Construction of Rural Roads

Training Module for Barefoot Technician
Learning Unit 2.2.1

Construction of Rural Roads
Training Module for Barefoot Technicians
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Technical Team
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Learning Unit 2.2.1

Construction of Rural Roads

Purpose of the learning Unit

This specific learning outcome will enable you to implement and supervise construction works of earthen, gravel and water-bound Macadam rural roads.

By the end of learning unit BFT will be able to:

1. Identify typical rural roads according to terrain and construction standard;
2. Interpret and describe common technical features for roads;
3. Set-out road alignments and construction measurements along existing tracks;
4. Plan the work activities for the construction of rural roads including the required resources and in terms of labour, material, equipment and tools;
5. Allocate activities with production tasks to labourers;
6. Implement and control construction activities including clearing, excavation to level, formation of carriageway and side drains;

Elements of the learning Unit

Element 01: Common Rural Road Features
Element 02: Setting out for Road Works
Element 03: Work Organisation
Element 04: Work Methods
Introduction

Building good quality rural roads is a particular skill in itself and relatively complex as it consists of many diversified activities carried out by labourers in combination with machines. In addition, road construction sites usually consist of spread-out activities, as they are not confined to one particular spot as for many other construction operations, e.g. building, dam, etc. This requires proper planning, effective supervision, good workmanship and the selection of the correct technology and work methods.

This Learning Unit provides you with principle information on labour-based rural road construction methods only. Therefore it will enable you to appreciate the complexity of the works involved and to basically supervise them.

To become an independent and fully competent Road Construction Supervisor additional training is required.
Element 2.2.1.1
Common Rural Road Features
Learning Element Outcomes:

This specific learning outcome will enable you to:

- Identify and describe the common rural road types constructed under MGNREGS according to standards and terrain.
- Identify and describe the common technical features of rural roads constructed under MGNREGS.

Summary:

Rural roads have typical features. They can be distinguished according to the terrain, for example in flat or hilly areas, but also by the type of surface. A road does not only consist of the carriageway, the surface where the traffic moves, but also of many other features that make a road, such as drains, embankment, culverts and many more. It is important for a BFT to be fully conversant with all common terms before being introduced to construction activities.

Introduction:

“Providing all-weather rural road connectivity to unconnected villages and to connect identified rural production centres to the existing pucca road network”. The rural road connectivity will be usable in all-weather, only when the required technical inputs are given in construction of road connectivity.

Purpose:

The roads selected under MGNREGA should be interconnected and all selected roads must connect one or more important roads;

- to transport agriculture produce from fields to village
- to take the products of the areas to the nearby market
- to connect unconnected habitations

Selections of roads:

- Generally the roads are constructed on existing paths, track/ kachcha-rasta, will be proposed for construction of all weather road under MGNREGS.
- Road should be planned and designed so as to have minimum number of curves.
• Cross drainage with proper engineering design
• Ensure the availability of land, the formation width should be at least 6 meter with carriageway 3.75 meter with minimum 1.25 meter wide side shoulders/berms

**Types of Rural Roads**

Types of rural roads constructed under MGNREGS may be differentiated by

a. Terrain conditions
b. Surface conditions

With regard to two **terrain** types there are mainly two conditions to be considered:

a. Flat areas/plain area
b. Hilly areas

The road features in flat areas to some extent the same as for those in hilly areas, but there are some features that are particular.

With regard to surface conditions there are three types to be considered under the MGNREGS:

a. Earthen surface
b. Gravel surface
c. Water-bound Macadam

### 2. **Common Road Features**

The following illustrations provide you with details on common road features, typical features for road in flat and hilly terrain and road with gravel or water-bound Macadam surface.
Typical Features for Roads in Flat Areas:
Typical Features for Roads in Hilly Areas:

The following Table provides detailed explanations for all the terms included in the above drawings:

