk. Remove any high spots with a pickaxe.

- Apply a tack coat using a watering can and a soft broom to spread a thin layer of 1:1 diluted emulsion, making sure the whole area is covered. Allow the tack coat to set and dry.
- Mix the asphalt on a clean surface next to the area to be repaired if a tray is not available. Measure (batching) and mix all aggregate (coarse and fine fractions) thoroughly, then apply a little water if the aggregate is dry. The mix should be moist, but not visibly wet. Apply the correct amount of emulsion by a measuring container, pouring it slowly over the aggregates as the mixing starts. Mix until all aggregate is coated and has the consistency of a thick soup.

- Quickly fill the rut or depression with the ready mix. In ruts and depressions deeper than 25mm, the fill is best done in two layers. The first layer is filled in the bottom of the ruts and compacted with a hand rammer before the final layer is placed on top. Allow for final compaction by leaving an excess thickness of about 1/3 of the depth of the final layer in the middle tapering evenly off to each side.
- Let the emulsion break and set. The emulsion breaks when the water in the mix separates from the bitumen. The mix then turns from dark brown to black and the bitumen starts to set. In high ambient temperatures, the setting goes quite fast and the compaction can start after a few minutes.
- Compact the layer with a small vibrating roller until an even surface is achieved slightly proud of the surrounding surface.

- Seal the repair to prevent penetration of water.
- Remove road signs on completion of work.

Note:

- This activity is done during the dry season or as directed by the Engineer.

QUALITY ASSURANCE

- Ensure the surface to be repaired is clean and free of dust.
- Ensure that the mixing tray is free of any foreign matter before any work starts.
- Ensure the batching of the mix is done correctly to specification or as directed by the Engineer.
- Control the mixing operation to ensure that the aggregate, water and emulsion are thoroughly mixed through.
- Ensure the last layer is approximately the same compacted thickness, also this with a final level just proud of the surrounding surface.

ENVIRONMENTAL

- Clean up all unused spoils on the site after construction.
- Clean up all tools used by the close of day or when work is completed.
- Contamination due to bituminous waste may be safeguarded by reuse or land filling of BW or use in subbase.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.
- Workers should wear boots, gloves and overall when handling bituminous materials.

LABOUR

- Supervisor
- Labour

MATERIAL

- Aggregate
- Bitumen emulsion
- Pre-mixed asphalt
- Water
- Paraffin (for cleaning)

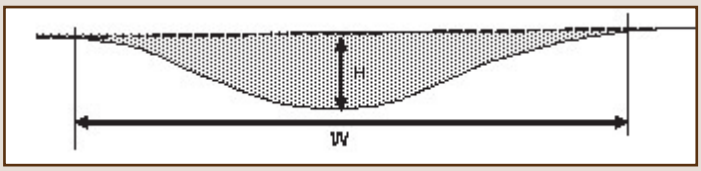
TOOLS AND EQUIPMENT

- Hand rammer
- Spade (for mixing)
- Broom
- Wheel barrow
- Watering can
- Spreader
- Boots
- Gloves
- Overall
- Mask
- Mixing pan
- Compacting equipment

LABOUR TASK RATE

The labour will be on day work basis.

Unit of measurement for payment is in m^3



Payment is based on the total volume of compacted cold mix asphalt used for the repair and shall include preparation of the surface, application of tack coat, supply of cold mix asphalt, allowance for hand tools and compaction equipment.

The volume is calculated as follows: **V = 0.5 × H × W × L**

Where: H = depth of the depression
L = length of the depression measured along its longest axis, normally parallel to centre line of road.

Sealing the patch is measured and paid separately.