<table>
<thead>
<tr>
<th>Terms and Definitions for Rural Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alignment</strong></td>
</tr>
<tr>
<td><strong>Carriageway</strong></td>
</tr>
<tr>
<td><strong>Camber</strong></td>
</tr>
<tr>
<td><strong>Camber Formation</strong></td>
</tr>
<tr>
<td><strong>Centre Line</strong></td>
</tr>
<tr>
<td><strong>Crown:</strong></td>
</tr>
<tr>
<td><strong>Culvert</strong></td>
</tr>
<tr>
<td><strong>Side Drain</strong></td>
</tr>
<tr>
<td><strong>Gravel Course</strong></td>
</tr>
<tr>
<td><strong>Right of the way</strong></td>
</tr>
<tr>
<td><strong>Scour Checks</strong></td>
</tr>
<tr>
<td><strong>Shoulders/Berms</strong></td>
</tr>
<tr>
<td><strong>Water-bound Macadam</strong></td>
</tr>
<tr>
<td><strong>Block top Road(BT)</strong></td>
</tr>
</tbody>
</table>
Rural roads are, by their very nature, roads that carry less traffic. They are therefore not as wide as highways and are in many cases also not paved. There are three types of surfaces for rural roads that are common in India:

Typical Cross section of Road

Earth Road

Rural Road with Earth Surface
Standard Measurements and Dimension

Standard measurements and dimension for a rural road in India are as shown in the following schematic drawing:

![Typical Measurements for Rural Road with Water Bound Macadam Pavement, Single Lane](image)

- Road Formation = 7.5 m
- Shoulder = 1.75 m
- WBM Carriageway = 3.75 m
- Shoulder = 1.75 m
- Gravel Base Course = 4.0 m
- Gravel Base Course 150mm Compacted
- Two Layers Metal: = 65mm aggregate of 75mm thickness compacted = 40mm aggregate of 75mm thickness compacted

**Remember**

- Basic types of roads under MGNREGS are roads in flat or hill areas
- Under MGNREGS roads are constructed to earth, or gravel of water-bound Macadam standard
- Remember all common terms and their definitions!
Element 2.2.1.2
Setting Out Road Works
Learning Element Outcomes:

This specific learning outcome will enable you to:

○ Set-out the centre line (horizontal alignment) of the road to be constructed including correction of curves and checking the vertical alignment using simple methods;

○ Set out all construction activities to allow for measured and controlled construction activities.

Summary:

Roads constructed under MGNREGS are usually following existing tracks. Extensive survey is therefore not required. When following the existing alignment of track, simple setting-out technique can be applied. The horizontal alignment has to be fixed to correct the road line where even necessary. Afterwards the levels (vertical alignment) need to be checked and corrected to ensure a smooth road surface.

Setting-out Centre Line (Horizontal Alignment)

Rural roads constructed under MGNREGS in most cases follow existing tracks. Therefore, general direction is given and only corrections have to be made to ensure a smooth alignment. The following drawing shows how such an alignment correction can be made:

A horizontal alignment consists of straight sections and curves. Straight sections are easy to set out, while curves are a bit more complicated. However, when following an existing track one does not need to apply difficult methods. The aim is to smoothen the alignment so that vehicles can drive easily. The following Job Sheets explain in detail how to set out the Straights and how to establish smooth Curves by establishing the centre line.
**Job Sheet for Road Works**

**Activity:** SETTING OUT STRAIGHTS

**Work Method:**
1. Establish the edges of the existing carriageway and measure the width.
2. Set the first centre peg at the middle of the established carriageway.
3. Repeat steps 1 and 2 after a maximum length of 100 metres or before the beginning of a curve.
4. Place a ranging rod on each end of the established length of straight.
5. Move with the third ranging rod along the established line and place a centreline peg every 10 metres. Knock the centreline pegs firmly into the ground so that their tops are almost flush with the existing ground.
6. After setting the centre line pegs over a 100 m section check again whether they are in a straight line using the ranging rods. If necessary correct - then move to the next section.
7. Set measurement reference peg every at 20 m intervals on both sites of the road and mark clearly.

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**Labour:**
- 1 BFT or one trained Mate
- 2 Labourers

**Tools + Equipment:**
- 3 Ranging Rods
- Tape Measure, 30 m
- 1 Hammer

**Material:**
- Wooden or Metal Pegs

**Quality Control:**
- Centre line pegs set at 10 metre intervals
- Measurement reference pegs set and marked at 20 metres intervals on both sides of the road way 1 metre outside the clearing width
**Job Sheet for Road Works**

**Activity:** SETTING OUT CURVES

**Work Method:**
1. Establish the centre line pegs at each end of the curve (A and B).
2. Set intermediate pegs at 5 metre intervals along the approximate centre line.
3. Tie a string/rope/thread along all centre pegs.
4. Adjust pegs which do not appear to be on a smooth curved line until the entire curve appears to be uniform.

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**Labour:**
- 1 BFT or one trained Mate
- 2 Labourers

**Tools + Equipment:**
- 3 Ranging Rods
- Tape Measure, 30 m
- 1 Hammer

**Material:**
- Wooden or Metal Pegs
- Strings

**Quality Control:**
Check that curve is uniformly round ("by eye")
Controlling the Road Levels (Vertical Alignment)

Roads following existing tracks have often already a surface that has a relatively even surface. There might potholes, humps or minor undulations that can be relatively easily filled or cut to ensure a level ground.

In order to achieve a reasonably smooth and aligned surface (horizontal or gradient) without unnecessary depressions or humps, it is necessary to control the levels. The simplest method is to use a set of Profile Boards or travellers.

<table>
<thead>
<tr>
<th>Activity: CONTROLLING LEVELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Method:</td>
</tr>
<tr>
<td>1. Fix profile boards at the two ends of the straight you want to check, assuming that those two points have the level/gradient you need to maintain.</td>
</tr>
<tr>
<td>2. While sighting from one end to the other, let an assistant place the third profile board at any point you want to check in-between the two end rods. Then sight from the first to the last board and check whether the intermediate board is in line with the two end boards. If not, you need to correct (lift or lower) until the intermediate board is in line. Set a reference peg with the correct level.</td>
</tr>
<tr>
<td>3. Mark the sections/areas where filling of depressions/holes or cutting of humps is required with pegs and chalk/ash. Fills which are more than 10cm high need to be made in layers and each layer to be compacted before adding the next layer.</td>
</tr>
</tbody>
</table>

![Diagram showing the use of profile boards to control road levels](image)

- For roads in hilly areas or where there are sections with significant slopes, a proper vertical alignment must be established. This has to be done by the Engineer in Charge who will establish the levels using more sophisticated methods and survey equipment.

<table>
<thead>
<tr>
<th>Labour:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 BFT or one trained Mate</td>
</tr>
<tr>
<td>• 2 Labourers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tools + Equipment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Set of 3 Profile Boards</td>
</tr>
<tr>
<td>• Tape Measure, 30 m</td>
</tr>
<tr>
<td>• 1 Hammer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Wooden or Metal Pegs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality Control:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressions or humps not to have a greater difference than +/- 10cm over 20m road length</td>
</tr>
</tbody>
</table>
Element 2.2.1.3

Work Organisation
Learning Element Outcomes:

This Specific Outcome will enable you to:

○ List and describe the construction activities normally applicable for rural earth and gravel roads in their sequence of construction and how to organise the work accordingly

○ Identify the required tools and equipment to be used for rural road construction and demonstrate their use.

Summary:

Road construction operations using mainly labourers are broken down into manageable activities that follow each other in sequence. Labour groups have to be organised to ensure a well-controlled work process.

The labourers carry out the earthwork activities using common handtools.

Simple measuring and control tools and instruments are used to set out works and control the quality. The BFT must be able to master all of them on a daily basis.

Construction Activities and their Sequence

In order to achieve satisfactory workmanship and simplify supervision, the road construction process is broken down into a series of manageable activities. They are carried out by separate groups of labourers, in a sequence. In this way a “train” of activities moves along the road improving the carriageway and drainage in a controlled step-by-step manner.