PERFORMANCE INDICATOR

All ruts and depression have been filled and fully compacted.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.05	**On-carriageway maintenance**
Specification Code:	1906	Repair of ruts and depressions on gravel roads
Unit of Measurement:	m^3	

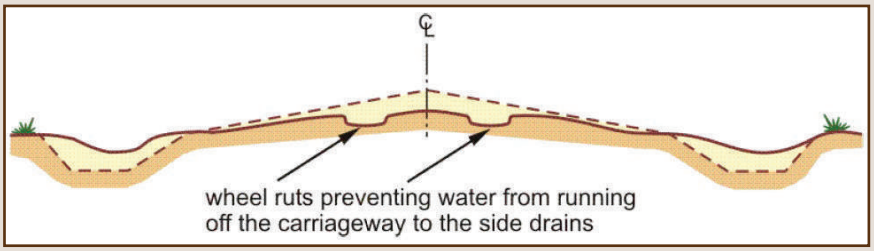
SCOPE AND PURPOSE

- Filling of ruts and depressions on gravel roads by replacing or adding fresh approved material and compacting with appropriate equipment as per the requirements of this specification and as directed by the Engineer.
- Ruts are caused when vehicles keep on passing in the same tracks made by vehicles before them. The weight of the vehicles and their speed push surface material to the sides of the road. This process eventually deforms the road surface camber. Finally the ruts obstruct the water from exiting the surface where stagnate water accelerates the wear of the surface when subjected to passing traffic.

PROCEDURE

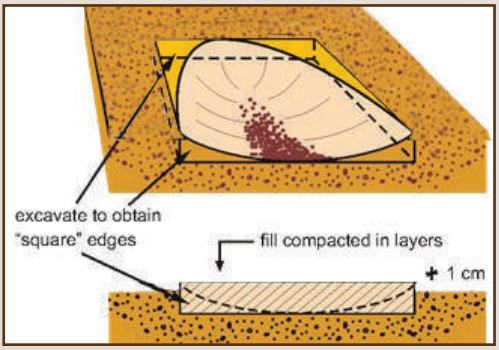
The ruts should be repaired using the same work methods as when filling potholes.

- Set up road traffic signs at the location where the road works is taking place to warn the road users.



- For minor ruts, raking excess materials from the road shoulder back onto the carriageway is done.
- For more severe rutting, it may be necessary to bring in additional material that is approved by the Engineer to compensate for the gravel loss.
- Remove any standing water.
- The affected area shall be excavated of any loose or unsuitable material (like expansive clay) brought to a rectangular shape and

formed vertical edges. The bottom surface is then compacted by hand rammers.



- Sprinkle with water for the fill material to bond with the existing surface.
- Place approved suitable material which has optimum moisture content and compacted in layers. When using hand rammers for compaction, the thickness of each layer should not exceed 5cm.
- The last layer should protrude about 3cm above the level of the surrounding road surface to compensate for settlement and secondary compaction by the traffic.
- Remove road signs on completion of work.

Note:

- This activity is done during the dry season or as directed by the Engineer.

QUALITY ASSURANCE

- Ensure the unsuitable materials are removed and the affected area excavated in rectangular shape.
- Ensure the fill materials is from approved location.
- Ensure the compaction is done in layers.
- Ensure the last layer is approximately the same compacted thickness, also this with a final level just proud of the surrounding surface.

ENVIRONMENTAL

- Clean up all unused spoils on the site after construction.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.

LABOUR

- Supervisor
- Labour

MATERIAL

- Gravel
- Water

TOOLS AND EQUIPMENT

- Hand rammer
- Spade
- Wheel barrow
- Watering can
- Boots
- Overall
- *Compacting equipment (if required)*

LABOUR TASK RATE

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Repair and filling of ruts with approved gravel inclusive of excavation and hauling			
- haul up to 100m	1.7 m^3/wd		
- haul 100m – 300m	1.5 m^3/wd		
- haul more than 300m	1.3 m^3/wd		

Payment is based on the total volume of compacted gravel used for the repair and shall include preparation of the surface, allowance for hand tools and compaction equipment.

The volume is calculated as follows: **$V = H \times W \times L$**

Where: H = depth of the depression
L = length of the depression measured along its longest axis, normally parallel to centre line of road.