A labour-based road construction project, with a large labour force and a work-site that is several hundred meters long, needs to be planned and organised carefully.

To be able to control the work, it must be split into simple activities (see activity list above). Each activity is then assigned to a separate labour group with its own Supervisor/Mate in charge. This also applies to large activities where many labourers need to be subdivided into smaller groups. To check that the activities of each group meet the targets of the overall construction plan, you will need to plan your work on a daily basis.
The groups have to be well balanced in size so that the activities follow each other at the same speed.

To complete a road, there are additional activities to follow depending on the desired standard, i.e.

- New pipe culvert installation,
- Small structures such as drifts and box culverts
- Gravelling as surface or as base course
- Water-bound Macadam
- Bituminous surface, etc.

These works are not explained here as they are technically more complex and require the attention of an Engineer.
Tools and Equipment

Tools required for works on rural roads are mainly common hand tools as usually used by farmers in the particular area where the work is carried out. As a BFT you have to make sure that the labourers use tools that are safe and are of good quality.

For road works compaction equipment is required. Any fill needs to be compacted. Where a fill is more than 10 to 15 cm high, the fill has to be done in layers of maximum 15 cm. Each layer must be compacted using a roller before the next layer is added.

Note: Hand Rammers are not suitable for road works!

For setting out and quality control various simple measuring aids are used. They need to be available on site all the time to ensure that you as the Supervisor can set out the activities and tasks as well as to control the quality of the achieved work by the labourers.

For details on measuring aids for setting-out refer to Learning Unit 1.4, Basic Surveying and Setting-out

It is very important to have sufficient templates for work control on site. The following need to be on site all the time:

<table>
<thead>
<tr>
<th>Profile Boards (also called Travellers):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boning rods are T-shaped and of a uniform height. They can easily be manufactured by nailing a wooden plank of 80 cm length and 10 cm height on another plank of 130 cm length and 10 cm width so that the end-result looks like a “T”. The horizontal planks should be painted in clearly visible colours. Boning rods have to be used in a set of three.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spirit Level:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spirit levels are available in all different sizes. For construction work robust and long spirit levels are ideal. The longer the spirit level the more exact the measurement will be.</td>
</tr>
</tbody>
</table>
Templates:

Templates are used to control certain shapes of the road. For example, to control the correct shape of the slope and ditch a template of the standard slope-ditch size can be used by the labourers to continuously check whether the correct shape is being dug. Templates are very useful control aids as any labourer can see the exact size and shape of the work she/he is required to carry out. They are usually made of wood and tailor-made for each particular project in accordance with the standard measurements (see specifications and drawings).

Make sure that you always use templates together with spirit levels. The upper side must be horizontal!

<table>
<thead>
<tr>
<th>Diagram 1</th>
<th>Diagram 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Ditch Template" /></td>
<td><img src="image2" alt="Camberboard" /></td>
</tr>
<tr>
<td>h = height of ditch</td>
<td>From shoulder to centre line (2.50 - 3.00m)</td>
</tr>
<tr>
<td>w = width of ditch</td>
<td>Camber gradient 8%</td>
</tr>
<tr>
<td><img src="image3" alt="Ditch/Slope Template" /></td>
<td><img src="image4" alt="Slope Template" /></td>
</tr>
<tr>
<td>h = height of ditch</td>
<td>s = slope</td>
</tr>
<tr>
<td>w = width of ditch</td>
<td>s = slope</td>
</tr>
</tbody>
</table>
Remember

The correct sequence of construction activities to formation level is:
1. Setting-out horizontal alignment consisting of straights and curves
2. Level Control by checking and adjusting the road levels at centre line
3. Clearing the road corridor from bushes, grass, roots and removing humus
4. Earth works to level the sub-base
5. Excavation of drains and camber formation consisting of ditch excavation, slope excavation and camber formation in layers including compaction