PERFORMANCE INDICATOR

All ruts and depression have been filled and fully compacted.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.06	**On-carriageway maintenance**
Specification Code:	1904	Local sealing / Surface patching
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- Local sealing is applied as the final stage of pavement repairs and repair of ruts and depressions, but can also be used to seal closely spaced hairline cracks in the surface.
- The seal prevents water from penetrating the surface and development of more serious pavement failures.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.
- Seals can be applied using pre-mixed material or by first spraying the surface with a bitumen coat and thereafter covering the surface with fine material. Local sealing is carried out in five steps:
- Sweep the surface area to be sealed by using broom or air compressor. The road surface should be clean and dry following this operation.
- Mark out the area to be sealed. The surfacing that is to be covered is outlined in chalk

Liquid seal coat – Type "A"

- Distribute the binder using a motorized sprayer and spray lance or a watering can and a soft broom at the following rates:
  - 1.2 ~ 1.4 kg/m^2 for bitumen emulsion
  - 0.98 kg/m^2 for cutback bitumen
- It is important not to overheat the bitumen as this affects its durability. Use a thermometer to check the temperature during heating. Anionic emulsion does not normally require heating.
- Spread the aggregate by shovel and brooms as evenly as possible making sure all areas are covered. The material used is:

  - chippings of nominal size 6.7 mm within the range of 2.36 to 11.6 mm @ 0.09 $m^3/10m^2$
- The whole surface should be covered with a single layer of chippings and rolled with static or vibratory roller to ensure that the chippings are firmly embedded in binder and excess chippings boomed.

Sand seal coat – Type "B"

- The seal can also be applied using a premix coat consisting of sand or stone chippings passing the 2.36mm sieve and retained on a 180 micron sieve. In this case the binder required is 1.0 to 1.2 kg/m^2 bitumen emulsion or 0.68 kg/m^2 bitumen. The quantity of aggregate used for premix shall be $0.06m^3/10m^2$
- Compact the sealing using a small vibrating roller or other equipment as per direction of the Engineer.

Note:

- Immediately upon completion of patching works. Sealing should be carried out during the dry season and preferably before the monsoon.

QUALITY ASSURANCE

- Ensure cleaning of surface and cracks using air compressor.
- Stone chippings used in Type A sealing should be free of fine aggregates / dust.
- The surface should be allowed for traffic after a day. In case of emergency the traffic may allowed to ply with speed limited to 16 km/hr.

ENVIRONMENTAL

- Clean up all unused spoils on the site after operation.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.

LABOUR

- Supervisor
- Labour

MATERIAL

- Bitumen emulsion
- Stone chipping / sand

TOOLS AND EQUIPMENT

- Hand rammer
- Spade
- Broom
- Wheel barrow
- Sprayer
- Boots
- Overall
- *Compacting equipment (if required)*
- *Air compressor*

LABOUR TASK RATE

Unit of measurement is in m^2 of total sealed area, inclusive of preparations, supply of materials, allowance for hand tools and compaction equipment, cleaning up and removing excess material upon completion.

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Type A sealing	40 m^2/wd		
Type B sealing	75 m^2/wd		

PERFORMANCE INDICATOR

All area effected with cracks have been sealed with seal coat and fully compacted.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.07	**On-carriageway maintenance**
Specification Code:		Crack sealing
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- Sealing cracks in a bituminous surface.
- Cracks allow water to penetrate into the pavement and reduce its bearing capacity. They also compromise the integrity of the surface seal, and left unattended, may trigger the development of potholes. The seal prevents water from penetrating the surface and development of more serious pavement failures.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.

Cracks < 3 mm wide (frequent and closely spaced cracks within a limited area):

- Sealing of fine cracks can be carried out by applying a fog seal to the damaged surface, consisting of a light application of low viscosity slow setting emulsion. As with any seal, the surface first needs to be thoroughly cleaned, preferably using compressed air which also allows for loose debris and dust to be easily removed from the cracks. The fog spray is applied at a rate of 0.5 ~ 1.0 litres/m^2.
- Cracking of this nature will accelerate the deterioration of the surface seal. If left unattended over time, it may instead be necessary to consider a re-seal in order to reinstate the integrity of the seal.
- It is permissible to use medium caring cutback for crack sealing in sub-zero temperature areas.