Additional activities to complete a road depending on specific standards and construction requirements are given below:
1. Cleaning of existing culverts and/or installation of new culverts
2. Construction of small structures, such as drifts and box culverts
3. Adding gravel layer to formation either as surface (gravel road) or as a base for water-bound Macadam
4. Construction of water-bound Macadam pavement including bituminous surface layer

Important setting out and control tools must be available on site at all times:
1. Tape measures
2. Pegs and strings
3. Profile boards (set of three)
4. Templates
5. Spirit level
Element 2.2.1.4
Work Methods
Learning Element Outcomes:
This specific learning outcome will enable you to:

○ Set out all road construction activities up to formation level including drains and culverts using simple measuring aids.
○ Plan and organise site works to be carried out by the labour groups including the required resources.
○ Instruct, guide and supervise the labour groups in executing their work.
○ Control the quality of the construction activities.

Summary:
This Learning Unit explains the most common labour-based construction activities for rural roads up to formation level. The activities described in the Job Sheets include setting-out, earthworks including side drains, formation of camber and compaction. These are the activities that a BFT should be able to plan, organise and supervise.

Construction Activities
In MGNREGS most works are carried out using labour. Machines are only used for activities that cannot be carried out by labour. The construction of road using labourers can only be effective if it is split into manageable activities. Each of these activities needs to be carefully planned, set-out, carried out by the labourers and controlled. The following Job Sheets illustrate the most common and typical activities for labour-based construction methods. However, these are not recipes for all types of rural roads in India but give principle guidance only. Depending on the very conditions and requirements in a particular area, the methods and construction details have to be adjusted.

Construction to formation (camber) level is described in the following Job Sheet:
1. Clearing bush, grass and removing humus
2. Levelling the sub-base
3. Side drain excavation and camber formation
   Step 1: Drain excavation, spreading and compaction
   Step 2: Slope Excavation and Shaping
   Step 3: Camber Formation
4. Compaction
5. Culvert Cleaning
Job Sheet for Road Works

Activity: CLEARING BUSH, GRASS AND REMOVING HUMUS

Work Method:
1. Set out pegs for bush clearing, and stripping and grubbing and humus removal at 10m intervals. Use the centre pegs as reference. Use the edge pegs to mark the exact location. Do not remove these pegs after bush clearing and grass with humus removal has been completed.
2. Tie strings along the bush clearing reference pegs.
3. Estimate the area to be cleared.
4. Allocate tasks to the labourers.
5. Control that all bushes and grass including roots are cleared and that the humus layer is also removed and deposited on the side.

Measure width of road formation plus side drains from Centre Line

Set pegs and fix strings to show width for clearing

<table>
<thead>
<tr>
<th>Labour:</th>
<th>Tools + Equipment:</th>
<th>Material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 trained Mate&lt;br&gt;• 1 - 2 Labourer Groups: one for bush clearing and one for grass and humus removal</td>
<td>• Tape Measure, 30 m&lt;br&gt;• 1 Hammer&lt;br&gt;• Bush Knives&lt;br&gt;• Grass Slashers&lt;br&gt;• Axes&lt;br&gt;• Rakes&lt;br&gt;• Spades&lt;br&gt;• Shovels</td>
<td>• Wooden or Metal Pegs&lt;br&gt;• Strings</td>
</tr>
</tbody>
</table>

Quality Control:
Check the cleared width and ensure that the area is free of trees, bushes, shrubs, grass including roots and humus is removed
Job Sheet for Road Works

Activity: LEVELLING THE SUB-BASE

Work Method:

1. Set out pegs at the two edges of the areas to be levelled. This is usually the width of the existing road but not less than 7.5m (road formation width) and tie strings along the pegs.
2. Estimate the area to be levelled.
3. Allocate tasks to the labourers and instruct where to cut and where to fill. Compact small areas using hand rammers.
4. Compact higher fills in larger areas using a roller. Fill in layers of not more than 15 cm and compact. The soil needs to be moist but not wet. Check with your hand the soil moisture, if you can form a ball without crumbling then the moisture content is sufficient. Otherwise you have to add water first.
5. Control the longitudinal levels using profile boards
6. Make sure that the sub-base is horizontal from the left to the right side of the road. Use Hydro-marker or Line-level.
7. Check uniformity using straight edge with spirit level.