Large cracks > 3 mm wide:

- Wider cracks normally appear in less frequency. These need to be filled and sealed in order to safeguard the integrity of the pavement.

Again, a slow setting emulsion can be used for sealing. Wide and deep cracks can be filled with crusher dust before filling the top 5mm below the road surface level with emulsion. Pour the binder into the cracks, taking care to minimise spillage. Crusher dust can be applied to the surface to bind excess bitumen on the surface and at the top of the cracks.

- Clean the cracks using an air compressor to blow out dirt and debris lodged inside the cracks prior to application of sealing.
- Fill the cracks using a spray lance or watering can. The nozzle of the spray lance or spout of the watering can is held close to the ground to limit the width of the spread. Repeat applications may be required for wide cracks.
- Apply a cover of coarse sand or crusher dust to blind off the strip of binder and any spillage to prevent pick-up on vehicle tyres.

Note:

- Crack sealing should be carried out routinely in the dry season prior to the onset of the rains.

QUALITY ASSURANCE

- The pavement surface should be cleaned by using air compressor.
- The traffic on the surface treated for sealing the cracks with emulsion should be allowed on the next day.

ENVIRONMENTAL

- Clean up all unused spoils on the site after crack sealing operation.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.

LABOUR

- Supervisor
- Labour

MATERIAL

- Bitumen emulsion
- Crusher sand

TOOLS AND EQUIPMENT

- Hand rammer
- Spade
- Wheel barrow
- Sprayer
- Boots
- Overall
- Broom

LABOUR TASK RATE

Unit of measurement is in: m^2 for closely spaced multiple cracks and m for single cracks.

Payment includes the preparatory works, supply of materials, allowance for hand tools and compaction equipment, cleaning up and removing excess material on completion.

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Crack sealing using emulsion	800 m^2/wd		Using mechanical means
Crack sealing using emulsion and sand	300 m^2/wd		

PERFORMANCE INDICATOR

Pavement surface area effected with cracks have been sealed.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.08	**On-carriageway maintenance**
Specification Code:		Improvement of surface texture
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- Applying sand or chippings to areas that exhibit bleeding and fatting-up.
- Areas exhibiting bleeding and fatting-up become slippery when wet and can cause accidents. Measures to improve the surface texture and thereby the skid resistance should be implemented as a matter of priority.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.

  This deficiency can be attained by three methods:
- **Sanding:** Apply coarse sand on areas with mild bleeding or fatting up. Allow traffic to embed the sand into the binder. The treatment may have to be repeated.
- **Spread heated chippings:** On areas with excessive bleeding, spreading heated chippings of nominal size 6 to 10 mm is more effective due to the amount of binder. The chippings can be heated in a tray over open fire and rolled into the bitumen for proper embedment.
- **Local sealing:** Follow the procedures for local sealing with a reduced binder application rate.

Note:

- This activity is done during the dry season or as directed by the Engineer.

QUALITY ASSURANCE

- This may be done in thin layers as per requirement.

ENVIRONMENTAL

- Clean up all unused spoils on the site after maintenance operation.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.

LABOUR

- Supervisor
- Labour

MATERIAL

- Coarse sand / stone chippings
- Bitumen

TOOLS AND EQUIPMENT

- Hand rammer
- Spade
- Wheel barrow
- Sprayer
- Basket
- Broom
- Boots
- Overall

LABOUR TASK RATE

Unit of measurement: m^2

Payment is for the total area treated inclusive of preparations, supply of materials, allowance for hand tools and compaction equipment, cleaning up and removal of excess material on completion.

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Spreading of sand/chippings	400 m^2/wd		

PERFORMANCE INDICATOR

All surface area effected with bleeding have been treated.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.09	**On-carriageway maintenance**
Specification Code:	1906	Profile corrections / Reshaping of gravel roads
Unit of Measurement:	m^2	

SCOPE AND PURPOSE

- Profile corrections are usually only carried out as a routine maintenance measure on gravel and WBM roads and often together with removing wheel ruts. Rural roads are often built in stages leaving a time gap between the construction of the base course and the final surfacing works. During this period, the unsealed surface needs to be kept free of ruts, potholes as well as maintaining the camber and longitudinal profile. Major profile correction works are normally included in the periodic maintenance programme.
- Maintaining a proper camber or cross-fall on the road surface is a crucial feature of the drainage system. Without proper surface drainage, water collects on the road leading to erosion of the surface and compromising the strength of the pavement.