![Levelled Road Sub-Base Diagram]

Labour:
- 1 - 3 trained Mate depending how many labourers will be available
- 1 - 3 Labourer Groups

Tools + Equipment:
- Tape Measure, 30 m
- Hydro-marker / Line-level
- Profile Boards (3)
- Straight Edge + Spirit Level
- Hammer
- Pickaxes
- Spades
- Shovels
- Earth Rammer (for compaction of small fills)

Material:
- Wooden or Metal Pegs
- Strings

Quality Control:
- Check the levels longitudinally = maximum difference +/- 10cm over 20m road length
- Check level across the road = horizontal difference maximum +/- 5cm over road width
- Check uniformity = no holes and no humps = maximum differences +/- 5cm
Job Sheet for Road Works

Activity: SIDE DRAIN EXCAVATION AND CAMBER FORMATION

STEP 1: Drain Excavation, Spreading and Compaction

Work Method:
1. Set out the width of the ditches on both side excluding the slopes. Mark with pegs (every 10m) and strings to guide the workers where to dig.
2. Mark with pegs (every 10m) and strings to mark the area in the middle where the material from the ditch excavation has to be thrown into.
3. Allocate tasks to the labourers. Check the depth of the ditch carefully using a template of the correct size for the ditch to be excavated and ensure that the labourers throw the excavated material to the middle.
4. Spread the material in the middle evenly
5. Compact with a roller/compactor !VERY IMPORTANT! If required add water to the spread out material before compaction.

<table>
<thead>
<tr>
<th>Labour:</th>
<th>Tools + Equipment:</th>
<th>Material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 trained Mate per Group</td>
<td>• Tape Measure, 30 m</td>
<td>• Wooden or Metal Pegs</td>
</tr>
<tr>
<td>• Labour Groups</td>
<td>• 1 Hammer</td>
<td>• Strings</td>
</tr>
<tr>
<td></td>
<td>• Pickaxes</td>
<td>• Water in case needed for compaction</td>
</tr>
<tr>
<td></td>
<td>• Rakes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Spades</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Shovels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Ditch Template</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Roller/Compactor</td>
<td></td>
</tr>
</tbody>
</table>

Quality Control:
• Check the correct size of the ditch using a ditch-template
• Ensure all material is thrown in the middle and afterwards evenly spread
• Check compaction: moisture content of material (material can be formed in the hand to a ball) ensure number of passes by the roller is according to the instructions of the Engineer
Job Sheet for Road Works

Activity: SIDE DRAIN EXCAVATION AND CAMBER FORMATION

STEP 2: Slope Excavation and Shaping

Work Method:
1. Mark the edges of the slope and back-slope with pegs (every 10m) and strings to guide the workers where to dig.
2. Allocate tasks to the labourers.
3. Check the shape of the slopes carefully using a template of the correct size for the slope to be excavated. Ensure that the labourers throw the material to the middle.

Labour:
- 1 trained Mate per Group
- Labour Groups

Tools + Equipment:
- Tape Measure, 30 m
- 1 Hammer
- Pickaxes
- Rakes
- Spades
- Shovels
- Slope Templates

Material:
- Wooden or Metal Pegs
- Strings

Quality Control:
- Check the correct size of the ditch using slope-templates of the correct shape and size
- Ensure all material is thrown in the middle

Construction Materials and Technology
Job Sheet for Road Works

Activity: SIDE DRAIN EXCAVATION AND CAMBER FORMATION

STEP 3: Camber Formation

Work Method:

1. Establish again the centre line with pegs every 10m. The tops of the pegs must be at the level that is required to achieve a camber of about 8%. For this use the hydro-marker or line-level to transfer the levels from the road edge (where the slope of the ditch starts) to the centre.
2. Mark the edge of the road with pegs (every 10m) and strings to guide the workers where to spread the material.
3. Allocate tasks to the labourers.
4. Check the shape of the camber carefully using the camber board (template) of the correct size and shape together with a spirit level. Ensure that the material is uniformly spread.