PROCEDURE

- Set up road traffic signs at the location where the road works is taking place to warn the road users.

  On gravel roads, minor profile corrections can be achieved by grading, however in most cases it involves importing quality material to reinstate the original profile. Similarly, correcting the profile of roads with a WBM base course involves importing such material to restore the camber and longitudinal profile.

- Check that all potholes, ruts and damaged edges have been repaired.
- Loosen the areas identified for profile corrections to a depth to suit damage and size of WBM to be used for repair.
- Place new WBM grade III material as required to achieve the camber and profile.
- Shape the road camber and profile to set tolerances, using a camber board and a 3 metre straight edge.
- Place approved blinding material, spread, water in and roll with an 8 ~ 10 ton static/vibratory roller.
- Provide approved gravel to achieve a 100mm compacted depth covering the full width of WBM pavement plus shoulders.
- Level the surface to prescribed camber and profile.
- Water and compact material to required density using an 8 ~ 10 ton steel roller.
- Check that there are no highs and lows in the final surface thereby allowing free drainage of the pavement. Where the profile is not correct add additional material to achieve required tolerances.

Note:

- Maintaining the correct profile ensures that water is drained off the road surface. Profile corrections should therefore be carried out before the onset of the rainy season.

QUALITY ASSURANCE

- Ensure the materials procured is from approved source.
- Ensure the compaction is done after checking the loose material profile with camber template and straight edge.
- Ensure compaction is done with roller.

ENVIRONMENTAL

- Clean up all unused spoils on the site after the operation.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.

LABOUR

- Supervisor
- Labour

MATERIAL

- Gravel
- Water

TOOLS AND EQUIPMENT

- Hand rammer
- Spade
- Basket
- Wheel barrow
- Watering can
- Template
- Boots
- Overall
- *Compacting equipment (if required)*

LABOUR TASK RATE

Unit of measurement: m^2

Payment is for the total volumes of material supplied, spread and compacted, inclusive of preparations, allowance for hand tools and equipment and cleaning up on completion.

Activity	Recommended Task Rate	Actual/Revised Task Rate	Remark
Profile correction with gravel	140 m^2/wd		

PERFORMANCE INDICATOR

All irregularities in cross and longitudinal profile have been corrected to required camber and fully compacted.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.10	**On-carriageway maintenance**
Specification Code:	1909/1910	Maintenance of culverts and causeways structure
Unit of Measurement:	Daywork	

SCOPE AND PURPOSE

- The work shall consist of repairs to cracks, parapets, protection works and invert of culverts and in case of causeways minor pavement surface repair, replacing guide posts, repairing flood gauges and protection works.
- These minor damages to cross drainage works may take shape of major distresses in their structures and may become the cause of traffic hazard.

PROCEDURE

It shall comprise following operations. These operations may be carried out as laid down in relevant clauses of specifications:

Culverts

- The minor cracks appearing in masonry works including parapets may be cleaned and filled with cement slurry or a sealing motor as directed by Engineer- in -charge. In case of wider cracks in a structure, the surrounding masonry may be dismantled and fresh masonry with proper bond may be done.
- The damaged portion of protection work may be repaired or reconstructed in accordance with section 1300 of MoRD Specifications for rural roads. In case of causeways the damaged guide posts and flood gauges may be replaced or repaired as per their condition.
- Cautionary boards placed along the road before commencement of maintenance work may then be removed.

Causeways

- Minor damages to surface of causeways and replacement of damage guide posts may be carried out in accordance with the relevant specifications.
- Flood gauges may be repaired and repainted before rains.

Note:

- These activities may be carried out time to time and specifically before rains.

QUALITY ASSURANCE

- All construction material such as cement, stone, aggregate etc. used in repairs operation should confirm to the standards laid down in the relevant MoRD specifications.
- Ensure curing of cement works for prescribed period.

ENVIRONMENTAL

- Clean up all unused spoils on the site after repair works.

HEALTH AND SAFETY

- Providing adequate traffic signs and protection at the location where maintenance works are taking place.

LABOUR

- Supervisor (part time)
- Mason
- Labour

MATERIAL

- Cement
- Sand
- Water
- Stone aggregate
- Shuttering material

TOOLS AND EQUIPMENT

- Stone hammer
- Spade
- Pickaxe
- Wheel barrow
- Watering can
- Chisel
- Basket/head pan
- Trowel
- Mason line
- Boots
- Overall
- Reflective clothing

LABOUR TASK RATE

The work will be paid on dayworks basis.

PERFORMANCE INDICATOR

The surface and structure should be free of any cracks or distress and parapets, guideposts and flood gauges are properly maintained.

JOB SHEET - ROUTINE MAINTENANCE WORKS NATIONAL RURAL ROADS DEVELOPMENT AGENCY		
Activity Code:	RM-02.11	**On-carriageway maintenance**
Specification Code:	1911/1913	Maintenance of road furniture
Unit of Measurement:	Daywork	

SCOPE AND PURPOSE

- The work shall consist of cleaning or repainting of mandatory / regulatory, cautionary/warning, informatory sign boards, re-fixing of tilted Kilometre / 5th KM. / 200 M. stones along with their repainting. These minor damages to cross drainage works may take shape of major distresses in their structures and may become the cause of traffic hazard.

PROCEDURE

- Over time, signs become faded and their retro-reflective properties diminish. This reduce both conspicuity and legibility. Excessively discoloured or faded signs (e.g. white backgrounds which have become grey or brown, or red borders faded to pink) and signs, where the legend or graphic is peeling cannot be fully effective, need to be replaced by signs conforming to the specifications as per IRC : 67.
- Signs along with the posts shall be maintained in proper position, and kept clean and legible at all times. Signs should be cleaned with shop water and damp cloth at intervals appropriate to the side condition. Signs at locations where they are subject to heavy soiling from passing traffic, or algae growth (a common problem with signs beneath tree canopies) will need more frequent cleaning.
- A reference number along with the month and year of installation should be placed on the back of sign in a contrasting colour or by stamping in characters not exceeding 50mm in height.

- All signs shall be inspected every month both in day and night times. All signs shall be replaced at the end of the warranty period provided for the retro- reflective sheeting used on the sign. Damaged signs shall be replaced immediately by signs conforming to the Specification as per IRC : 67.
- The 200m and kilometre stones shall be maintained in proper position and kept clean and legible at all times. Damaged as well as tilted stones shall be re-fixed or repaired / replaced immediately. Special care shall be taken to see that weeds, shrubbery, mud etc. are not allowed to obscure any 200m or kilometre stone.
- Each Km/5th Km stone along the road be painted just above the ground level, the type and year of last surface treatment to that particular Km of road.

QUALITY ASSURANCE

- Ensure that the retro-reflective sheets replaced are conforming to specification laid down in IRC : 67.

ENVIRONMENTAL

- Clean up all unused material on the site after maintenance.

HEALTH AND SAFETY

- Provide protection to workmen at the location where maintenance work are taking place.

LABOUR

- Supervisor (part time)
- Skilled painter
- Labour

MATERIAL

- Paint
- Brushes
- Cement
- Water
- Stone
- Aggregate
- Sand
- Retro-reflective signs

TOOLS AND EQUIPMENT

- Hand rammer
- Spade
- Watering can
- Pickaxe
- Basket / head pan
- Trowel
- Overall
- Reflective clothing

LABOUR TASK RATE

Measurement shall be done in numbers of boards, 200 M , Km. and 5th Km stones for their cleaning, repairing and repainting and it shall be paid in terms of job works for removing and re-fixing with CC.

PERFORMANCE INDICATOR

All signs boards, 5thKm, Km, 200 M stones are properly placed and painted.

Notes

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