Labour:
- 1 trained Mate per Group
- Labour Groups

Tools + Equipment:
- Tape Measure, 30 m
- 1 Hammer
- Pickaxes
- Rakes
- Spades
- Shovels
- Camber-Board with Spirit Level

Material:
- Wooden or Metal Pegs
- Strings

Quality Control:
- Check the correct size and shape of the camber board and make sure you have a spirit level
- Check uniformity of the spread material = no depressions and no humps
- Check the camber using the camber board with spirit level = tolerance +/- 2cm
Job Sheet for Road Works

Activity: COMPACTATION

Work Method:
1. Mark the exact length and width of the carriageway to be compacted after camber formation.
2. Establish the number of passes (depending on the thickness of the layer, the chosen type of compaction device and the natural moisture content).
3. Compact if possible on the same day as the camber was formed.
4. Check with the straight edge where depressions on the running surface appear.
5. Fill depressions on the same day and repeat compaction on these spots (material to be borrowed from the back slope or if necessary widen the ditch).
6. Where compaction cannot be achieved on the same day, make sure it is organised as early as possible on the next day.

- Compact layers of not more than allowed thickness
- Depending on the equipment 4 to 12 passes are required at each point of the carriageway
- Passes should overlap each other
- Start rolling from the edge and work towards the centre-line, then repeat on the other side

<table>
<thead>
<tr>
<th>Labour:</th>
<th>Tools + Equipment:</th>
<th>Material:</th>
</tr>
</thead>
</table>
| • BFT to control passes and check quality  
• Plant Operator  
• 4 to 6 Labourers to assist (cleaning roller cylinder, filling depressions, etc.) | • Compaction Equipment  
• Water Bowser if necessary  
• Straight Edge, Camber Board with Spirit Level  
• Spades, Shovels, Rakes  
• Water carriers | • Water for Compaction |

Quality Control:
• Count passes and ensure uniform rolling as indicated above (this does not replace compaction tests).
• Ensure rolling only at optimum moisture content.
## Job Sheet for Road Works

**Activity:** CULVERT CLEANING

**Note:** This activity is only required where an existing road with culverts already in place is to be improved

**Work Method:**
1. Check culvert inlets, barrel and outlets for silt, sand and debris (use torch to check barrel).
2. Remove material from the inlet, barrel and outlet, and dispose of material well clear of the drainage system preferably on the lower side of the road or as instructed by the Engineer.
3. Check outlet gradient and ensure a min. gradient of 2% using line-level and boning rods. Ensure the drain bottom has a uniform gradient. Set out outlet width and length using pegs and strings.
4. When the culvert is cleaned out check for cracks in the barrels (use torch if necessary). In case of damages report to the Engineer.

![Diagram of culvert cleaning](image)

**Special Considerations:**
If the culvert is severely blocked use long handled tools, like shovel and rode (iron bar 10 to 12mm, 12m long) or scoop with a bucket tied to a rope.

<table>
<thead>
<tr>
<th>Labour:</th>
<th>Tools + Equipment:</th>
<th>Material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• BFT to control passes and check quality</td>
<td>• Tape Measure, 30 m</td>
<td>• Cement and Sand for repairs, if required.</td>
</tr>
<tr>
<td>• Plant Operator</td>
<td>• Set of profile boards</td>
<td></td>
</tr>
<tr>
<td>• 4 to 6 Labourers to assist (cleaning, roller cylinder, filling depressions, etc.)</td>
<td>• Shovel, Spade, Pick Axe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Long handled shovel</td>
<td></td>
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</tbody>
</table>

**Quality Control:**
• Visual inspection to check that the culvert, inlet and outlet are cleaned out and maintained to the correct standard dimensions.
• Check longitudinal profile of outlet using profile boards, hydro marker or line-level.